PROCEEDING

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"Navigating the Human-AI Collaboration in Education: Challenges and Opportunities"

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@October 2025

WELCOME MESSAGE FROM THE ORGANIZING COMMITTEE

Assalamu'alaikum warrahmatulah wabarakatuh

I would first like to express my gratitude for the blessings and guidance that have brought us together for this conference.

It is my pleasure to welcome you to the 13th International Conference on Educational Research and Innovation (ICERI) at Universitas Negeri Yogyakarta. This year's theme is "Navigating Human-AI Collaboration in Education: Challenges and Opportunities," with a special focus on Artificial Intelligence in education.

We would like to welcome and recognize our esteemed keynote and invited speakers: Dr. Fauzan Adziman, M.Eng., Director General of Research and Development, the Ministry of Higher Education, Science, and Technology, Indonesia; Prof. Oh Jin Park, Ph.D., CEO, 3PLINK, Korea; Prof. Nur Hidayanto Pancoro Setyo Putro, Ph.D., Vice-Rector for Academic Affairs, Universitas Negeri Yogyakarta, Indonesia; Assoc. Prof. Chailerd Pichitpornchai, Ph.D., Director of International Institute for Learning, Mahidol University, Thailand; and Assoc. Prof. Kuan-Ting Lai, AIoT Laboratorium, National Taipei University and Technology**.** Thank you to all our speakers for sharing your valuable time and wisdom at this conference.

This conference is a forum for participants to share and discuss the latest advancements and issues in Education. We have received more than 1000 abstracts. We hope you find the keynote presentations, plenary panels, and paper presentations interesting and illuminating. We encourage you to participate in the discussion, take advantage of the many benefits the Conference offers, and connect with new friends.

We are very honored to welcome you to Yogyakarta. The city is the capital and administrative center of the Special Region of Yogyakarta, Indonesia. Yogyakarta is a large urban area that preserves Javanese culture and traditions. It is home to the Sultan's palace, several universities, and the famous World Heritage Site of Borobudur. I hope you have a memorable experience exploring the city, the palace, and this World Heritage Site.

Thank you to all Committee members for making this conference possible. I warmly welcome you to Yogyakarta, and wish you an inspiring conference experience.

Wassalamu'alaikum warrahmatulah wabarakatuh

Prof. Dr. Yudik Prasetyo, S.Or., M.Kes.
Director of the Directorate for Research and Community Service
Universitas Negeri Yogyakarta

RECTOR' SPEECH

Assalaamu'alaikum Warahmatullaahi Wabarakaatuh

I gratefully welcome all participants to the 2025 International Conference on Educational Research and Innovation (ICERI). This conference is a crucial opportunity for the academic community, education practitioners, and policymakers from various countries to discuss and collaborate in responding to global dynamics in education, particularly in the era of collaboration between humans and artificial intelligence.

The development of digital technology, particularly artificial intelligence, has brought about major changes in the way we learn, teach, and conduct research. However, this progress also demands that we ensure that technology remains aligned with humanitarian values, ethics, and social justice. This is where human AI collaboration becomes crucial, not to replace humans, but to strengthen their capacity to create more adaptive, inclusive, and meaningful learning.

Universitas Negeri Yogyakarta is strongly committed to being an active part of this transformation. Through strategic policies in developing a smart campus, improving digital literacy among its academic community, and strengthening interdisciplinary research in the field of artificial intelligence in education, UNY continues to encourage innovation oriented towards human well-being and the sustainability of education. We believe that research and learning that utilize technology wisely will expand access, improve quality, and foster national competitiveness on the global stage.

ICERI 2025 is a concrete manifestation of this collaborative spirit. Through this forum, we hope to forge a cross-national knowledge network capable of generating strategic ideas for the future of ethical and equitable AI-based education. May the discussions during this conference inspire and provide new direction for the development of more humane educational policies, research, and practices.

Finally, I would like to express my appreciation to all the committee members, speakers, and participants for their dedication and participation. Let us continue to move together toward a future of intelligent, ethical, and humanity-oriented education.

Have a great conference.

Wassalaamu'alaikum Warahmatullaahi Wabarakaatuh

Prof. Dr. Sumaryanto, M.Kes., AIFO
Rector of Universitas Negeri Yogyakarta

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DEVELOPMENT OF GUIDELINES FOR INTERNALIZING MULTICULTURAL VALUES TO IMPROVE TEACHER COMPETENCE AT UNY LABSCHOOL PRIMARY SCHOOL LEVEL

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Abstract. Multicultural education plays a pivotal role in supporting teachers' pedagogical competence, particularly in the internalization of multicultural values within learning processes involving diverse student populations. As a laboratory school, UNY Labschool reflects Indonesia's rich social and cultural diversity, thereby presenting unique challenges for teachers in accommodating learners from various backgrounds. This study aims to develop a guideline for the internalization of multicultural values in primary-level teaching at UNY Labschool, which can serve as a practical reference for teachers in designing inclusive and contextual learning processes. The research employed a Research and Development (R&D) approach using the 4-D model (Define, Design, Develop, Disseminate). The research subjects consisted of primary school teachers at Pedagogia UNY Labschool, with data collected through questionnaires, interviews, and classroom observations. The feasibility test conducted by four UNY experts and two external experts indicated that the guideline was categorized as highly feasible. Furthermore, a practicality test based on teachers' responses confirmed that the product was considered suitable for implementation. Consequently, the guideline for the internalization of multicultural values is deemed effective in enhancing teachers' pedagogical competence in managing learning processes that emphasize tolerance, respect for diversity, and the reinforcement of students' character values in the priamry-level context of UNY Laboratory School..

Kata Kunci: primary school, multicultural values, teacher competence

INTRODUCTION

Indonesia is a country with a wide variety of cultures, religions, languages, and ethnic groups [1], [2]. This is due to the fact that Indonesia consists of thousands of islands and is inhabited by hundreds of millions of people. Indonesia's large population has diverse backgrounds and characteristics, including cultural, ethnic, linguistic, and religious differences spread across 38 provinces, each with its own unique natural characteristics. These differences in natural characteristics play a role in shaping different cultures and characters (Supriatin & Nasution, 2017). This diversity is both an important asset and a challenge in building tolerance within society, especially among the younger generation who are prone to social conflicts based on cultural, religious, and ethnic differences [4].

In this context, education plays an important role in increasing understanding of multiculturalism in various circles, from primary to higher education, as well as among the general public. Multicultural education not only serves as a tool for transferring knowledge but also as a medium for shaping attitudes and characters that can reduce prejudice, discrimination, and conflicts arising from cultural, religious, ethnic, and racial differences. Multicultural education can be defined as an awareness of cultural diversity, human rights, and the reduction of

prejudice in order to create a more just and advanced society (Hummelstedt et al., 2021; Supriatin & Nasution, 2017). Multicultural education also emphasizes the importance of respecting differences, equality, and justice, as well as instilling an open attitude towards diversity in society [7], [8], [9]. Through multicultural education, it is hoped that individuals can build awareness and appreciation of the various cultural, ethnic, and social identities that exist in their surroundings [10].

According to [7], multicultural education is a philosophy and educational framework designed to help students understand and appreciate cultural diversity. This approach aims to develop students' competence in critical thinking, empathy, and constructive interaction with different community groups. Multicultural education plays an important role in building a tolerant and peaceful society [11]. Therefore, primary school is a strategic level of education for instilling the values of tolerance and multiculturalism. At this stage, students are still in a stage of cognitive and social development characterized by a high level of curiosity and a more open acceptance of differences [12]. By interacting with peers from different cultural backgrounds, students learn to understand and appreciate diversity as part of Indonesia's diversity. Multicultural education in primary school also contributes to shaping students' characters to be more inclusive and tolerant of differences and increases their awareness of the importance of respecting and appreciating diversity [13]. Through structured and diversity-oriented education, students can develop into critical, creative individuals with an open attitude in social and national life.

Primary school education plays an important role in shaping teachers' pedagogical competencies so that they are able to internalize multicultural values in learning. The diversity of cultures, religions, languages, and genders in Indonesia requires an educational approach that is inclusive, adaptive, and relevant to the social context of society. The increasing diversity within schools presents significant challenges for educators, particularly in bridging cultural differences, designing effective multicultural learning environments, and ensuring equity in education [14], [15]. Teachers who respond adaptively to diversity contribute not only to strengthening students' social and emotional well-being[16], but also to reducing the academic achievement gap [17], [18] and to fostering democratic and harmonious societies through the cultivation of a global understanding of cultural diversity [19].

Laboratory schools such as Labschool UNY reflect the social and cultural diversity that exists in Indonesia, thus requiring learning strategies that are able to manage these differences optimally. However, preliminary analysis results at primary Labschool UNY in February 2025 show that teachers still experience difficulties in implementing multicultural-based learning effectively, especially in guiding students who are diverse. Based on interviews conducted in February 2025 with the principal of SD Labschool UNY, several issues were identified, including that students still need guidance in improving their academic potential and assistance in identifying their talents and interests. In addition, teachers still face difficulties in the inclusive teaching process and in helping children with special needs. Students also still have difficulty complying with applicable rules, such as haircut rules. Students also still need guidance on tolerance towards different genders, religious diversity, and sexual orientation.

Investing in teacher training on cultural diversity and multicultural education is regarded as a key strategy to address the challenges within multicultural learning contexts. Such efforts can empower teachers to support students' development in an increasingly interconnected world through equitable educational opportunities [20], [21], [22]. In line with this, professional development (PD) has consistently been shown to exert a positive impact on teachers' instructional practices by equipping them with effective strategies to strengthen classroom implementation and enhance student learning outcomes [23]. This need, in turn, underscores the importance of providing continuous PD for teachers, ranging from initial training to advanced stages of their professional careers [24].

When examined empirically, these issues are related to multicultural competence. Multicultural competence is an important aspect in education that aims to create an inclusive learning environment that respects diversity [25]. The aspects of multicultural education consist of abilities and disabilities; religion; sexual orientation; and gender. These issues are obstacles in the process of implementing multicultural education, mainly because there are no structured guidelines or strategies for teachers in developing learning that instills effective values of diversity.

The internalization of multicultural values in learning is very important because it serves to instill attitudes of tolerance, equality, and appreciation for differences from an early age. Unfortunately, teachers still face limitations in systematic learning guidelines to support multicultural pedagogical competencies. This condition hinders the realization of SD Labschool UNY's mission, namely "Developing culturally inclusive learning in the 21st century" and "Developing national character values and socio-cultural values in learning." Therefore, learning guidelines are needed to help teachers design inclusive learning strategies and adaptive teaching methods. Therefore, learning guidelines are needed to help teachers design inclusive learning strategies, adaptive teaching methods, and relevant assessments to support the implementation of multicultural values in primary schools.

This study focuses on the development of guidelines for internalizing multicultural values in learning at SD Labschool UNY. This guide is designed to be a reference for teachers in implementing learning that is responsive to the diversity of students as well as the history and needs of a laboratory school that is oriented towards innovation. With this guide, it is hoped that teachers will be more focused in instilling the values of tolerance, democracy, equality, and respect for differences in their daily teaching and learning activities.

Through this research, it is hoped that effective guidelines for the internalization of multicultural values can be produced to support teachers in implementing inclusive learning that is responsive to student diversity. The results of this study are expected to be useful for Primary Labschool UNY as a laboratory school, policy makers, and educational institutions in developing multicultural learning strategies. Thus, this study is expected to strengthen the role of primary schools in promoting tolerance, equality, and respect for differences from an early age and in line with the demands of 21st-century education.

RESEARCH METHOD

A. Problem Solving Framework

This study uses a research and development (R&D) approach, which aims to develop a guide for internalizing multicultural values in learning at UNY Elementary School Laboratory Schools. These development steps will follow the stages according to the 4-D model (Four-D) to ensure that the resulting model can be implemented and evaluated properly. The 4-D model consists of four stages, namely Define, Design, Development, and Disseminate. This method and model were chosen based on considerations of the objectives to be achieved, namely to produce a product in the form of a Guide for Internalizing Multicultural Values in Learning to Improve Teacher Pedagogical Competence at UNY Elementary School Laboratory Schools. The details of the 4 stages include the stages of defining, designing, developing, and disseminating, which are described as follows:

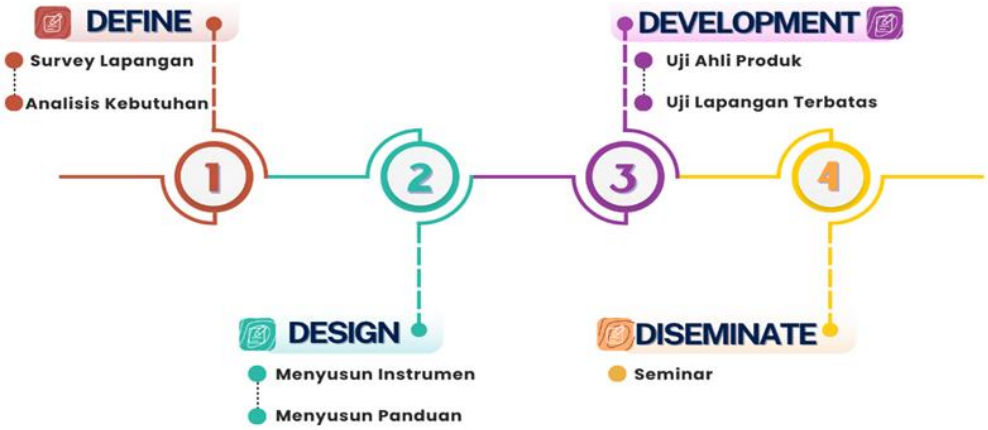
1. Define Stage
   The definition stage (define), namely the stage that is useful for determining and defining needs in the learning process and collecting various information related to the product to be developed.
2. Design Stage
   The planning stage is the next stage after the definition stage, or in other words, after identifying the problem in the previous stage. This design stage serves to develop the multicultural scale used in Labschool and the expert validation questionnaire to assess the developed product.
3. Development Stage
   The development phase aims to produce a revised capacity development scale and module based on expert input and trials.
   a. Expert Validation
      Expert validation serves to validate the scale of capacity development and previous modules were tested and the validation results will be used to revise the initial product.
   b. Product Trial
      After expert validation, a limited field trial was conducted to determine the results of the application of the capacity development scale and guidelines.
4. Dissemination Stage
   This stage involves disseminating guidelines for internalizing multicultural values in learning to improve teachers' pedagogical competence. This stage is implemented after limited trials and instrument revisions based on suggestions and input.

B. Target Audience

The target audience for this study included three teachers in the practicality test and 30 teachers in the limited test. The teachers involved were from SD Pedagogia UNY. The study was conducted on Thursday, July 24, 2025, in the SD Pedagogia UNY meeting room from 10:00 a.m. until finished.

C. Activity Method

The following is the flow of activities in Community Service Education on the 3R Concept (Reduce, Reuse, and Recycle) for School-Age Children. The research methods used in the research and development of multicultural values guidelines in learning are as follows:



Data Picture 1. Research Flowchart (Thiagarajan, 1974)

collection techniques in the research and development of guidelines for internalizing multicultural values in learning to improve teachers' pedagogical competence at UNY laboratory schools at the elementary level are through questionnaires, interviews, and observations. The instruments used are teacher and student interviews, observation instruments for learning implementation, assessment questionnaires from material experts and media experts, and questionnaires to measure improvements in teachers' pedagogical competence. Data analysis is carried out through pretests and posttests.

RESULTS AND DISCUSSION

Results of Activity Implementation

This research and development aims to produce a product in the form of a Guide to Internalizing Multicultural Values in Learning that is valid, practical and effective to Improve the Pedagogical Competence of Elementary School Teachers at UNY Laboratory Schools. The research and development stages are as follows:

1. Define Stage

The definition stage contains activities to determine and define the needs in the learning process and collect various information related to the needs in the field, more precisely at Labschool UNY. Based on the needs analysis that has been carried out through interviews and observations on February 11-14, 2025, it was found that there were obstacles felt by teachers, namely the lack of guidelines for being able to develop and facilitate inclusive learning for the diversity of students at SD Pedagogia UNY. This urgent need is related to a practical guideline that not only contains theory, but also concrete examples of implementation, strategies and assessment instruments that can be used to internalize multicultural values.

Besides the lack of a guideline available for teachers to use, another obstacle is the lack of teacher skills in implementing multicultural education-based learning. This relates to teachers' competency in designing and developing learning that accommodates student diversity. Therefore, a guideline for internalizing multicultural values in learning will be developed, which is expected to serve as a reference for teachers in implementing learning.

2. Design Stage

After obtaining the needs analysis in the previous stage, the next step is the design phase. This design phase serves to design the scale of capacity development and modules.

a. Academic Manuscript Draft

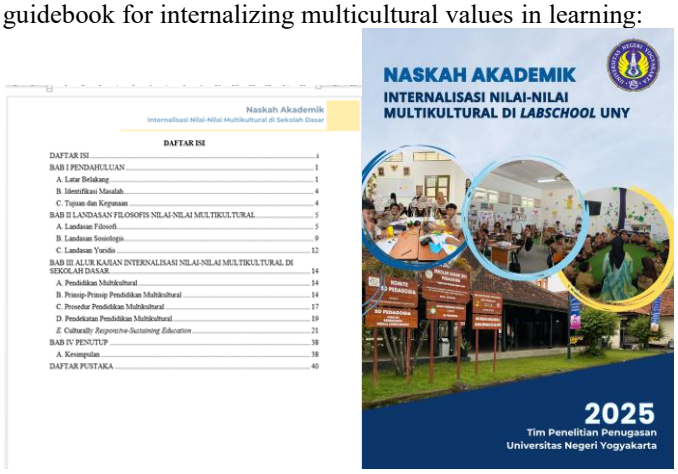
This stage begins with the preparation of a comprehensive academic paper. This academic paper serves as a philosophical and scientific foundation that strengthens the urgency and relevance of the developed guidelines. In the paper, three main, complementary pillars are constructed: 1) Theoretical Foundation, which refers to theories of multicultural education and inclusive learning, 2) Legal Foundation, which relies on national laws and regulations on multicultural education, 3) Sociological Foundation that describes SD Pedagogia UNY and the cultural diversity of its students that colors the school environment and society as a learning context.

This academic paper serves not only as a theoretical basis but also as a roadmap explaining why internalizing multicultural values such as tolerance, empathy, justice, and democracy regarding differences is a necessity in pedagogical practice. These values are not internalized as separate additional material, but rather internalized within the learning process.

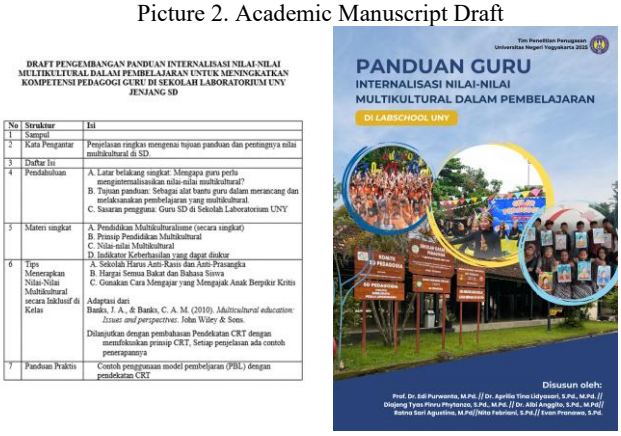
b. Draft Guidelines for Internalizing Multicultural Values in Learning

The development of a guidebook for internalizing multicultural values in learning to improve the pedagogical competence of elementary school teachers at the UNY laboratory school began with the development of an academic paper. The teacher's guide was born from the academic paper for internalizing multicultural values, which presents three main pillars: theoretical, legal, and sociological foundations that reinforce the urgency of internalizing multicultural values. The academic paper provides a foundation to support the process of internalizing multicultural values so that diversity in schools can be better managed and become part of the ongoing learning process.

Based on the academic text that has been developed, a practical guidebook was then developed for teachers to internalize multicultural values in learning. This practical guide was developed to provide a reference that teachers can use with a set of knowledge, attitudes, and practical skills in designing and implementing learning that is responsive to multiculturalism. Through this guide, it is hoped that teachers can manage the diversity of student backgrounds not as a challenge but as a very valuable asset and social capital to create a more lively, authentic, and meaningful learning experience. The following is a draft of the academic text and guidebook for internalizing multicultural values in learning:



Picture 2. Academic Manuscript Draft



Picture1. Draft Guidelines

c. Expert Assessment Instrument

The assessment instrument from the expert validator aims to measure the suitability of the guidelines for internalizing multicultural values in learning for use by teachers. Several aspects were assessed in the expert validation, including:

Table1. Assessment Instrument by Experts

No	Rated aspect	Assessment Indicators
1	Substantial/Content Aspects	The suitability of the contents of the guide with multicultural values in the context of elementary school education.
		The relevance of the material in the guide to teacher competencies and the characteristics of elementary school students in internalizing the multicultural values of elementary school students.
		The suitability of the contents of the guide with the applicable curriculum in internalizing the multicultural values of elementary school students
2	Aspect of Usefulness (Practicality)	An easy-to-understand and implement guide for teachers in the field in internalizing multicultural values in elementary school students.

		The guide provides clear technical direction in designing meaningful learning in internalizing multicultural values in elementary school students.
		The guide encourages teachers to be active, creative, and reflective in teaching multicultural values to elementary school students.
3	Language and Format Aspects	The language used in the guide is appropriate, effective, and easy for teachers to understand in internalizing multicultural values in elementary school students.
		The presentation format (structure, layout, illustrations) supports the readability of the guide to internalizing multicultural values for elementary school students.
4	Innovation Aspects and Implementation Feasibility	The developed guide has innovative value in the learning approach that internalizes the multicultural values of elementary school students.
		Activities in pandyan enable the application of internalization of multicultural values by elementary school students in various school conditions.

3. Development Stage

This development phase contains activities to produce revised capacity development scales and modules based on expert input and trials.

a. Product Validation Results

Product validation aims to determine the feasibility of the internalization guide for multicultural values in learning before being implemented in the field. Product validation is carried out by involving experts from academics and practitioners to obtain assessments, criticisms and constructive input. Internal product validation involves UNY lecturers, namely Prof. Dr. Entoh Tohani, M.Pd, Prof. Dr. Suranto, M.Pd, M.Si, Prof. Dr. Nurtanio Agus Purwanto, S.Pd., M.Pd., and Prof. Nur Hidayanto Pancoro Setyo Putro, M.Pd., Ph.D. While external validation of UNY involves lecturers from UPI Prof. Dr. Prayoga Besari, S.Pd., M.Si., and lecturers from UNESA namely Prof. Dr. Sujarwanto, M.Pd. Meanwhile, validation by practitioners from SD Pedagogia was conducted by Ratna Sari Agustina, M.Pd., Nafisa Risma Zuhara, M.Pd., and Aprivia Kapitania, S.Pd. The validation results indicate that the academic text and guidelines are suitable for field testing. The results of the feasibility test are as follows:

Table 22. Validation of Academic Manuscripts

No	Rated aspect	Expert Validator
1.	Academic manuscripts are based on philosophical, legal and sociological foundations.	24
2.	Identification of problems in academic papers has been explained in a coherent manner.	22
3.	Academic papers are based on the urgency of clear formation	23
4.	The relevance of academic manuscript regulations is compiled specifically and relevantly.	22
5.	The purpose of creating an academic paper is to be written in a specific and relevant manner.	24
6.	Academic texts are prepared in accordance with multicultural values in elementary schools.	22
7.	Academic texts targeting the internalization of multicultural values in elementary schools	23
8.	Academic texts provide clear technical direction in designing meaningful learning	24
9.	The language used in academic texts is precise, effective and easy to understand.	23
10.	The presentation format (structure and layout) in academic manuscripts supports readability.	21
Total		**228**
Average		**38**
Category		**Very Worthy**

Table 33. Guide Validation Results

No	Rated aspect	Expert Validator
1.	Substantial/Content Aspects	70
2.	Aspect of Usefulness (Practicality)	69

3.	Language and Format Aspects	47
4.	Innovation Aspects and Implementation Feasibility	45
Total		**231**
Average		**38.5**
Category		**Very Worthy**

The validation results for the guideline yielded an average score of 38, categorized as "very appropriate." Furthermore, the validation results for the academic manuscript by academic experts yielded a score of 38.5, categorized as "very appropriate." Both the manuscript and guideline validation results indicate that the guideline and academic manuscript are suitable for use.

The guide was also assessed for practicality by practitioners in the field. This assessment focused on the substance/content aspect to determine the extent to which the guide was easy to understand, applicable, and useful in everyday learning practices. The results of the practicality assessment are shown in Table 2.

Table 44. Practicality Test Results

No	Rated aspect	Practitioner Assessment
1.	Substantial/Content Aspects	30
2.	Aspect of Usefulness (Practicality)	24
3.	Language and Format Aspects	16
4.	Innovation Aspects and Implementation Feasibility	30
Total		**100**
Average		**33.33**
Category		**Practical**

b. Product Testing (Development Testing)

Table 55. Effectiveness Test Results

Test Statistics

	Post Test - Pre Test
Z	-4.787b
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

Based on the results of the Wilcoxon Signed Rank Test, the Z value was obtained at -4.787 with a significance value (Asymp. Sig. 2-tailed) of 0.000. Because the significance value is smaller than the $\alpha = 0.05$ level, it can be concluded that there is a significant difference between the pre-test and post-test results. These results indicate that the developed guide is effective in improving participant competency after being given treatment, so it can be stated that the resulting product is not only feasible and practical, but also proven effective for use in learning.

Table 6. N-Gain Score Results

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Ngain_score	30	.33	1.00	.6638	.25256
Ngain_Persen	30	33.33	100.00	66.3782	25.25616
Valid N (listwise)	30				

The N-Gain results also showed a value of 0.66, which is considered moderate. This means that the training on internalizing multicultural values increased teachers' understanding by 66% of the maximum potential. This indicates that the improvement was quite effective, demonstrating that the training provided tangible benefits for teachers in understanding and implementing the internalization of multicultural values in their learning.

Discussion

Teachers are the most important element in an education system. The learning process is influenced by how they treat their students. Teachers' personalities, such as being attentive, warm, and supportive (encouraging), are believed to motivate students to improve their academic achievement [26].However, the role of teachers in today's era of globalization goes beyond mere academic achievement, but also serves as the spearhead in shaping the character and worldview of students who live in a pluralistic society [27], [28]. Therefore, teachers' pedagogical skills enable them to internalize multicultural values in elementary schools. Multicultural pedagogy is not simply about conveying diversity material, but also about creating inclusive learning experiences where every child, regardless of ethnicity, religion, race, or culture, feels valued and has equal opportunities to participate.

Internalizing multicultural values at the elementary school level is crucial because it is at this age that the foundations of character, social attitudes, and perceptions of differences begin to form. If teachers succeed in creating a classroom that respects diversity, students will not only achieve optimal academic achievement but will also grow into a generation that hassocial intelligence, high tolerance, and readiness to become a contributing global citizen[27]. Thus, multicultural teacher pedagogy is not an option, but rather a necessity to prepare students to face a complex and diverse life.

The development of a guide for internalizing multicultural values in elementary school learning at the UNY Laboratory School aims to provide systematic guidance for teachers in integrating multicultural principles into the learning process. This guide is presented in response to teachers' needs to improve pedagogical competence, particularly in managing student diversity, building an inclusive classroom climate, and fostering mutual respect among students. Internalizing multicultural values in learning will help teachers shape students' character by appreciating, accepting, and respecting differences, thus supporting an inclusive learning environment [29].

The relevance of developing this guide is further strengthened by the dual function of the UNY Laboratory School, serving as both a basic educational institution and an academic laboratory focused on the development and implementation of educational innovation. Given the diverse student population, teachers are required to possess adequate pedagogical competencies to design learning that is sensitive to differences in social, cultural, and religious backgrounds [30]. Furthermore, this competency is important for teachers to provide awareness to students that multicultural reality will be the basis for progress in global competition which is often hampered by polarization, privatization, and marginalization of diversity in society[31]. This is crucial to ensure teachers can create an inclusive learning environment that supports students' optimal achievement of their potential. Furthermore, teachers' multicultural competence is necessary to broaden and deepen students' awareness of the importance and role of their learning in a multicultural society [32]Therefore, schools need to implement an inclusive and supportive approach for students with diverse cultural and racial backgrounds to facilitate them in the school environment .

The strategies for internalizing multicultural values offered in this guide focus on three main aspects. First, the integration of multicultural values into lesson planning through the development of lesson plans that reflect learning objectives based on respect for differences. Second, the application of participatory learning methods such as group discussions, case studies, and collaborative projects that naturally encourage cross-cultural interactions. Third, the creation of an inclusive classroom climate by emphasizing empathy, assertive communication, and peaceful conflict resolution skills. This strategy aligns with the notion that emphasizes the importance of developing content, processes, and learning environments that support inclusivity.

The results of a limited trial indicate that this guide has a positive impact on improving teachers' pedagogical competence. This is evident in more systematic lesson planning rich in multicultural values, learning implementation that accommodates heterogeneous student interactions, and learning evaluation that emphasizes not only academic achievement but also students' multicultural attitudes and values. Thus, this guide has been proven to support the strengthening of pedagogical competence as mandated by Minister of National Education Regulation No. 16 of 2007, namely the ability of teachers to understand students, design, implement, and evaluate learning professionally. Furthermore, the internalization of these multicultural values can also have a positive impact on improving students' academic performance [33].

In its implementation, there are supporting and inhibiting factors that influence the effectiveness of the guidelines. Supporting factors include teacher commitment to improving competency, school institutional support, and student diversity relevant to the implementation of multiculturalism. Inhibiting factors include teachers' limited time to develop teaching materials, variations in teachers' understanding of multiculturalism, and the tendency of some teachers to still use conventional approaches in teaching.

In a wayOverall, the development of this guide for internalizing multicultural values has both practical and theoretical implications. The practical implication is that this guide can be used directly by elementary school teachers at the UNY Laboratory School as a reference in designing and implementing multicultural values-based learning. Meanwhile, the theoretical implication is a contribution to the study of multicultural pedagogy by emphasizing its role in improving teachers' pedagogical competence..

CONCLUSION

Based on the research conducted, it can be shown that the development of a guide for internalizing multicultural values in learning has made a significant contribution to improving the pedagogical competence of teachers at the UNY Laboratory School at the elementary level. The guide, produced through a series of research and development stages, has proven not only substantively appropriate according to the assessment of experts who validated the content and systematics of the material, but also practical by practitioners in the field due to its ease of understanding, applicability, and relevance to daily learning needs. Furthermore, through limited trials, the guide has also proven effective in improving teachers' pedagogical competence, as reflected in pre- and post-implementation test results, which showed significant differences in teachers' understanding, skills, and attitudes in managing multicultural-based learning.

The results of this study also confirm that the guide not only provides additional tools for teachers but also serves as a strategic reference that provides clearer and more systematic direction in planning and implementing diversity-sensitive learning. This guide facilitates teachers in integrating important values in multicultural education, such as tolerance, democracy, justice, respect for differences, and empathy, into daily classroom learning. These values are realized through various strategies, ranging from selecting participatory and adaptive learning methods, using media responsive to student diversity, to implementing inclusive assessments.

With this guide, teachers are not only equipped with practical guidance for teaching and learning activities but are also guided to play an active role as facilitators in building a more open, democratic, and diversity-respecting school culture. This supports and achieves the mission of the UNY Laboratory School, namely to realize inclusive, adaptive, and character-based learning, and aligns with the demands of 21st-century education, which emphasizes developing a generation with global competence, tolerance, and life skills in a multicultural society. Therefore, this guide can be seen as a significant innovation in educational practice, particularly in strengthening the role of teachers as agents of change in providing humanistic and equitable learning for all students.

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REFERENCES

[1] N. S. Dinarti, D. A. Dewi, and Y. F. Furnamasari, “Meningkatkan Integrasi Nasional melalui Implementasi Nilai-Nilai Bhinneka Tunggal Ika,” Jurnal Pendidikan Tambusai, vol. 5, no. 3, pp. 7890–7899, 2021.

[2] F. Lintang and F. U. Najicha, “NILAI-NILAI SILA PERSATUAN INDONESIA DALAM KEBERAGAMAN KEBUDAYAAN INDONESIA,” Jurnal Global Citizen : Jurnal Ilmiah Kajian Pendidikan Kewarganegaraan, vol. 11, no. 1, pp. 79–85, Jul. 2022, doi: 10.33061/jgz.v11i1.7469.

[3] A. Supriatin and A. R. Nasution, “Multikulturalisme di indonesia dan pengaruhnya bagi masyarakat,” Elementary: Jurnal Ilmiah Pendidikan Dasar, vol. 3, no. 1, 2017.

[4] S. Mahardika, N. P. Lestari, O. Cherly, and O. C. Wuwung, “Pendidikan Kristiani Berbasis Multikultural dalam Konteks Moderasi Beragama di SMP Negeri 2 Arso,” Jurnal Ilmiah Wahana Pendidikan, vol. 8, no. 18, pp. 283–291, Oct. 2022.

[5] A. Supriatin and A. R. Nasution, “Implementasi pendidikan multikultural dalam praktik pendidikan di Indonesia,” Elementary: Jurnal Iilmiah Pendidikan Dasar, vol. 3, no. 1, pp. 1–13, 2017.

[6] I. P. Hummelstedt, G. I. M. Holm, F. J. Sahlström, and H. A.-C. Zilliacus, “Diversity as the new normal and persistent constructions of the immigrant other–Discourses on multicultural education among teacher educators,” Teach Teach Educ, vol. 108, p. 103510, 2021.

[7] M. Ubhi, “An Introduction to Multicultural Counselling,” Mental Health Practice, vol. 3, no. 5, pp. 37–37, Feb. 2000, doi: 10.7748/mhp.3.5.37.s20.

[8] S. May, Critical multiculturalism: Theory and praxis. Routledge, 2010.

[9] S. Nieto, "Defining multicultural education for school reform," S. Nieto & P. Bode, Affirming Diversity: The Sociopolitical Context of Multicultural Education, pp. 40–59, 2012.
[10] T. H. Itkonen, "Contradictions of Finnish education: Finnishness, interculturality and social justice," 2018.
[11] M. D. Toriyono, A. R. Sibilana, and B. W. Setyawan, "Urgensi Pendidikan Multikultural dalam Pengembangan Karakter di Era Society 5.0 pada Perguruan Tinggi," Jurnal Intelektual: Jurnal Pendidikan dan Studi Keislaman, vol. 12, no. 2, pp. 127–140, Sep. 2022, doi: 10.33367/ji.v12i2.2728.
[12] N. A. B. Badrul Hisam and K. F. Khairuddin, "Pendidikan Inklusif Murid Berkeperluan Khas Kategori Autisme di Sekolah Rendah: Perspektif Ibu Bapa," Malaysian Journal of Social Sciences and Humanities (MJSSH), vol. 7, no. 2, p. e001286, Feb. 2022, doi: 10.47405/mjssh.v7i2.1286.
[13] I. W. Ningsih, A. Mayasari, and U. Ruswandi, "Konsep pendidikan multikultural di Indonesia," Edumaspul: Jurnal Pendidikan, vol. 6, no. 1, pp. 1083–1091, 2022.
[14] D. Paris, "Culturally sustaining pedagogy: A needed change in stance, terminology, and practice," Educational researcher, vol. 41, no. 3, pp. 93–97, 2012.
[15] C. E. Sleeter, "Confronting the marginalization of culturally responsive pedagogy," Urban Educ (Beverly Hills Calif), vol. 47, no. 3, pp. 562–584, 2012.
[16] L. Rigney, R. Garrett, M. Curry, and B. MacGill, "Culturally responsive pedagogy and mathematics through creative and body-based learning: Urban Aboriginal schooling," Educ Urban Soc, vol. 52, no. 8, pp. 1159–1180, 2020.
[17] E. Yu, "The impact of culturally inclusive pedagogy on student achievement in a multicultural urban school setting," Urban Educ (Beverly Hills Calif), vol. 57, no. 1, pp. 135–153, 2022.
[18] H. Kye, "Beginning teachers' knowledge-in-practice of multicultural science education," Journal for Multicultural Education, vol. 14, no. 3–4, pp. 189–207, Dec. 2020, doi: 10.1108/JME-02-2020-0014.
[19] J. A. Banks, Cultural diversity and education: Foundations, curriculum, and teaching. Routledge, 2015.
[20] Y. Acar-Çiftçi, "Teachers' perception of their cultural competencies within the context of multicultural education," Unpublished doctoral dissertation). Yıldız Teknik University, İstanbul, 2015.
[21] V. Donnelly and A. Watkins, "Teacher education for inclusion in Europe," Prospects (Paris), vol. 41, no. 3, pp. 341–353, 2011.
[22] G. Gay and T. C. Howard, "Multicultural teacher education for the 21st century," The teacher educator, vol. 36, no. 1, pp. 1–16, 2000.
[23] L. Darling-Hammond, M. E. Hyler, and M. Gardner, "Effective teacher professional development.," Learning policy institute, 2017.
[24] B. B. Babayiğit, D. Sever, B. Ç. Aktaş, B. K. Kayabaş, E. A. Şenel, and M. Güven, "Professional Development for Multicultural Education: Lessons from a Blended In-Service Teacher Training Programme," Teach Teach Educ, vol. 165, p. 105151, 2025.
[25] A. M. Anam, "Penanaman Nilai-Nilai Pendidikan Islam Multikultural di Perguruan Tinggi Keagamaan Islam (Studi Kasus di Universitas Islam Malang)," ISTIGHNA, vol. 2, no. 2, pp. 12–27, Jul. 2019.
[26] H. M. Fajri, A. Maksum, and A. Marini, "Desain Pendidikan Multikultural pada Pendidikan Dasar," Jurnal Inovasi Pendidikan dan Pembelajaran Sekolah Dasar. Jurnal Inovasi Pendidikan Dan Pembelajaran Sekolah Dasar, vol. 8, no. 1, pp. 235–249, 2024.
[27] R. Yuniar Aprilia, "Mengelola Guru Belajar Dalam Yang Kelas Menciptakan Menyenangkan Yang Nyaman: Lingkungan Strategi," MANAJEMEN PENDIDIKAN MI/SD: Berbasis Teknologi dan Neurosains dalam Kurikulum Merdeka, p. 133, 2025.
[28] A. Akbar, "Pentingnya kompetensi pedagogik guru," JPG: Jurnal Pendidikan Guru, vol. 2, no. 1, pp. 23–30, 2021.
[29] I. Basri, "Evaluasi Pembelajaran Sekolah Dasar (SD) Berbasis Pendidikan Karakter dan Multikultural," Jurnal Ilmiah Sekolah Dasar, vol. 1, no. 4, pp. 247–251, 2017.
[30] A. Supriatin and A. R. Nasution, "Multikulturalisme di indonesia dan pengaruhnya bagi masyarakat," Elementary: Jurnal Ilmiah Pendidikan Dasar, vol. 3, no. 1, p. 1, 2017.
[31] S. Futaqi, "Memperkuat Kompetensi Multikultural Siswa dalam Menghadapi Tantangan Global," MIDA: Jurnal Pendidikan Dasar Islam, vol. 4, no. 1, pp. 30–37, 2021.
[32] A. Arifin, G. Santoso, M. Kudori, and T. Tugiman, "Peran budaya dan bahasa dalam membentuk identitas diri melalui berkebhinekaan global, kreatif dan kritis di kelas 5," Jurnal Pendidikan Transformatif, vol. 2, no. 4, pp. 438–463, 2023.
[33] A. Aprillitzavivayarti and H. Hendri, "Pengaruh Multikultural Leadership, Kompetensi Multikultural Guru, Kompetensi Multikultural Siswa, Terhadap Kinerja Akademik Siswa se SMA Muara Jambi," Educational Leadership and Management Journal (Element Journal), vol. 1, no. 1, pp. 49–70, 2023.

DEVELOPMENT OF A VIRTUAL REALITY–BASED LEARNING VIDEO FOR VOCATIONAL EDUCATION IN YOGYAKARTA

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Abstract. Virtual Reality (VR) has strong potential to enhance vocational learning by providing immersive and practice-oriented experiences. This study aims to develop a Virtual Reality–based learning video to support broadcasting education in vocational high schools in Yogyakarta. The research employed a research and development approach using the APPED model, consisting of analysis, planning, production, evaluation, and dissemination. The development process involved needs analysis, video production using 360-degree VR technology, expert validation, product revision, and limited field testing with vocational students. The results indicate that the developed VR learning video is highly feasible. Content expert validation yielded an average score of 4.66, while media expert validation resulted in an average score of 4.63, both categorized as "very feasible." A limited field trial involving students showed highly positive responses, with an overall average score of 4.7. Students reported improved understanding, higher engagement, and better visualization of broadcasting production processes. The final product includes a 360-degree VR learning video and a user guidebook for teachers and students. This study demonstrates that VR-based learning media can effectively support practice-based learning in vocational education.

INTRODUCTION

Vocational education emphasizes practice-based learning to prepare students with skills that are directly applicable to the workplace. In fields such as broadcasting, students are required to understand not only theoretical concepts but also complex production processes involving cameras, lighting, audio systems, and teamwork. However, conventional instructional approaches often face limitations, including restricted access to production equipment, limited observation opportunities during practice sessions, and time constraints that prevent students from fully understanding each stage of the production process.

Advances in digital technology have introduced new opportunities to address these challenges. One such technology is Virtual Reality (VR), which enables users to experience immersive and interactive learning environments. VR allows learners to observe processes from multiple perspectives, repeat learning experiences independently, and engage more actively with instructional content. Previous studies have shown that VR can improve student engagement, motivation, and conceptual understanding, particularly in learning contexts that require spatial awareness and procedural knowledge.

In vocational broadcasting education, the use of VR-based learning media is especially relevant. Broadcasting practices often involve simultaneous technical activities that are difficult to observe in real time, especially in classrooms with a large number of students. As a result, some students may miss critical learning moments during practice. VR-based instructional videos, particularly those using 360-degree video technology, offer an alternative solution by enabling students to explore production environments freely and revisit learning materials as needed.

Despite the growing interest in VR for education, its implementation in vocational schools, especially in Indonesian contexts, remains limited. Many existing studies focus on general education or higher education settings, while fewer address the specific needs of vocational broadcasting programs. Therefore, there is a need for systematic development and evaluation of VR-based learning media that align with vocational curricula and practical learning objectives.

This study aims to develop and evaluate a Virtual Reality–based learning video to support broadcasting education in vocational high schools in Yogyakarta. By employing a research and development approach, this study seeks to provide empirical evidence on the feasibility and effectiveness of VR-based learning media for enhancing practice-oriented learning in vocational education.

LITERATURE REVIEW

1. Virtual Reality in Education

Virtual Reality (VR) is a computer-based technology that enables users to interact with immersive, three-dimensional environments that simulate real or imagined situations. In educational contexts, VR has been widely recognized as an effective medium for experiential learning, allowing learners to actively engage with learning content rather than passively receiving information (Radianti et al., 2020). By integrating visual, auditory, and spatial elements, VR supports deeper cognitive processing and enhances learner engagement.

Several studies have demonstrated that VR can improve learning motivation, conceptual understanding, and retention, particularly in subjects requiring spatial awareness and procedural knowledge (Makransky & Petersen, 2019). VR environments allow learners to explore complex processes from multiple perspectives, repeat learning experiences independently, and learn at their own pace. These characteristics make VR especially suitable for technical and skills-oriented learning domains, including vocational education.

2. 360-Degree Video as Learning Media

One increasingly popular form of VR-based media in education is 360-degree video. Unlike fully interactive VR simulations, 360-degree video captures real-world environments and enables learners to control their viewing direction during playback. This format offers high realism while remaining relatively accessible, as it can be used with smartphones and low-cost VR headsets (Pribadi et al., 2019).

Research indicates that 360-degree video enhances learner immersion and supports authentic learning experiences, particularly in practice-based instruction (Rambing et al., 2017). By presenting real environments and workflows, 360-degree video helps learners visualize procedures that are difficult to observe directly in conventional classrooms. Moreover, the ability to replay videos multiple times supports self-directed learning and reflective practice, which are essential components of effective instructional design (Parlindungan et al., 2020).

3. Virtual Reality and Practice-Based Learning in Vocational Education

Vocational education emphasizes the acquisition of practical skills aligned with workplace demands. Practice-based learning plays a central role in vocational programs, as students are expected to master tools, procedures, and professional standards relevant to their field (Winangun, 2017). However, vocational institutions frequently encounter challenges such as limited access to equipment, safety risks, and unequal learning opportunities during hands-on practice.

Previous studies suggest that VR-based learning media can effectively address these challenges. VR provides a safe and controlled environment where learners can observe and rehearse procedures without the risk of equipment damage or personal injury (Musril et al., 2020). Additionally, VR supports observational learning by enabling students to repeatedly examine critical steps that might be missed during live demonstrations. As a result, VR can enhance both skill acquisition and learner confidence in vocational settings.

4. VR and 360-Degree Video in Broadcasting Education

Broadcasting education involves complex production processes, including camera operation, lighting setup, audio management, and coordination among production teams. These activities often occur simultaneously, making it difficult for all students to observe each component during live practice sessions. Consequently, some students may fail to fully understand the workflow and technical details of broadcasting production.

The integration of VR and 360-degree video into broadcasting education offers a promising instructional solution. By immersing learners in a virtual production environment, VR-based media allows students to explore broadcasting workflows holistically and from multiple viewpoints (Sundoro & Wibawa, 2019). This approach facilitates a deeper understanding of production roles and technical procedures while enhancing learner engagement and motivation.

5. Research Gap

Although numerous studies have reported positive outcomes of VR and 360-degree video in education, empirical research focusing specifically on vocational broadcasting education at the secondary school level remains limited, particularly in the Indonesian context. Many existing studies concentrate on higher education or general technical training, leaving a gap in research that systematically develops and evaluates VR-based learning media tailored to vocational high school curricula. Therefore, further research is needed to provide evidence-based models for integrating VR into vocational broadcasting instruction.

METHOD

This study employed a research and development (R&D) design aimed at developing, validating, and evaluating a Virtual Reality (VR)–based learning video to support broadcasting education in vocational high schools. R&D is appropriate for studies that focus on producing educational products and systematically testing their feasibility and effectiveness (Richey & Klein, 2007).

The development process followed the APPED model, which consists of five stages: Analysis, Planning, Production, Evaluation, and Dissemination. This model was selected because it provides a structured framework for instructional media development and emphasizes iterative evaluation and refinement to ensure product quality (Surjono, 2017).

The development procedures were conducted according to the APPED stages:

1. Analysis
   A needs analysis was conducted through focus group discussions with vocational teachers and classroom observations. This stage aimed to identify instructional problems, learner characteristics, and technical constraints in broadcasting practice-based learning.
2. Planning
   Based on the needs analysis, learning objectives were formulated, and a detailed script and storyboard for the 360-degree VR video were developed. This stage also included planning camera placement, lighting, narration, and learning flow.
3. Production
   The VR video was produced using a 360-degree camera to capture authentic broadcasting studio environments. Video editing involved color correction, audio enhancement, subtitle integration, and stabilization to ensure user comfort during VR viewing.
4. Evaluation
   Evaluation was carried out in two phases:
   a. Expert validation, involving content and media experts who reviewed the product using structured validation instruments.
   b. Limited field testing, involving vocational students who completed a questionnaire to assess attractiveness, usability, clarity, understanding, and engagement.
5. Dissemination
   The final product was disseminated through workshops with teachers and accompanied by a user guidebook designed to support classroom implementation.

RESULTS AND DISCUSSION

This study aimed to develop and evaluate a Virtual Reality (VR)–based learning video to support broadcasting education in vocational high schools. The results of expert validation and limited field testing indicate that the developed media meets pedagogical, technical, and practical requirements, and effectively supports practice-based learning in vocational education.

The content expert validation yielded an overall mean score of 4.66 out of 5, categorized as very feasible. This result indicates that the instructional content presented in the VR video aligns well with the vocational broadcasting curriculum, accurately represents industry-standard procedures, and provides sufficient depth for vocational students. High scores were obtained particularly in curriculum alignment and relevance of the material, suggesting that the learning objectives, production stages, and technical explanations correspond to expected vocational competencies. Minor revisions recommended by the content expert included clarifying specific technical terms and extending explanations in certain segments through subtitles. These findings support the argument that content validity is a critical factor in the effectiveness of instructional media development (Richey & Klein, 2007).

Media expert validation also demonstrated a high level of feasibility, with an overall mean score of 4.63, categorized as very feasible. The expert highlighted the strengths of the VR video in terms of visual consistency, audio-visual integration, and stability of the 360-degree recording. The use of authentic studio environments contributed to the realism of the learning experience. Suggested improvements focused on technical refinements, such as enhancing indoor lighting, extending subtitle duration, and adding visual cues to guide learners' attention within the immersive environment. These recommendations are consistent with previous research emphasizing the importance of usability, comfort, and visual guidance in immersive learning environments (Radianti et al., 2020).

Following expert validation and product revision, a limited field trial was conducted with five vocational broadcasting students. The results showed highly positive student responses, with an overall mean score of 4.7, categorized as very good. Students reported that the VR-based learning video was engaging, easy to use, and helpful in improving their understanding of broadcasting production processes. In particular, students noted that the ability to freely explore the studio environment and observe camera placement, lighting arrangements, and production workflows from multiple perspectives significantly enhanced their comprehension. This finding aligns with studies indicating that immersive learning environments can improve observational learning and procedural understanding (Makransky & Petersen, 2019).

The integration of VR into vocational broadcasting education addressed several instructional challenges commonly found in practice-based learning. In conventional practical sessions, students often have limited opportunities to observe all stages of production due to space constraints, equipment limitations, and the simultaneous nature of broadcasting activities. The VR-based learning video mitigated these issues by enabling repeated observation and self-paced exploration, thereby supporting learner autonomy and reflection. This result supports previous findings that VR can reduce inequalities in learning opportunities and enhance skill acquisition in vocational contexts (Musril et al., 2020).

The use of 360-degree video as the primary VR format proved to be an effective and accessible solution for vocational schools. Compared to fully interactive VR simulations, 360-degree video offers high realism while requiring relatively low technical and financial resources. This makes it suitable for educational settings with limited infrastructure, as it can be accessed using smartphones and affordable VR headsets (Pribadi et al., 2019). The findings of this study confirm that 360-degree video can serve as a practical entry point for integrating immersive technologies into vocational education.

From a pedagogical perspective, the VR-based learning video supports student-centered and constructivist learning approaches by allowing learners to actively explore learning environments, control their viewing direction, and revisit learning content as needed. Such characteristics align with constructivist learning principles that emphasize active engagement and learner control in knowledge construction (Creswell & Plano Clark, 2018). The positive responses from students indicate that VR-based media can complement traditional instructional methods and enhance the overall quality of learning experiences in vocational education.

Overall, the integrated results demonstrate that the developed VR-based learning video is a feasible, effective, and innovative instructional medium for vocational broadcasting education. The convergence of expert validation results and positive student feedback provides strong empirical support for the use of VR-based learning media in practice-oriented educational contexts.

CONCLUSION

This study aimed to develop and evaluate a Virtual Reality (VR)–based learning video to support broadcasting education in vocational high schools in Yogyakarta. Using a research and development approach with the APPED model, the study systematically produced, validated, revised, and tested a 360-degree VR instructional video designed to support practice-based learning.

The findings demonstrate that the developed VR-based learning video is highly feasible and effective. Validation results from content experts (mean score = 4.66) and media experts (mean score = 4.63) indicate that the product meets pedagogical, technical, and curricular standards. Furthermore, the limited field trial involving vocational students produced very positive responses (mean score = 4.7), showing that the VR video enhanced students' understanding, engagement, and learning experience in broadcasting production processes.

The use of 360-degree video proved to be a practical and accessible form of VR for vocational education. It allowed students to observe authentic broadcasting environments from multiple perspectives and revisit learning materials independently. This approach addressed common challenges in vocational practice-based learning, such as limited access to equipment and unequal observation opportunities during live practice sessions.

Overall, this study provides empirical evidence that VR-based learning media, particularly 360-degree video, can effectively support vocational education when developed through a systematic instructional design process. The findings suggest that integrating immersive media into vocational learning can enhance student-centered learning and better prepare students for real-world professional contexts.

Future research is recommended to involve larger-scale field testing, integrate interactive elements within VR environments, and explore the application of VR-based learning media in other vocational disciplines.

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REFERENCES

1. Akker, J. van den, Gravemeijer, K., McKenney, S., & Nieveen, N. (2013). Educational design research. Routledge.
2. Creswell, J. W., & Plano Clark, V. L. (2018). Designing and conducting mixed methods research (3rd ed.). SAGE Publications.
3. Makransky, G., & Petersen, G. B. (2019). Immersive virtual reality and learning: A meta-analysis. Educational Psychology Review, 31(2), 325–352. https://doi.org/10.1007/s10648-018-9442-8
4. Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). Qualitative data analysis: A methods sourcebook (3rd ed.). SAGE Publications.
5. Musril, H. A., Jasmienti, J., & Hurrahman, M. (2020). Implementation of virtual reality technology in computer assembly learning media. Journal of Education and Learning (EduLearn), 14(1), 83–90. https://doi.org/10.11591/edulearn.v14i1.14403
6. Parlindungan, D. P., Mahardika, G. P., & Yulinar, D. (2020). Effectiveness of video-based learning media in distance learning. Proceedings of the National Seminar on Research and Community Service, 1–8.
7. Pribadi, P., Cahyani, T. N., Waluyo, R., Saputra, D. I. S., & Handani, S. W. (2019). Virtual reality based on 360-degree video as an alternative information delivery media. Journal of RESTI (Rekayasa Sistem dan Teknologi Informasi), 3(3), 336–342. https://doi.org/10.29207/resti.v3i3.973
8. Radianti, J., Majchrzak, T. A., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. Computers & Education, 147, 103778. https://doi.org/10.1016/j.compedu.2019.103778
9. Rambing, X. S., Tulenan, V., & Najoan, B. N. (2017). Virtual reality based on 360-degree video for Minahasa traditional dances. Journal of Informatics Engineering, 11(1), 1–9. https://doi.org/10.35793/jti.11.1.2017.16976
10. Richey, R. C., & Klein, J. D. (2007). Design and development research: Methods, strategies, and issues. Lawrence Erlbaum Associates.
11. Sundoro, D. P., & Wibawa, S. C. (2019). Development of interactive VR-based learning video for digital photo composition in vocational schools. Journal of Information Technology Education (IT-EDU), 4(1), 219–224.
12. Surjono, H. D. (2017). Multimedia pembelajaran interaktif: Konsep dan pengembangan. UNY Press.
13. Winangun, K. (2017). Vocational education as a foundation for facing globalization. Taman Vokasi, 5(1), 72–78. https://doi.org/10.30738/jtvok.v5i1.1493

Hazard and Operability (HAZOP) Study in Resin-Based 3D Printing for SOP Development

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Abstract. Resin-based 3D printing provides high precision and versatility but presents occupational risks such as chemical exposure, ultraviolet (UV) radiation, and flammable solvents. Ensuring safe practices requires structured risk assessment and safety management. This study applies the Hazard and Operability Study (HAZOP) method to systematically identify hazards and process deviations in resin 3D printing. Observations, interviews, and expert discussions were used to analyze critical process nodes including resin preparation, printing, washing with isopropyl alcohol (IPA), curing, and waste handling. Each node was evaluated using standard guide words (No, More, Less, Reverse, Other than) to identify deviations, causes, consequences, safeguards, and recommendations. Findings show that resin handling and washing stages pose the highest risks due to chemical exposure and flammability, while curing poses UV-related hazards. Recommendations include the use of personal protective equipment (PPE), installation of exhaust ventilation, shielding of UV curing units, and proper segregation of hazardous waste. The analysis was used to develop a draft Standard Operating Procedure (SOP) emphasizing engineering controls, administrative measures, and PPE requirements. This research provides an early framework for improving occupational health and safety (OHS) in resin-based additive manufacturing, particularly in laboratory and educational settings. It also serves as a foundation for future studies that will complement HAZOP with Job Safety Analysis (JSA) to strengthen SOP development and compliance strategies.

Keywords: HAZOP, Resin 3D Printing, Occupational Safety, SOP, Additive Manufacturing

INTRODUCTION

Additive manufacturing using resin-based 3D printing is increasingly applied in prototyping, creative industries, and educational laboratories. While the technology enables the production of complex geometries with high accuracy, it introduces Occupational Health and Safety (OHS) risks. These include exposure to volatile organic compounds (VOCs) from photopolymer resins, flammability and inhalation risks from isopropyl alcohol (IPA) used in washing, and ultraviolet (UV) radiation hazards during curing (Chan et al., 2018; Väisänen et al., 2022). Risk assessment methods are essential to systematically identify, evaluate, and mitigate these hazards.

The Hazard and Operability Study (HAZOP), commonly used in chemical and process industries, provides a structured approach to analyzing process deviations and proposing safeguards (Kletz, 1999). Although HAZOP has proven effective in chemical operations, its application in resin-based 3D printing remains limited. This study is designed as a preliminary research focusing on HAZOP as a process-level risk assessment method for resin 3D printing. The findings aim to produce a draft Standard Operating Procedure (SOP) for safer practices in laboratory settings.

At the same time, this research also positions itself as the first stage of a broader project: the next phase will apply Job Safety Analysis (JSA) to complement HAZOP by identifying task-level hazards and assessing operator compliance. Thus, the two studies—HAZOP and JSA—are intended to provide a comprehensive framework for safety-oriented SOP development in resin-based additive manufacturing. Occupational health and safety in additive manufacturing has been a growing concern in recent years. Resin-based 3D printing, particularly those using stereolithography (SLA) and masked stereolithography (MSLA), is associated with the emission of volatile organic compounds (VOCs), fine particles, and other hazardous substances. Studies show that prolonged exposure to these emissions can cause respiratory issues and skin irritation (Chan et al., 2018; Väisänen et al., 2022). In addition, the use of isopropyl alcohol (IPA) for cleaning presents risks of fire and

inhalation (Du Preez et al., 2018), while ultraviolet (UV) curing poses eye and skin hazards if proper shielding is not applied (Petretta et al., 2019).

Risk assessment methods are essential to mitigate such hazards. Job Safety Analysis (JSA) has been widely applied in educational and industrial environments to identify hazards at the task level and develop Standard Operating Procedures (OSHA, 2020). However, JSA focuses more on human-task interactions, while resin 3D printing also involves process-level risks such as chemical concentration, flow, and equipment operation. For this reason, HAZOP provides an additional perspective. Originally developed in the chemical industry, HAZOP uses systematic guide words such as *No, More, Less, Reverse, Other than* to identify potential deviations, their causes, consequences, and safeguards (Kletz, 1999). Its structured nature makes it suitable for processes involving chemicals and sequential operations. Although HAZOP has rarely been applied in additive manufacturing, Leso et al. (2021) and Antic et al. (2023) emphasize the need for more comprehensive risk assessments in 3D printing beyond emission monitoring, integrating both process safety and occupational safety.

FIGURE 1. Practical Use of MSLA 3D Printing Resin

In addition to chemical hazards, ergonomic risks have also emerged as a significant concern in resin 3D printing. Previous research has demonstrated that tasks such as print removal and tank cleaning pose high ergonomic risks due to awkward postures and repetitive motions. Ergonomic approaches using REBA and RULA assessments have been applied to design ergonomics-based SOPs, indicating that safety in additive manufacturing must integrate both process-level and human-factor perspectives.

This study therefore represents the first stage of a broader research roadmap. The current paper focuses on applying HAZOP to analyze process deviations and hazards at the system level. The next stages will involve JSA to capture task-level risks, and ergonomic studies to optimize workspace design and operator posture. Finally, all findings will be synthesized using a Design Thinking approach to develop a comprehensive and user-centered SOP for resin 3D printing.

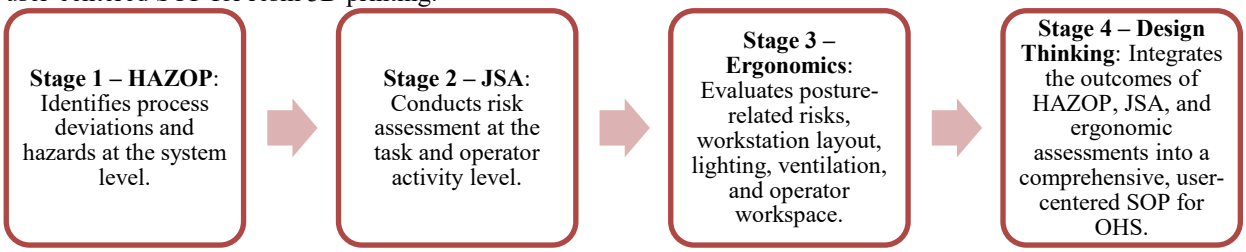

FIGURE 2. Research Roadmap for Developing Safety SOPs in Resin 3D Printing

RESEARCH METHOD

The study employed a descriptive-qualitative method with expert validation. Data collection included observation of resin 3D printing workflows, interviews and FGDs with operators, students, and safety experts, and review of safety standards (ISO 45001, OSHA, SMK3 Indonesia). The HAZOP procedure involved defining nodes such as resin preparation, printer operation, washing tank, curing chamber, and waste container. Each node was analyzed using guide words (No, More, Less, Reverse, Other than) and parameters (flow, concentration, exposure, handling, protection). Deviations, consequences, safeguards, and recommendations were identified. The draft SOP developed from HAZOP findings was validated through expert review and limited laboratory testing.

3.1 Study Design and Setting

This study adopts a descriptive, qualitative–quantitative HAZOP approach applied to resin-based 3D printing workflows in a laboratory environment. The process under study consists of five nodes: (1) Resin preparation, (2) Printing, (3) Washing with isopropyl alcohol (IPA), (4) UV curing, and (5) Waste handling and storage. A multidisciplinary HAZOP team (process engineer, OHS specialist, lab supervisor, and operator) conducted the sessions.

3.2 Equipment and Materials

Equipment: desktop MSLA resin printer, washing tank (IPA-based), UV curing chamber, local exhaust ventilation (LEV) with carbon filter, fire extinguisher (Class B), spill kit, and hazardous-waste containers with secondary containment. Measuring instruments: handheld VOC meter (ppb), UV radiometer (315–400 nm), light meter (lux), anemometer (m/s), thermo-hygrometer, and noise meter (dBA). Materials/Chemicals: photopolymer resins (manufacturer Safety Data Sheets available), isopropyl alcohol (≥99%), nitrile gloves, splash goggles, lab coat, respirator (as required), absorbent pads, and labeling tags. Equipment and materials are summarized in Table 1.

TABLE 1. Equipment and Materials

No.	Equipment	Materials/ Chemicals
1	desktop MSLA resin printer	photopolymer resins
2	washing tank (IPA-based)	isopropyl alcohol (≥99%)
3	UV curing chamber	nitrile gloves
4	local exhaust ventilation (LEV)	splash goggles
5	fire extinguisher (Class B)	lab coat
6	spill kit	respirator (as required)
7	hazardous-waste containers	absorbent pads
8		labeling tags

3.3 Procedures

This procedure was adapted from the structured steps recommended in *HAZOP: Guide to Best Practice* (3rd Edition, 2015), which emphasizes systematic node selection, parameter identification, application of guide words, and team consensus.

1. Process mapping: Observe each node to define normal operating conditions (NOC), inputs/outputs, and existing safeguards; document with photos and P&ID-style schematics where applicable.
2. Data collection: (a) Spot measurements (VOC, air velocity at LEV inlet, illuminance, temperature/humidity), (b) time–motion of key tasks (approx. duration per node), and (c) review of SDS and equipment manuals.
3. HAZOP workshops: For each node, apply guide words to parameters to generate deviations, causes, consequences, safeguards, and recommendations. Record consensus-based risk ratings using the matrix in Section 3.5.
4. Field verification: Cross-check high-risk deviations in situ (e.g., simulate lid interlock failure on UV chamber without exposure risk). Verify feasibility of safeguards (e.g., duct routing for LEV, interlock compatibility).
5. Translation to SOP: Convert accepted recommendations into engineering controls, administrative controls (signage, checklists, training), and PPE. Draft SOP steps and acceptance criteria; align with ISO 45001 clauses and local SMK3 requirements.

FIGURE 3. HAZOP Procedure

3.4 HAZOP Guide Words and Parameters

The guide words applied in this study were adapted from the standard terminology outlined in HAZOP: Guide to Best Practice (3rd Edition, 2015), including No, More, Less, As well as, Part of, Reverse, and Other than, to ensure a systematic and comprehensive identification of potential deviations.

3.5 Risk Ranking Method

A semi-quantitative 5×5 risk matrix was employed in line with the recommendations of *HAZOP: Guide to Best Practice* (2015). This approach emphasizes the integration of severity and likelihood assessments to systematically prioritize corrective and preventive actions.

3.6 Data Recording and Quality Assurance

Consistent with the guidance in *HAZOP: Guide to Best Practice* (2015), all findings were documented in structured HAZOP worksheets. In addition, quality assurance measures—such as independent reviews and cross-validation within the team—were applied to enhance traceability and reliability of the analysis outcomes.

3.7 Validation and Ethics

Face validity was obtained through expert review (OHS professional and process engineer). A pilot run of the SOP was performed with volunteer operators after safety briefing; no personally identifiable data were collected. The study complies with institutional OHS policies and applicable chemical handling regulations.

RESULTS AND DISCUSSION

Results

The HAZOP analysis was applied to five critical nodes of resin-based 3D printing: resin preparation, printing, washing, curing, and waste handling. Table 1 illustrates the results for the washing process with isopropyl alcohol (IPA). Additional analyses for other stages are summarized in Tables 2–6.

TABLE 2. HAZOP Analysis – Resin Preparation

Node	Parameter	Guide Word	Deviation	Consequence	Safeguard	Recommendation
Resin Preparation	Resin volume	More	Excess resin poured	Spillage, skin contact, waste	Visual check	Use graduated container
Resin Preparation	Handling	Reverse	Resin container tilted incorrectly	Spillage	Gloves, training	Provide funnels
Resin Preparation	Exposure	Other than	Resin handled without PPE	Skin irritation, allergy	Signage	Mandatory PPE policy

TABLE 3. HAZOP Analysis – Printing Process

Node	Parameter	Guide Word	Deviation	Consequence	Safeguard	Recommendation
Printing	Platform leveling	Other than	Not calibrated	Print failure, rework	Operator check	Routine calibration checklist
Printing	Exposure time	More	Excess UV exposure	Degraded resin, operator hazard	Timer	Automatic cut-off
Printing	Machine cover	Less	Open cover during print	Resin vapor exposure	Warning label	Interlock mechanism

TABLE 4. HAZOP Analysis for Post-Processing (Washing) with IPA

Node	Parameter	Guide Word	Deviation	Consequence	Safeguard	Recommendation
Washing Tank	Solvent level	No	No IPA available	Residual resin not removed	Operator check	Maintain minimum stock
Washing Tank	Solvent concentration	Less	Diluted IPA	Incomplete cleaning	Visual inspection	Replace solvent regularly
Washing Tank	Vapor exposure	More	Excess vapor released	Inhalation risk, fire hazard	Natural ventilation	Install exhaust + PPE mask
Washing Tank	Handling	Reverse	IPA poured incorrectly	Spill, skin contact	Gloves, training	Secondary containment
Washing Tank	Waste disposal	Other than	IPA disposed with general waste	Environmental hazard	Segregated container	Hazardous waste protocol

TABLE 5. HAZOP Analysis – UV Curing

Node	Parameter	Guide Word	Deviation	Consequence	Safeguard	Recommendation
UV Curing	Door closure	Less	Door not closed	UV leakage, exposure	Warning sign	Install interlock system
UV Curing	Exposure duration	More	Excess curing time	Overheating, brittle print	Timer	Automatic shut-off
UV Curing	Shielding	Other than	Insufficient shielding	Operator eye/skin hazard	Protective goggles	Install UV shield

TABLE 6. HAZOP Analysis – Waste Handling & Disposal

Node	Parameter	Guide Word	Deviation	Consequence	Safeguard	Recommendation
Waste Handling	Segregation	Other than	Resin mixed with general waste	Environmental contamination	Label container	Hazardous waste SOP
Waste Handling	Storage	More	Excess waste accumulation	Spillage, fumes	Periodic disposal	Scheduled collection
Waste Handling	Handling	Reverse	Incorrect pouring	Spillage, contact	Training, gloves	Secondary containment

The initial HAZOP worksheet for the washing process using isopropyl alcohol (IPA) revealed multiple deviations associated with solvent handling, vapor emissions, and waste disposal. These deviations highlight not only the potential chemical and fire hazards but also the importance of proper ventilation and waste segregation. To provide a more comprehensive overview, further HAZOP assessments were conducted for the preceding and subsequent stages of resin 3D printing, including resin preparation, the printing process itself, UV curing, and final waste handling.

Resin Preparation

- Deviation: Excess resin poured into the vat (*More*)
- Cause: Operator error, lack of measurement tools
- Consequence: Resin spillage, skin contact, unnecessary waste
- Safeguard: Visual inspection, manual handling
- Recommendation: Use graduated containers, provide training on resin measurement

Printing Process

- Deviation: Build platform not leveled (*Other than*)
- Cause: Incorrect calibration
- Consequence: Print failure, increased exposure time
- Safeguard: Operator calibration check
- Recommendation: Implement checklist, periodic machine maintenance

UV Curing

- Deviation: Door not properly closed (*Less protection*)
- Cause: User negligence, defective lock system
- Consequence: UV leakage, operator eye/skin exposure
- Safeguard: Warning label, basic shielding
- Recommendation: Install interlock system, provide protective goggles

Waste Handling & Disposal

- Deviation: Waste resin mixed with general waste (*Other than*)
- Cause: Lack of segregation protocol
- Consequence: Environmental contamination, legal compliance issues
- Safeguard: Waste container with labels
- Recommendation: Implement hazardous waste protocol, operator training

Key findings indicated that resin handling and washing stages pose the highest risks. Existing safeguards such as PPE and natural ventilation were insufficient, highlighting the need for stronger engineering controls, UV shielding, and structured waste management. The HAZOP results were translated into SOP elements: engineering controls (exhaust ventilation, UV shielding), administrative controls (training, signage, inventory checks), and PPE (gloves, goggles, respirators, lab coats).

Discussion

The HAZOP analysis was applied to five critical nodes of resin-based 3D printing: resin preparation, printing, washing, curing, and waste handling. The initial worksheet for the washing process using isopropyl alcohol (IPA) revealed multiple deviations associated with solvent handling, vapor emissions, and waste disposal. These deviations highlight not only the potential chemical and fire hazards but also the importance of proper ventilation and waste segregation. To provide a more comprehensive overview, further HAZOP assessments were conducted for the preceding and subsequent stages of resin 3D printing, including resin preparation, the printing process itself, UV curing, and final waste handling.

The results show that:

1. Resin preparation is vulnerable to chemical spillage and dermal exposure, especially when containers are mishandled or PPE is not used. Simple engineering solutions such as graduated containers and funnels, combined with administrative controls (PPE policy, signage), were identified as effective safeguards.
2. Printing process hazards include poor platform leveling, incorrect UV exposure times, and opening the machine cover during operation. These issues can lead to product failures, degraded resin, and operator exposure to fumes. The most effective safeguards are routine calibration, interlock mechanisms, and automatic timers.
3. Washing with IPA presents the highest flammability and inhalation risks due to vapor release. Safeguards include local exhaust ventilation (LEV), strict PPE enforcement, and safe waste segregation procedures.
4. UV curing hazards stem from UV radiation leakage and overheating due to prolonged curing. Interlock doors, shielding, and automatic shut-off systems are essential controls.
5. Waste handling and disposal risks involve improper segregation of resin-contaminated waste, accumulation of IPA waste, and spillage during transfer. Adoption of hazardous waste SOPs, labeling, and scheduled disposal is recommended.

Across all nodes, the highest-risk deviations were associated with flammability of IPA vapors and UV radiation exposure. The application of the semi-quantitative risk matrix showed that these hazards fall into the High to Extreme categories, requiring immediate engineering and administrative interventions. This analysis underscores the importance of integrating engineering controls (LEV, interlocks, shielding), administrative measures (signage, training, checklists), and PPE into a comprehensive SOP framework. It also confirms that HAZOP is a suitable tool for system-level hazard identification in resin-based 3D printing.

CONCLUSION

This study demonstrated the application of Hazard and Operability Study (HAZOP) to identify and assess risks in resin-based 3D printing processes. Five critical nodes were analyzed: resin preparation, printing, washing with IPA, UV curing, and waste handling. The results revealed significant risks, particularly related to IPA vapor flammability, chemical exposure during resin handling, and UV radiation leakage during curing. The analysis provides practical recommendations for engineering, administrative, and personal protective safeguards that can be directly translated into Standard Operating Procedures (SOPs). These findings serve as a foundation for enhancing occupational health and safety in educational and laboratory environments where resin-based 3D printing is implemented.

Importantly, this research is positioned as the first stage of a broader project. Future work will complement the HAZOP results with Job Safety Analysis (JSA) at the task level, ergonomic assessments (REBA/RULA), and a design thinking approach to integrate user-centered perspectives. Together, these efforts will contribute to the development of a comprehensive and practical OHS SOP framework for resin 3D printing.

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REFERENCES

1. Antic, J. et al. (2023). The Risk assessment of 3D printing FDM technology. Procedia Structural Integrity, 48, 274–279.
2. Chan, F. L. et al. (2018). Health survey of employees regularly using 3D printers. Occupational Medicine, 68(3), 211–214.
3. Crawley, F., Tyler, B., & Preston, M. (2015). HAZOP: Guide to Best Practice (3rd Edition). Elsevier/IChemE.
4. Du Preez, S. et al. (2018). Exposures during industrial 3-D printing and post-processing tasks. Rapid Prototyping Journal, 24(5), 865–871.
5. Kletz, T. (1999). HAZOP and HAZAN: Identifying and Assessing Process Industry Hazards. Institution of Chemical Engineers.
6. Leso, V. et al. (2021). Three-dimensional (3D) printing: Implications for risk assessment and management in occupational settings. Annals of Work Exposures and Health, 65(6), 617–634.
7. OSHA. (2020). Job Hazard Analysis Guide. U.S. Department of Labor.
8. Petretta, M. et al. (2019). 3D printing of musculoskeletal tissues: Impact on safety and health at work. Journal of Toxicology and Environmental Health, 82(16), 891–912.
9. Väisänen, A. et al. (2022). Organic compound and particle emissions of additive manufacturing with photopolymer resins. Journal of Toxicology and Environmental Health, 85(5), 198–216.
10. Kementerian Ketenagakerjaan Republik Indonesia, Peraturan Menteri Ketenagakerjaan Republik Indonesia Nomor 5 Tahun 2018 tentang Keselamatan dan Kesehatan Kerja Lingkungan Kerja, Jakarta: Kemenaker, 2018.
11. International Organization for Standardization, ISO 45001:2018 – Occupational Health and Safety Management Systems – Requirements with Guidance for Use, Geneva: ISO, 2018.
12. Occupational Safety and Health Administration (OSHA), Job Hazard Analysis (OSHA 3071), Washington, DC: U.S. Department of Labor, 2002.
13. V. Gaspersz, Total Quality Management, Jakarta: Gramedia Pustaka Utama, 2002.
14. P. Swuste, M. Frijters, and J. Guldenmund, “The future of safety science,” Safety Science, vol. 61, pp. 1–3, 2014.
15. J. Ridley and J. Channing, Safety at Work, 7th ed., Oxford: Butterworth-Heinemann, 2008.
16. D. Zohar, “A group-level model of safety climate: Testing the effect of group climate on microaccidents in manufacturing jobs,” Journal of Applied Psychology, vol. 85, no. 4, pp. 587–596, 2000.

DEVELOPING "JELAJAHI PULAU JAWA": A CULTURAL LEARNING MEDIA TO FOSTER TOLERANCE IN PRIMARY SCHOOLS

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Abstract. This study develops "Jelajah Pulau Jawa", a culturally-based learning media aimed at fostering tolerance among primary school students in Yogyakarta, Indonesia. Grounded in the need to integrate character education with local wisdom, the research employed a research and development (R&D) approach using ADDIE models. The research consisting of needs analysis, design, development, implementation, and evaluation.The media presents an interactive journey across Java Island, introducing students to cultural diversity and values of harmonious coexistence. Data were gathered through expert validation, teacher feedback, and student responses. Findings show that the media is feasible, engaging, and effective in enhancing students' understanding and practice of tolerance. Experts highlighted its cultural relevance, while classroom implementation demonstrated improved appreciation of diversity and collaborative behaviour among students.The study concludes that contextualized cultural learning media can strengthen tolerance education at the primary school level and contribute to broader efforts in promoting peace and inclusive character development.

Keywords: tolerance education, cultural learning media, primary schools, character education

INTRODUCTION

Tolerance education has become a global urgency amid rising social polarization, identity-based conflicts, and the declining sensitivity toward diversity among younger generations. UNESCO emphasizes that education for tolerance is an essential component of peace education and human rights education (UNESCO, 1994). Through education, young people are expected to understand, appreciate, and respect religious, ethnic, and cultural differences as an inherent part of shared life.

In Indonesia, this issue holds particular significance considering the nation's multicultural and multireligious character. Yogyakarta—known as the City of Education and the City of Tolerance—serves as a miniature reflection of Indonesia's diversity, with thousands of students from various regions, religions, and cultural backgrounds

(Humas DIY, 2023; KESBANG DIY, 2022). Nevertheless, educational reports and several studies still indicate that intolerance occasionally emerges within school settings, taking the form of stereotypes, exclusion, or bullying based on differences (Sudirman, 2019; Sularto, 2018). This is concerning, as elementary education represents a crucial period in children's character formation, during which their moral and social capacities develop rapidly (Mangunwijaya, 1986). Therefore, efforts to instill the value of tolerance in children must be carried out systematically and contextually from the primary school level.

At the elementary school age, according to Piaget, children are in the concrete and symbolic stages of thinking. They comprehend moral values more easily through visual experiences, narratives, and role models rather than through lectures or abstract explanations (Muro & Jeffrey, 2008). Consequently, story-based learning becomes a more effective approach to teaching social values such as empathy, cooperation, and tolerance. Bandura's social learning theory explains that children learn through observation and imitation of modeled behaviors. Thus, tolerant characters and attitudes can be developed through story figures who demonstrate respect for differences and harmonious coexistence in diversity. Illustrated storybooks, therefore, offer a promising alternative for teaching tolerance to children. Unfortunately, most children's storybooks in Indonesia still focus on general moral themes or entertainment, rather than promoting intercultural and interfaith tolerance values (Rahmadonna, 2023).

Storybooks possess great potential as enjoyable instruments for character education. Effiong and Igiri assert that contextually designed learning materials can enhance students' understanding and engagement (Effiong &

Igiri, 2015). A well-developed children's storybook should not only contain engaging narratives but also reflective activities that invite learners to contemplate the moral messages conveyed within (Mudlofir, 2011). Illustrated storybooks, in particular, provide distinct pedagogical advantages compared to conventional teaching materials. First, the combination of text and visual illustrations helps children understand the meaning of stories more deeply, as information is processed through dual cognitive channels—verbal and visual (Mayer, 2009). Second, appealing illustrations can improve children's attention span and foster intrinsic motivation to read (Nikolajeva & Scott, 2006). Third, narrative structures in illustrated books offer wide imaginative space, allowing children to interpret moral messages personally, thereby creating more meaningful learning experiences. Several studies have demonstrated that illustrated storybooks are effective in fostering social and cultural values because they present contexts that are closely related to children's real-life experiences (Effiong & Igiri, 2015; Yuliani & Hermawan, 2020).

Within this context, the development of the illustrated storybook Jelajahi Pulau Jawa ("Explore the Island of Java") emerges as a relevant and contextual solution for tolerance education in primary schools. This book highlights the rich cultural heritage of Java Island as an entry point for nurturing mutual respect. Children are invited to explore traditional houses, local cuisines, clothing, and customs from various provinces across Java while learning that such diversity is part of a shared identity. This local-culture-based approach aligns with the view that character education should be rooted in social contexts and local wisdom, ensuring that the values taught are not abstract but embedded in students' everyday experiences (Al Majali & AlKhaaldi, 2020; Astri, 2020). More than merely a literacy medium, Jelajahi Pulau Jawa functions as a form of multicultural learning that connects cultural knowledge with universal moral values. When children perceive cultural diversity as something beautiful and worthy of appreciation, they simultaneously learn to accept religious, ethnic, and social differences in positive ways. Therefore, this illustrated storybook is not only a reading aid but also a strategic instrument of character education for cultivating tolerance values from an early age.

LITERATURE REVIEW

1. Tolerance and Tolerance Education in the Context of Primary Education

Tolerance is a fundamental prerequisite for peaceful coexistence within a pluralistic society. UNESCO emphasizes that education for tolerance is not merely about teaching "patience toward differences," but about cultivating a critical awareness that diversity constitutes a strength enriching collective life (UNESCO, 1994). In this regard, education should not only impart cognitive knowledge about differences but must also foster attitudes and behaviors that support harmonious living.

Tolerance encompasses three interrelated dimensions: the cognitive dimension, which concerns understanding differences; the affective dimension, which focuses on acceptance; and the behavioral dimension, which manifests in respectful actions. These three dimensions should be taught integratively through concrete learning experiences, particularly in primary education (Witenberg, 2019). In primary education, these three dimensions should be taught integratively through concrete learning experiences. This reinforces the notion that tolerance represents a value interpreted uniquely by each individual according to their personal characteristics and experiences (Rahmadonna, Setyosari, Kuswandi, & Sulton, 2025).

Children at the elementary school level are not yet capable of abstract thinking. Consequently, values such as empathy and appreciation for diversity are more effectively taught through real-life contexts and stories that relate closely to their everyday experiences (Muro & Jeffrey, 2008). The formation of tolerant character must begin early, since this developmental stage is when children build social and moral understanding that will shape their future attitudes (Sudirman, 2019).

Nationally, Indonesia's character education policy, through the Profil Pelajar Pancasila (Kemendikbudristek, 2020), positions "global diversity" (berkebinekaan global) as one of the core competencies required of 21st-century learners. This aligns with UNESCO's Global Citizenship Education framework, which encourages students to think openly, understand other cultures, and develop empathy across identities (UNESCO, 2016). Thus, tolerance education in primary schools functions not only to shape moral behavior but also to equip students with essential life skills for interacting in multicultural societies.

2. Children's Storybooks and Illustrated Storybooks as Media for Value Learning

Children's storybooks are among the most effective learning media for character education because they naturally integrate cognitive, affective, and social aspects. They function as a "social mirror" through which children recognize moral values by observing the experiences of story characters (Nodelman, 2008). Stories not only convey messages but also invite children to empathize and reflect on the consequences of characters' actions.

Illustrated storybooks expand this potential by combining the power of verbal and visual narratives. Learning becomes more effective when information is presented through two complementary cognitive channels—verbal and visual—according to multimedia learning theory (Mayer, 2009). As a result, children do

not merely read words but also interpret meanings through images. The relationship between text and image creates an "interplay" in which illustrations not only clarify the narrative but also add emotional depth that helps children understand complex values such as tolerance and empathy(Nikolajeva & Scott, 2006).

From a pedagogical perspective, illustrated storybooks serve as instruments that facilitate social learning. Individuals learn by observing and imitating the behavior of models (Albert Bandura, 1977). In the context of children's learning, story characters act as social models who demonstrate respect for differences and peaceful conflict resolution. When children read or listen to stories, they internalize these modeled behaviors through identification processes, which explains why narrative-based media are often more effective than abstract explanations in value education.

Empirical research supports this perspective. Illustrated storybooks have been found to enhance children's understanding of character values, including empathy and mutual respect (Yuliani & Hermawan, 2020). Contextual teaching materials—such as culturally familiar stories—can also increase emotional engagement and learning motivation (Effiong & Igiri, 2015). Therefore, illustrated storybooks function not only as literacy media but also as effective tools for moral and social learning.

3. Landasan Teoretis: Konstruktivisme dan Teori Pembelajaran Sosial

Constructivism and social learning theory complement each other in explaining how children learn tolerance through narrative media. Constructivism views learning as an active process in which learners construct meaning from experience and social interaction (Fosnot & Perry, 2005). In this sense, storybooks act as stimuli that encourage learners to reflect on the meaning of difference, connect it to their personal experiences, and construct new understandings about diversity. Teachers serve as facilitators who guide students to discuss and explore values from stories, making the learning process participatory and meaningful.

Social learning theory explains that prosocial behaviors such as tolerance are formed through observation and imitation of socially reinforced models (A. Bandura, 1999; Albert Bandura, 1977). Storybooks offer behavioral models in the form of admired characters. When children observe that characters who respect differences are rewarded with social acceptance and happiness, these behaviors are strengthened through *vicarious reinforcement*.

The connection between the two theories is evident. Constructivism explains how children construct meaning about tolerance through reading and reflection, whereas social learning theory explains why they imitate tolerant behaviors modeled in stories. Together, they provide a strong theoretical basis for developing narrative-based learning media such as *Jelajahi Pulau Jawa*.

4. Integrating Local Cultural Values into Tolerance Education

Character education becomes more meaningful when it is linked to the cultural context in which learners grow. In Javanese culture, the values of *tepa selira* (empathy and consideration for others) and *ngewongke uwong* (treating others with dignity) express deep respect for human feelings and dignity (Astri, 2020). These are local manifestations of universal principles of tolerance.

Integrating cultural values into learning media helps children perceive tolerance not as a foreign concept but as part of their own cultural identity. The internalization of social values is more effective when supported by culturally familiar contexts (Al Majali & AlKhaaldi, 2020). Accordingly, the development of *Jelajahi Pulau Jawa*, which highlights the cultural richness of Javanese provinces, represents not only a literacy initiative but also a pedagogical strategy for strengthening character education through local wisdom.

The illustrated storybook is designed not merely to transfer knowledge but to facilitate meaning-making, behavioral observation, and the internalization of social values through cultural symbols. Such a learning process enables children not only to understand what tolerance means but also to experience and live it as part of their daily lives.

METHOD

This study employed a research and development (R&D) approach aimed at producing an educational product in the form of an illustrated storybook entitled Jelajahi Pulau Jawa (Explore the Island of Java), designed as a learning medium for tolerance education among elementary school students. The R&D approach was selected because it enables researchers to integrate product development activities with systematic evaluation and validation processes (Borg, W. R., & Gall, 1989).

The development model used in this research was the ADDIE model (Branch, 2009). This model consists of five main stages: Analysis, Design, Development, Implementation, and Evaluation. The ADDIE framework was chosen for its flexibility and adaptability to primary education contexts, as well as its allowance for iterative product revisions based on expert validation and field testing results.

In this study, all five stages—Analysis, Design, Development, Implementation, and Evaluation—were conducted to produce a feasible, engaging, and pedagogically relevant illustrated storybook that aligns with the

objectives of tolerance education. The research was carried out in several elementary schools across Yogyakarta, a city renowned for its strong educational culture and high level of cultural diversity (Humas DIY, 2023). The participants involved in the study included:

1. Content experts—lecturers in primary education and character education;
2. Media experts—lecturers or practitioners in instructional design; and
3. Elementary school teachers and students as end users of the product.

Participants were selected purposively, considering their competence, experience, and relevance to the context of character education in primary schools (J. W. Creswell & Plano Clark, 2018; John W. Creswell, 2014). Data were collected through multiple techniques:

1. Interviews and observations were conducted to identify learners' and teachers' needs;
2. Validation questionnaires were used to obtain assessments from content and media experts;
3. Response questionnaires were distributed to students and teachers to evaluate readability, attractiveness, and comprehension of values; and
4. Documentation and field notes were maintained throughout the development process.

Quantitative data obtained from validation and field testing were analyzed using descriptive statistics to calculate mean feasibility scores. Meanwhile, qualitative data derived from interviews and expert comments were analyzed thematically to identify patterns of feedback relevant to improving the product design. This process employed an *iterative refinement* approach, which involves continuous revision to enhance product quality (Branch, 2009).

All research procedures adhered to established principles of academic ethics. Permissions were obtained from schools and teachers prior to implementation, and all child participants received simplified explanations of the research purpose. The confidentiality of respondents' identities was also safeguarded. These ethical measures were consistent with the guidelines for educational research involving children established by the British Educational Research Association, which emphasize the importance of informed consent and the emotional well-being of participants (BERA., 2018).

RESULT

This study produced a developed product in the form of an illustrated storybook entitled *Jelajahi Pulau Jawa* (*Explore the Island of Java*), designed as a learning medium for teaching tolerance values to elementary school students. The book was developed through three primary stages of the ADDIE model—analysis, design, and development—before its implementation in classroom learning. The main objective of this research was to produce a storybook that is valid, feasible, engaging, and effective for teaching tolerance to children through a joyful and contextual approach.

The development process began with a needs analysis, which revealed that primary school teachers still lacked teaching materials explicitly designed to instill social values—particularly tolerance—in ways that are engaging and age-appropriate. Observations and interviews with teachers showed that most students were more interested in learning through illustrated media and short stories relevant to their daily lives. Based on these findings, *Jelajahi Pulau Jawa* was designed by integrating cognitive, affective, and social aspects. The story follows a main character, **Jolina**, who travels across various provinces on Java Island using a hot-air balloon. Each region introduces a new cultural experience—from traditional houses, local cuisines, and clothing to the social behaviors of the people. Through Jolina's journey, children are encouraged to understand that diversity is something to be appreciated and can be a source of shared happiness.

Visually, the book presents bright-colored illustrations and representative child characters, helping students easily grasp the cultural contexts depicted in the story. Each chapter concludes with two reflective elements: *"Did You Know?"* and *"What Can You Learn from This Story?"* These features are designed to stimulate students' critical thinking and moral reflection. With this structure, the storybook not only provides cultural information but also guides students to interpret the meaning of tolerance through reading experiences.

A validation phase was conducted to evaluate the feasibility of the book before classroom implementation. Two categories of experts were involved: **content experts** and **media experts**. Content experts assessed the appropriateness of the content, the depth of the tolerance values presented, alignment with the curriculum, and the comprehensibility of the material for primary school students. The results showed an average score of **3.9 out of 4**, which falls into the *excellent* category. Experts agreed that the book successfully portrays cultural diversity positively and provides concrete examples of tolerant behaviors that children can easily understand. Some technical suggestions were made, such as simplifying sentences in the reflective sections to make them more communicative for students aged 9–11 years.

Media experts evaluated the visual appearance, layout, typography, color harmony, and balance between text and illustrations. The results also yielded an average score of **3.9 out of 4**, categorized as *excellent*. Experts

praised the coherence between narrative and visualization, which effectively built readers' emotional engagement. The illustrations depicting various Javanese cultures were considered successful in representing differences naturally without emphasizing stereotypes. Minor recommendations were given, such as enlarging the font size in certain sections to improve readability for younger readers.

The results from both expert validations indicate that *Jelajahi Pulau Jawa* meets the pedagogical and aesthetic criteria of children's learning materials. The high scores from both expert groups demonstrate consistency between the content and design quality, confirming that the book is ready for classroom implementation.

After revising the product based on expert feedback, teachers were involved in evaluating the suitability of the book for classroom use. Teachers assessed the relevance of the content to the primary school curriculum, ease of use in teaching, and the alignment of the values presented with character education objectives. The results showed a **perfect score of 4.0 out of 4**, classified as *excellent*. Teachers stated that *Jelajahi Pulau Jawa* is highly appropriate for use in both classroom instruction and school literacy programs. Teachers also noted that the storybook was effective because it combined engaging storytelling with explicit moral values without being didactic. The stories were viewed as closely related to students' real-life experiences, which made the moral messages easier to internalize and recall. Additionally, teachers highlighted the book's flexibility for use across different subjects, including Pancasila Education, Indonesian Language, and character reinforcement programs. These findings support the notion that contextual illustrated storybooks hold stronger appeal and emotional impact than conventional text-based materials, as they simultaneously engage children's emotional and social dimensions.

Following validation and teacher assessment, the storybook was tested with students through two main stages: a **small-group trial** and a **medium-group trial**. These trials aimed to measure readability, attractiveness, and comprehension of the tolerance values embedded in the story. The **small-group trial** involved a limited number of purposively selected students to observe initial reactions to the book's content, illustrations, and language. The results showed an average score of **2.8 out of 3**, categorized as *good*. Students expressed high interest in the main character and storyline. They were enthusiastic about learning the traditional houses, clothing, and cuisines of each region Jolina visited. Interviews revealed that most students could recall tolerance values demonstrated in the stories—such as mutual respect, cooperation, and acceptance of differences. Teachers observed that students more easily remembered moral values presented through illustrated stories compared to long text-based narratives.

The **medium-group trial** engaged a larger group of students in a setting closer to real classroom conditions. This stage aimed to ensure the consistency of students' responses and to assess comprehension after shared reading and discussion sessions. The results indicated an average score of **2.78 out of 3**, still within the *good* category. This stable score across groups suggested that the book maintained consistent readability and appeal among diverse students. Observations showed active participation, as students shared personal experiences related to cultural differences and expressed curiosity about traditions in other regions. Teachers also reported positive behavioral changes, such as students showing greater respect for peers' differences during class discussions.

The next step is a limited implementation. It was conducted in partner schools to examine how the book functioned in real learning situations. Implementation activities included shared reading sessions and reflective discussions facilitated by teachers. The results yielded an average score of **2.83 out of 3**, also in the *good* category. Students demonstrated increased reading motivation and active participation in discussing tolerance-related values found in the stories. The *"Did You Know?"* activities effectively reinforced cultural knowledge, while the reflective sections encouraged students to think critically about the importance of appreciating diversity in their school environment.

A comprehensive evaluation was then conducted to review the book based on feedback from experts, teachers, and students. The evaluation confirmed that the book met the required standards of content quality, visual presentation, and educational functionality. Final revisions included enlarging the text in the reflection sections, adjusting certain cultural terms to make them more familiar to students, and strengthening the moral messages in the concluding parts of the story.

Overall, the results of this study indicate that the illustrated storybook *Jelajahi Pulau Jawa* is of high quality and effective as a learning medium for teaching tolerance in primary schools. Expert validation confirmed excellent alignment between content and design, teacher evaluations provided strong support for classroom relevance and usability, and student trials and implementation demonstrated consistent readability, attractiveness, and learning effectiveness. Based on these findings, *Jelajahi Pulau Jawa* can be categorized as a valid, feasible, and promising educational media product for broader use in character education and tolerance-based literacy programs in primary schools.

DISCUSSION

The results of this study demonstrate that the illustrated storybook *Jelajahi Pulau Jawa*, developed as a learning medium to teach tolerance values to elementary school students, meets the criteria of a valid, feasible, and effective educational product. Expert validation produced excellent results, teacher assessments yielded perfect scores, and both student trials and classroom implementation produced stable mean scores within the *good* category. These findings confirm that an illustrated storybook rooted in local culture can function optimally as a medium for character education by integrating the cognitive, affective, and social dimensions of child development. Within this context, the following discussion explores how these results relate to existing theories and previous studies, and why media such as *Jelajahi Pulau Jawa* are relevant and effective within Indonesia's primary education context.

The success of this product can be explained theoretically through the *Cognitive Theory of Multimedia Learning*, which asserts that humans process information through two primary cognitive channels—verbal and visual—that work in parallel to construct meaningful understanding (Mayer, 2009). The design of *Jelajahi Pulau Jawa*, combining simple narrative with colorful illustrations, facilitates this dual-channel processing, allowing children to comprehend moral messages not only through text but also through concrete visualization. This principle aligns with findings by Fiorella and Mayer, who demonstrated that the combination of text and imagery enhances semantic memory and moral value retention more effectively than text alone (Fiorella & Mayer, 2016). In this storybook, local cultural illustrations serve not as decorative elements but as meaning enhancers. Each image contextualizes the narrative and helps children "see" how tolerance is manifested in real life through the cultural differences represented in the story.

Beyond cognitive processing, the success of this storybook can also be explained through the social and affective dimensions of learning. *Social Learning Theory* provides a strong foundation for understanding how children acquire character values through observation and imitation (Albert Bandura, 1977, 2016). The main character, **Jolina**, in *Jelajahi Pulau Jawa* acts as a prosocial model demonstrating respect, empathy, and openness toward cultural diversity. Students who read the story not only understand the concept of tolerance but also learn by observing and modeling the character's behavior—a process known as *vicarious learning*, where positive behaviors are imitated because they produce emotional satisfaction or social approval. The high enthusiasm students showed toward Jolina supports this mechanism: learners actively discussed the character's actions and related them to their own experiences. This aligns with research showing that exposure to moral stories featuring positive role models increases children's tendency to emulate ethical and prosocial behaviors within their social environments (Liang, Z., Yin & Li, 2025).

From a moral education perspective, visual narratives such as those in *Jelajahi Pulau Jawa* possess a unique power that is often unattainable through traditional instructional approaches. Narratives engage the affective domain, evoking empathy and emotional identification with story characters. Previous studies have shown that picturebooks hold great potential for moral education due to their ability to reach children's emotional side while simultaneously nurturing moral reasoning through narrative conflict and resolution (Zhao, 2021). In this study, students not only recalled the storyline but also reflected on its moral implications. The development of *Jelajahi Pulau Jawa* thus exemplifies Zhao's view that visual and moral literacy should be integrated to form a holistic understanding of character.

The inclusion of cultural elements significantly strengthens the pedagogical value of this book. Contextual character education that reflects local culture has proven more effective than universal approaches detached from learners' social realities. In Javanese culture, the values of *tepa selira* (empathy and consideration for others) and *ngewongke uwong* (treating others with dignity) embody the essence of tolerance by promoting empathy and respect for human dignity (Astri, 2020). Studies have shown that the success of values education in multicultural societies depends largely on the degree to which those values align with students' local culture and experiences (Al Majali & AlKhaaldi, 2020; van Doorn, 2014). This finding reinforces that *Jelajahi Pulau Jawa* is not merely a means of introducing regional culture but a vehicle for transforming cultural understanding into meaningful moral learning.

Teacher evaluations, which received perfect scores, further strengthen the pedagogical legitimacy of the book. Teachers reported that the book was engaging, easy to use, and aligned with the *Profil Pelajar Pancasila* curriculum framework, particularly within the dimension of "global diversity." They also found that the stories could be used across multiple learning themes, including Pancasila Education, Indonesian Language, and literacy enrichment activities. This supports Turan's assertion that teachers' acceptance of educational media is a critical determinant of its successful classroom implementation (Turan, 2016). Turan also emphasizes that the effectiveness of character education media—such as illustrated stories—depends on teachers' ability to facilitate moral discussion after reading activities. In this study, teachers not only guided the reading process but also facilitated reflection sessions, ensuring deeper transmission of tolerance values.

The stability of the findings across the three testing phases (2.8, 2.78, and 2.83) indicates consistent effectiveness of the book across various student groups and learning settings. This consistency is essential

because it demonstrates that the product can be applied broadly without a decline in quality of engagement or comprehension. These results align with the study of Zakiah, Sarkadi, and Marini, who found that culturally based literacy media maintained effectiveness in promoting tolerant attitudes across diverse groups of elementary students in Jakarta (Zakiah, Sarkadi, & Marini, 2023). Their research confirmed that tolerance learning becomes more meaningful when presented in cultural contexts familiar to children. In *Jelajahi Pulau Jawa*, illustrations of traditional houses, clothing, and social customs foster emotional connection and cultural pride, which in turn enhance the internalization of tolerance values.

From a constructivist standpoint, the findings indicate that students did not passively absorb moral messages but actively constructed meaning through their interaction with the story. Learning, as Fosnot and Perry explain, is a process of personalizing experience and reflecting on acquired knowledge (Fosnot & Perry, 2005). The reflective component in *Jelajahi Pulau Jawa*—specifically the section *"What Can You Learn?"*—encouraged students to relate tolerance values to their personal experiences, such as interactions with peers of different cultural or religious backgrounds. This reflective process is critical for value internalization. Observations showed that students spontaneously shared personal experiences after reading, indicating that narrative media successfully stimulated reflective awareness. These findings reinforce Haste's argument that effective moral education allows learners to "experience moral conflict imaginatively" and negotiate value meanings personally within their social contexts (Haste, 2025).

In relation to tolerance theory, the findings of this study align with Witenberg's conceptualization of tolerance as encompassing three interrelated components: understanding differences (cognitive), accepting diversity (affective), and showing respect (behavioral) (Witenberg, 2019). All three components are reflected in both the design of the book and the research outcomes. Cognitively, students understood cultural diversity through the narrative and factual elements. Affectively, illustrations and simple conflicts in the stories fostered empathy toward others. Behaviorally, classroom discussions and reflections helped students practice concrete expressions of respect for differences. Thus, the book not only conveyed the concept of tolerance but also facilitated its holistic formation. Moral story-based approaches have been shown to be highly effective in teaching social values because they simultaneously activate children's imagination and empathy(Rahiem, 2020). This aligns with the findings of the present study, where students exhibited active participation, emotional engagement, and increased reflective ability after reading *Jelajahi Pulau Jawa*. Therefore, a narrative-visual approach demonstrates pedagogical superiority over expository methods in value education.

Nevertheless, this study also reveals several challenges. Although the mean scores fall within the *good* category, the fact that they did not reach the maximum score indicates that value internalization requires a longer and more iterative process. Some students still needed teacher assistance to understand less familiar cultural terms. Additionally, since the book focuses primarily on Javanese culture, adaptations may be necessary for other cultural contexts to ensure broader inclusivity and universality of the tolerance message. These challenges are consistent with the findings of Cohen, Simmons, and Chen, who argued that the formation of active tolerance attitudes cannot be achieved through a single intervention but must be developed through repeated experiences across diverse social contexts (Cohen, Simmons, & Chen, 2021).

Overall, *Jelajahi Pulau Jawa* demonstrates both empirical effectiveness and strong theoretical grounding. Mayer's multimedia principles explain the cognitive efficiency of combining text and illustration; Bandura's social learning theory elucidates the mechanism of learning through modeling; the constructivist approach of Fosnot and Perry highlights the importance of reflection in meaning-making; and Witenberg's psychology of tolerance provides a framework for evaluating the cognitive, affective, and behavioral dimensions of values education. Together, these frameworks converge within Indonesia's local cultural context to affirm that character education must be rooted in the learners' social realities. Through these contributions, the study advances the development of culturally grounded learning media for fostering tolerance, empathy, and respect for diversity—values that are increasingly vital in 21st-century education.

CONCLUSION AND RECOMENDATION

This study successfully developed an illustrated storybook titled *Jelajahi Pulau Jawa* (*Explore the Island of Java*) as an effective learning medium for cultivating tolerance values among elementary school students. The systematically conducted development process resulted in a valid and feasible product, as reflected in the expert evaluations of content and media, both categorized as *excellent*, and teacher assessments, which achieved a perfect score. Student trials and classroom implementation further demonstrated positive responses, with consistent levels of readability, attractiveness, and value comprehension falling within the *good* category.

Jelajahi Pulau Jawa effectively integrates literacy, cultural visualization, and reflective activities into a cohesive, contextual, and engaging learning experience. Through stories and illustrations closely related to children's daily lives, the book helps students understand cultural diversity, foster empathy, and internalize mutual respect. The positive reception from teachers and students demonstrates that culturally grounded media can function optimally in character education at the primary level.

Accordingly, the findings of this study reaffirm that value education can be effectively developed through creative and contextually relevant narrative–visual media. *Jelajahi Pulau Jawa* functions not merely as a reading tool but as a social learning medium that cultivates tolerance awareness from an early age. The product holds strong potential for broader use in strengthening student character formation and serves as a model for future culturally based educational media development.

Based on the findings, several practical recommendations are proposed to expand the benefits and effectiveness of *Jelajahi Pulau Jawa* as a medium for teaching tolerance in primary education:

1. Teachers are encouraged to utilize this book as thematic literacy media that integrate character and cultural dimensions within classroom instruction.
2. Schools are advised to incorporate culturally based media such as *Jelajahi Pulau Jawa* into regular literacy activities and as part of the *Profil Pelajar Pancasila* (Pancasila Student Profile) character development program.
3. Curriculum developers and education policymakers should consider expanding this model of media development to represent other cultural contexts across Indonesia, ensuring inclusivity and diversity in value education.
4. Researchers and educational practitioners are recommended to conduct extended longitudinal studies to examine the long-term effectiveness of this storybook in shaping tolerant attitudes and behaviors.
5. School principals and character education coordinators are encouraged to cultivate a school culture that supports tolerance learning by integrating this medium into school-wide programs and extracurricular activities.

Collectively, these recommendations emphasize the importance of synergy between instructional media, teachers, school policy, and local culture. *Jelajahi Pulau Jawa* has demonstrated that tolerance values can be taught in enjoyable, visual, and contextually meaningful ways. With deliberate and collaborative implementation, this book holds the potential to become a national model for inclusive and sustainable culture-based character education.

REFERENCES

1. Al Majali, S., & AlKhaaldi, K. (2020). Values of Tolerance in Relation to Academic Achievements, Cultures, and Gender among UAE Universities Students. *International Journal of Instruction*, *13*(3), 571–586. https://doi.org/10.29333/iji.2020.13339a
2. Astri, L. (2020). Membangun damai berbasis kearifan lokal (Bag. III): Mendalami konsep tepa selira. Retrieved September 1, 2025, from Aliansi Indonesia Damai (AIDA). website: https://www.aida.or.id/2020/06/7138/membangun-damai-berbasis-kearifan-lokal-bag-iii-mendalami-konsep-tepa-selira
3. Bandura, A. (1999). A social cognitive theory of personality. In O. P. Pervin, L. A. & John (Ed.), *Handbook of personality: Theory and research* (pp. 154–196). New York: Guilford Press.
4. Bandura, Albert. (1977). *Social learning theory*. New Jersey: Practice Hall.
5. Bandura, Albert. (2016). *Moral disengagement* (C. Cardone & C. Michaelsen, Eds.). New York: Worth Publishers.
6. BERA. (2018). *Ethical guidelines for educational research*. Retrieved from https://www.bera.ac.uk/publication/ethical-guidelines-for-educational-research-2018
7. Borg, W. R., & Gall, M. D. (1989). *Educational Research: An Introduction* (5th ed.). New York: Longman.
8. Branch, R. M. (2009). *Instructional Design: The ADDIE Approach*. https://doi.org/10.1007/978-0-387-09506-6
9. Cohen, A. B., Simmons, Z., & Chen, E. (2021). Tolerance, dissenting beliefs, and cultural diversity: Understanding acceptance and respect for difference. *Frontiers in Psychology, 12*. https://doi.org/10.3389/fpsyg.2021.789882
10. Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research (3rd ed.).* (3rd editio). Thousand Oaks, CA: Sage Publications.
11. Creswell, John W. (2014). *Reseach design: Qualitative, quantitative, and mixed methods approaches* (4th editio; V. Knight, Ed.). Retrieved from http://www.ghbook.ir/index.php?سانه های نوین&option=com_dbook&task=readonline&book_id=13650&page=73&chkhashk=ED9C9491B4&Itemid=218&lang=fa&tmpl=component
12. Effiong, O. E., & Igiri, C. E. (2015). Impact of Instructional Materials in Teaching and Learning of Biology in Senior Secondary Schools in Yakurr LG A. *International Letters of Social and Humanistic Sciences*. Retrieved from https://doi.org/10.18052/www.scipress.com/ilshs.62.27.
13. Fiorella, L., & Mayer, R. E. (2016). Eight Ways to Promote Generative Learning. *Educational Psychology Review*, *28*(4), 717–741. https://doi.org/10.1007/s10648-015-9348-9
14. Fosnot, C. T., & Perry, R. S. (2005). Constructivism: A psychological theory of learning. In

Constructivism: Theory, perspectives, and practice (2nd ed., pp. 8–38). New York: Teachers College Press.
15. Haste, H. (2025). Moral imagination and the construction of civic virtue: How narrative shapes moral understanding. *Theory & Research in Education*, *23*(1), 22–41. https://doi.org/https://doi.org/10.1177/14778785251315736
16. Humas DIY. (2023). Tingkatkan Kompetensi PTS Wujudkan Mahasiswa Siap Kerja. Retrieved January 26, 2024, from jogjaprov.go.id website: https://jogjaprov.go.id/berita/tingkatkan-kompetensi-pts-wujudkan-mahasiswa-siap-kerja#:~:text=Data dari LL DIKTI%2FKopertis,Politekhnik dan 1 Akademi Komunitas.
17. Kemendikbudristek. (2020). *Profil Pelajar Pancasila*. Jakarta.
18. KESBANG DIY. (2022). Yogyakarta, The city of tolerance.
19. Liang, Z., Yin, S., & Li, H. (2025). Children's moral storytelling and the development of ethical reasoning in late childhood. *Frontiers in Psychology*, *16*. https://doi.org/https://doi.org/10.3389/fpsyg.2025.1185230
20. Mangunwijaya, Y. . (1986). *Menumbuhkan sikap religiusitas anak-anak.* Gramedia.
21. Mayer, R. E. (2009). *Multimedia Learning*. https://doi.org/10.1017/CBO9780511811678
22. Mudlofir, A. (2011). *Aplikasi Pengembangan Kurikulum Tingkat Satuan Pendidikan dan Bahan Ajar dalam Pendidikan Agama Islam.* Jakarta: Rajawali Pers.
23. Muro, M., & Jeffrey, P. (2008). A critical review of the theory and application of social learning in participatory natural resource management processes. *Journal of Environmental Planning and Management*, *51*(3), 325–344. https://doi.org/10.1080/09640560801977190
24. Nikolajeva, M., & Scott, C. (2006). *How picturebooks work.* New York: Routledge.
25. Rahiem, M. D. H. (2020). The use of stories as moral education for young children: A teacher's perspective. ,. *Journal of Early Childhood Education Research*, *9*(1), 233–245. https://doi.org/https://journal.fi/jecer/article/view/111051
26. Rahmadonna, S. (2023). *Pembelajaran Toleransi di Sekolah Dasar (Studi Fenomenologi Pada Siswa kelas IV Sekolah Dasar di Yogyakarta)*. Universitas Negeri Malang.
27. Rahmadonna, S., Setyosari, P., Kuswandi, D., & Sulton. (2025). Perceived as tolerant but intolerant? Evidence from various public elementary schools in Indonesia. *Kasetsart Journal of Social Sciences*, *46*(1). https://doi.org/10.34044/j.kjss.2025.46.1.17
28. Sudirman, S. (2019). The 21st-century teacher: teacher's competence within the character education framework towards a cultural-oriented development and promoting tolerance. *International Education Studies*, *12*(8), 21. https://doi.org/10.5539/ies.v12n8p21
29. Sularto, S. (2018). Pluralisme dan toleransi, keniscayaan hakiki. In A. Suwignyo (Ed.), *Post-truth dan (anti) pluralisme* (pp. 20–28). Jakarta: Kompas Buku.
30. Turan, F. (2016). Using storybooks as a character education tool. *Journal of Education and Learning*, *5*(2), 111–118. Retrieved from https://files.eric.ed.gov/fulltext/EJ1103139.pdf
31. UNESCO. (1994). *Tolerance : the threshold of peace. A teaching / learning guide for education for peace, human rights and democracy*. Retrieved from https://inee.org/system/files/resources/Tolerance%2C the threshold of peace.pdf
32. UNESCO. (2016). *Global education monitoring report 2016: Education for people and planet: Creating sustainable futures for all*.
33. van Doorn, M. (2014). The nature of tolerance and the social circumstances in which it emerges. *Current Sociology*, *62*(6), 905–927. https://doi.org/10.1177/0011392114537281
34. Witenberg, R. T. (2019). *The psychology of tolerance*. https://doi.org/10.1007/978-981-13-3789-5
35. Yuliani, N., & Hermawan, D. (2020). Buku cerita bergambar sebagai media penanaman nilai karakter anak sekolah dasar. *Jurnal Pendidikan Karakter*, *10*(2), 276–288. https://doi.org/https://doi.org/10.21831/jpk.v10i2.31789
36. Zakiah, N., Sarkadi, & Marini, A. (2023). Teachers' strategies in teaching social tolerance to elementary school students. *Issues in Educational Research*, *33*(1), 435–450. Retrieved from https://www.iier.org.au/iier33/zakiah.pdf
37. Zhao, L. (2021). Analysis on the moral education value of picture books. *The 2nd International Conference on Education, Language, and Social Science*, 223–229. https://doi.org/https://doi.org/10.2991/assehr.k.210727.120

LECTURER READINESS IN EQUIPPING PRE-SERVICE TEACHERS WITH PEDAGOGICAL COMPETENCE: INSIGHTS FROM A DEEP LEARNING PERSPECTIVE

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Abstract. This pre-study explores lecturer readiness in equipping pre-service teachers with pedagogical competence from a deep learning perspective. Conducted at Universitas Negeri Yogyakarta (UNY), the study aims to provide a foundation for the future development of a deep learning-based instructional model in teacher education. Findings indicate that pre-service teachers have been consistently introduced to pedagogical knowledge since the early semesters of their studies. However, the current learning process remains dominated by theoretical aspects rather than practical application. As a result, when students enter school-based teaching practice, they often rely heavily on theoretical understanding with limited opportunities for authentic implementation. Data were collected through surveys, interviews, and curriculum document analysis involving lecturers from the faculty of education. The results show that while lecturers are committed to strengthening pedagogical competence, challenges remain in integrating reflective practice, real-life classroom simulation, and student-centered approaches that characterize deep learning. This study underscores the need for shifting from theory-heavy delivery toward more practice-oriented strategies, ensuring that pre-service teachers can smoothly apply their pedagogical knowledge in teaching practice. Insights gained from this pre-study provide a valuable basis for designing a deep learning-oriented instructional model that better prepares future teachers for the demands of the classroom.

Keywords: lecturer readiness, pedagogical competence, pre-service teachers, deep learning approach, teacher education

INTRODUCTION

Teachers are key actors in determining the quality of education. In the Indonesian context, teacher professionalism is regulated by Law No. 14 of 2005 on Teachers and Lecturers, which mandates that teachers possess four core competencies: pedagogical, personal, social, and professional. Among these, pedagogical competence is the distinctive hallmark of the teaching profession, as it encompasses the ability to effectively manage the learning process—from understanding learner characteristics, designing instruction, implementing appropriate strategies, to conducting evaluation and reflection. However, various national reports and results from the Teacher Competency Test (Uji Kompetensi Guru/UKG) indicate that teachers' pedagogical competence in Indonesia remains relatively low. National average scores in pedagogical domains have yet to reach the expected standards, and many teachers are categorized as underqualified (Mardhatillah & Surjani, 2023; Kemdikbud, 2017; Husain & Muslim, 2021). This situation underscores the urgent need to strengthen pedagogical competence from the early stages of teacher education in teacher training institutions (Lembaga Pendidikan Tenaga Kependidikan, LPTK).

As one of Indonesia's leading LPTKs, Yogyakarta State University (UNY) bears a strategic responsibility to prepare professional pre-service teachers. Students at UNY are provided with pedagogically oriented courses such as Learner Development, Learning Strategies, Theories of Learning and Instruction, Instructional Media, and Teaching Practice. Nevertheless, preliminary findings suggest that instructional processes in these courses tend to emphasize theoretical mastery over practical implementation. As a result, when students engage in field teaching practice, they often rely heavily on theoretical knowledge with limited hands-on pedagogical experience. This indicates a persistent gap between conceptual understanding and practical application—one of the most pressing challenges in teacher education.

In recent decades, there has been growing recognition of deep learning as a promising pedagogical approach to bridge this gap. Deep learning emphasizes active learner engagement, critical reflection, authentic problem-

solving, and the contextual application of theory. In contrast to surface learning, which focuses on memorization and rote understanding, deep learning fosters meaningful and contextualized knowledge construction (Illeris, 2009; Joyce, Weil, & Calhoun, 2015). Accordingly, integrating a deep learning approach into teacher education is expected to enhance pre-service teachers' pedagogical competence through reflective, integrative, and experiential learning processes.

This study was conducted to explore the actual conditions of courses that support the development of pedagogical competence among pre-service teachers at UNY. Data were collected through surveys, interviews, and curriculum document analyses involving lecturers of relevant courses. Initial findings reveal that while lecturers show a strong commitment to strengthening pedagogical competence, the implementation of authentic simulations, reflective practice, and student-centered learning remains limited. Thus, this study serves as a crucial pre-study or needs assessment to develop a prototype of a deep learning-based instructional model. The model is expected to be not only valid and practical but also effective in enhancing pre-service teachers' pedagogical readiness.

The urgency of this study lies in its attempt to address the pressing need for an instructional model capable of bridging the divide between theory and practice. The results are expected to contribute academically to the development of deep learning-oriented instructional theory and provide practical implications for improving the quality of teacher education in Indonesia, particularly in preparing professional, adaptive, and reflective educators ready to navigate the complexities of real classroom settings.

Addressing the need for a model that can bridge the theory–practice gap in teacher education requires a strong theoretical foundation. The concept of deep learning should not be understood merely as a technological paradigm but as a pedagogical approach emphasizing active engagement, critical reflection, and meaningful learning experiences. Illeris (2009) asserts that deep learning is grounded in constructivist perspectives, in which learners construct knowledge through engagement in authentic situations that require linking abstract concepts to real-world practice. This is particularly relevant in teacher education, where pedagogical competence must go beyond cognitive understanding to include the ability to design, implement, and evaluate real learning processes.

The development of a deep learning-based instructional model is grounded in several interconnected learning theories. The dominance of theoretical and uniform approaches to learning has long been criticized for failing to capture the true essence of learning and teaching. Educational systems that prioritize uniformity often suppress individual potential, even though each learner has unique characteristics, learning styles, and readiness levels (Budiningsih, 2018). This highlights the importance of pedagogical strategies that can accommodate diversity while promoting active engagement among pre-service teachers.

Constructivist learning theory provides a fundamental basis for deep learning. Scholars such as Piaget, Bruner, and Ausubel emphasize that knowledge is constructed through active involvement in assimilating and accommodating new experiences. Ausubel's concept of meaningful learning asserts that new information must be related to existing cognitive structures to be understood and retained effectively. This principle is highly relevant to pre-service teachers who must connect pedagogical theory to classroom practice. Therefore, deep learning demands that students move beyond rote memorization toward conceptual understanding and practical application (Perkins, 1991; Joyce, Weil, & Calhoun, 2015). In addition, humanistic learning theory provides another key foundation. The humanistic perspective underscores that learning should be humanizing, allowing learners to explore, express, and realize their full potential (Goble, 1993; Freire, 2007). In teacher education, lecturers must design challenging yet supportive learning experiences that foster self-reflection and critical engagement, enabling students to internalize pedagogical competence through lived experiences rather than theoretical exposure alone.

Vygotsky's sociocultural theory also provides an essential underpinning. His concept of the zone of proximal development (ZPD) suggests that effective learning occurs through social interaction and collaboration, where learners are supported in overcoming challenges slightly beyond their current capabilities (Moll, 1994). In this sense, deep learning encourages pre-service teachers to engage in dialogue, collaborative inquiry, and critical reflection—mechanisms that deepen pedagogical understanding through social mediation.

Furthermore, the instructional model theory proposed by Joyce, Weil, and Calhoun (2015) strengthens this framework by conceptualizing teaching models as systematic procedures for organizing meaningful learning experiences. The five essential elements of a model—syntax, social system, principles of reaction, support system, and instructional as well as nurturant effects—can be strategically structured to create deep learning environments through problem-based learning (PBL) and project-based learning (PjBL). However, early findings reveal that the implementation of these models at UNY remains inconsistent with the prescribed Outcome-Based Education (OBE) curriculum.

In sum, constructivist, humanistic, and sociocultural theories, along with instructional model theory, provide a robust foundation for developing a deep learning-based instructional model. These theoretical perspectives collectively affirm that pre-service teachers' pedagogical competence can only be optimally developed through learning experiences that are deep, reflective, and contextually grounded. Therefore, this study aims to produce

an instructional model that is valid, practical, and effective in bridging the gap between theoretical mastery and pedagogical practice among pre-service teachers.

RESEARCH METHOD

This study employed an exploratory qualitative approach. The purpose of this initial phase (pre-study) was to explore the actual condition of the learning process at Yogyakarta State University (UNY) that supports the development of pedagogical competence among pre-service teachers, as well as to assess students' learning motivation and understanding of relevant course content. This design was chosen to obtain a factual overview as the foundation for developing a deep learning-based instructional model in the next stage of the research.

The subjects involved in this study were students from teacher-education programs within UNY who were preparing for their Praktik Pengalaman Lapangan (PPL) or teaching internship. The sample was selected using a simple random sampling technique, taking into account representation from various teacher-education programs. In addition to students, the study also involved lecturers who teach pedagogical competence-related courses as additional respondents to enrich the data. The research was conducted in several faculties of education at UNY that offer courses supporting pedagogical competence. The data in this study were collected through three main techniques, namely:

1. Questionnaires, used to obtain information about students' learning motivation, their perceptions of pedagogical courses, and their experiences in attending classes that support the development of pedagogical competence.
2. Tests, designed to measure the level of students' understanding of course materials related to pedagogical competence, including understanding of learners, learning theories, instructional strategies, instructional design and implementation, evaluation, and learner potential development.
3. Focus Group Discussions (FGDs) and interviews, conducted with course lecturers and students to obtain in-depth information regarding the learning strategies used, forms of evaluation, and the extent to which *deep learning* approaches have been integrated into teaching practices.

The collected data were then analyzed using both quantitative and qualitative descriptive techniques. Quantitative data from questionnaires and tests were analyzed using mean and percentage calculations to describe the emerging tendencies. The results were then converted into a qualitative scale consisting of five categories: very good, good, fair, poor, and very poor. Meanwhile, qualitative data from FGDs and interviews were analyzed through several stages: data reduction, coding, classification, interpretation, and conclusion drawing. Source triangulation was applied to ensure data validity and reliability.

RESULTS

This study found that the curriculum of Yogyakarta State University (UNY) in its teacher-education programs has included a set of courses explicitly designed to develop the pedagogical competence of pre-service teachers. Based on data obtained through focus group discussions (FGDs), questionnaires, and curriculum analysis, these courses include Learner Development, Instructional Strategies, Theories of Learning and Instruction, Instructional Media, Curriculum Development, Educational Evaluation, Educational Research, and Teaching Practice. The number of credits (SKS) allocated for these courses varies between 20 and 35 credits, depending on the study program. This variation indicates differences in emphasis among programs: some allocate a substantial portion to pedagogical courses, while others balance them more evenly with disciplinary competencies. Consequently, the depth of pedagogical mastery among students differs—some experience more intensive pedagogical learning, while others have relatively limited exposure.

Discussions with course lecturers revealed that the most frequently used instructional strategies include classroom discussions, case studies, and problem-solving approaches. These models are designed to train students to identify real problems in schools, analyze them, and propose theoretically grounded solutions. In practice, such methods have the potential to promote deep learning, as they require active student engagement. However, the findings indicate that class discussions often focus more on mastering theoretical concepts than on reflective practice or applied learning. In other words, although these strategies theoretically support deep learning, their implementation remains largely "surface-oriented." This highlights the gap between the Outcome-Based Education (OBE) curriculum design—which encourages problem-based learning (PBL) and project-based learning (PjBL)—and the reality of classroom implementation. In many cases, the full syntactical stages of PBL or PjBL are not followed. Steps such as problem formulation, data collection, solution evaluation, and reflection are often missing from the instructional process.

The evaluation aspect also shows an interesting dynamic. Field data reveal that the forms of assessment used in pedagogical courses are quite diverse, including daily assignments, class participation, midterm and final exams, as well as product-based tasks such as developing instructional media, assessment instruments, and lesson plans. However, this study found that these assessments are rarely aligned with comprehensive pedagogical competence indicators. For instance, when students are asked to produce instructional media, the evaluation focuses more on the technical quality of the product rather than on how the media reflect students' understanding of learner characteristics, learning theories, or their ability to foster learners' potential. Consequently, assessment outcomes highlight technical skills more than integrative pedagogical abilities. As a result, even though students are able to complete their tasks successfully, their pedagogical competence development is not well documented. This condition may hinder reflective processes and the reinforcement of pedagogical expertise, which should be a core component of evaluation in teacher-education institutions.

Field observations also show that most lecturers attempt to integrate contextual approaches into their teaching; however, the application of innovative strategies such as PBL and PjBL has not been optimal. For example, in the Instructional Strategies course, students are asked to discuss real cases from schools. Nevertheless, key stages of PBL—such as problem formulation, data gathering, hypothesis generation, and evaluation of alternative solutions—are often not explicitly implemented. Similarly, in PjBL, students' projects are frequently limited to producing tangible outputs without involving critical reflection or dissemination of results. In fact, reflection and dissemination are essential elements of deep learning. This inconsistency indicates that the deep learning paradigm remains largely conceptual in UNY's classroom practices. Students are exposed to theoretical knowledge, but opportunities to engage in a complete learning cycle—from exploration and reflection to collaboration and evaluation—remain limited.

The data on students' understanding of pedagogical competence are still being collected, but preliminary indications show that students are aware of the importance of this competence as a key professional requirement. They recognize that pedagogical mastery is not merely an academic obligation but a prerequisite for performing their professional duties effectively. Students' learning motivation in pedagogical courses is relatively high, primarily because they perceive its relevance to teaching practice. However, the depth of understanding varies: some students perceive pedagogical competence merely as the ability to teach in class, while others associate it with broader aspects such as understanding learner characteristics, designing fair assessments, and facilitating learner development. This variation reflects differences in students' learning experiences in developing a comprehensive understanding of pedagogy.

Overall, this preliminary study reveals several key findings. First, structurally, the UNY curriculum provides substantial space for developing pedagogical competence, with a relatively large allocation of credits. However, variations among programs result in disparities in competence achievement. Second, instructional strategies used by lecturers emphasize discussion and problem solving but have not fully represented the practice of PBL or PjBL in line with OBE standards. Third, evaluation systems tend to focus on product outcomes or content mastery rather than on the integrative dimensions of pedagogical competence. Fourth, students' understanding of pedagogical competence remains varied, even though their learning motivation is high. These findings highlight a gap between curriculum design and instructional practice. In other words, although the teacher-education system at UNY has made significant efforts to strengthen pedagogical competence, actual implementation is still inconsistent with deep learning principles.

These results form a strong foundation for developing a deep learning-based instructional model that is more valid, practical, and effective. Such a model is expected to bridge the gap between theory and practice, ensuring that pre-service teachers not only master conceptual knowledge but also acquire the applied, reflective, and collaborative skills required in real educational contexts. The implications of this study can be viewed from two perspectives. From a theoretical standpoint, the findings reinforce the argument that teacher education requires a deep learning approach to meaningfully internalize pedagogical competence. Constructivist, humanistic, and sociocultural theories underlying this approach are proven relevant in the UNY context, as they effectively address the divide between theoretical learning and practical application. From a practical standpoint, the findings provide valuable insights for course lecturers to more consistently integrate PBL and PjBL syntaxes into instruction, strengthen assessment systems that measure integrative pedagogical competence, and create more reflective learning experiences for students. Furthermore, the findings are also relevant for curriculum developers in teacher-education institutions, encouraging them to align curricula not only in terms of credit allocation but also in the quality and authenticity of learning experiences.

DISCUSSION

The findings of this study highlight a clear gap between the teacher-education curriculum design at Yogyakarta State University (UNY)—which has allocated various courses to strengthen pedagogical competence—and the actual instructional practices that remain predominantly theoretical. This condition

demonstrates that, although pre-service teachers have been exposed to courses such as *Learner Development, Instructional Strategies, Theories of Learning and Instruction, Instructional Media, Curriculum Development, Educational Evaluation,* and *Teaching Practice,* their learning experiences still focus largely on conceptual understanding rather than on real classroom application. These findings are consistent with the preliminary study showing that students often enter teaching practicum with strong theoretical knowledge but limited practical ability.

From the perspective of constructivist theory, this phenomenon can be interpreted as a result of learning processes that have not fully provided opportunities for students to construct knowledge through active engagement. Piaget, Bruner, and Ausubel emphasize that meaningful knowledge is formed when learners can connect new information to their existing cognitive structures. Ausubel specifically underscores the importance of *meaningful learning*, a condition in which theory is not merely memorized but applied to understand and solve real-world problems. However, the present findings reveal that students tend to produce technical outputs—such as instructional media or learning instruments—without undergoing a deep reflective process. This suggests that learning in UNY's teacher-education context still operates at the *surface learning* level and has not yet achieved genuine *deep learning*.

From a humanistic perspective, this situation also reflects certain limitations. Humanistic theorists such as Maslow and Rogers emphasize that ideal education is one that humanizes the learner, allowing room for self-actualization, creativity, and reflection. Yet, the findings indicate that instructional evaluation at UNY still focuses mainly on end products and technical outcomes rather than assessing learning processes involving students' critical reflection. This condition illustrates that students' affective and reflective dimensions are not yet fully facilitated. In line with Freire's (2007) view, a liberating education process should position students not as passive recipients of knowledge but as active subjects who construct critical consciousness.

Furthermore, when examined through Vygotsky's sociocultural lens, the variation in students' understanding of pedagogical competence can be explained through the concept of the *zone of proximal development* (ZPD). Vygotsky posits that effective learning occurs when learners are presented with challenges slightly beyond their current abilities, with scaffolding provided by lecturers or peers. However, the findings suggest that instruction at UNY still emphasizes theoretical mastery, providing limited opportunities for collaborative learning that challenges students to operate within their ZPD. Consequently, opportunities to internalize pedagogical competence through social interaction and scaffolding remain underdeveloped.

The instructional model theory proposed by Joyce, Weil, and Calhoun also provides a valuable framework for interpreting these findings. Instructional models are conceptual structures that guide systematic steps in organizing learning experiences. However, field data indicate that the syntactical stages of models such as *problem-based learning* (PBL) and *project-based learning* (PjBL) have not been fully implemented. Critical stages—such as problem formulation, data collection, the generation of alternative solutions, reflection, and dissemination—are often overlooked. Yet, these stages are essential for ensuring active learner engagement and knowledge construction. The inconsistency in applying these instructional models shows that classroom practices have not yet fully aligned with the *Outcome-Based Education* (OBE) paradigm outlined in the curriculum.

The findings of this study are consistent with previous research indicating the persistent low levels of teachers' pedagogical competence in Indonesia, as reflected in national *Teacher Competency Test* (UKG) results, which remain below expected standards (Mardhatillah & Surjani, 2023; Kemdikbud, 2017). This evidence suggests that pedagogical challenges do not merely occur among in-service teachers but originate during the pre-service stage of teacher education. Similarly, the study by Rahmadonna, Budiningsih, and Sumiyati found that although lecturers demonstrate strong commitment to strengthening pedagogical competence, integrating reflective practice and student-centered learning remains a major challenge. International findings also corroborate these conclusions. Illeris (2009) emphasizes that *deep learning* is essential for developing complex competencies, as it enables learners to connect theory with practice, while Joyce et al. (2015) highlight the importance of designing instructional models that focus on authentic and reflective learning experiences.

Drawing on these findings and relevant theoretical perspectives, it can be concluded that the main weakness in UNY's teacher-education programs lies in the dominance of *surface learning* approaches, which prioritize theoretical mastery over experiential engagement. This gap prevents students from acquiring sufficient learning experiences to internalize pedagogical competence through reflection, collaboration, and authentic practice. Constructivist theory asserts that learners must actively construct understanding; humanistic theory stresses the importance of affective and reflective dimensions in learning; sociocultural theory highlights the role of social interaction and mediation in learning processes; and instructional model theory underscores the necessity of systematic design to ensure student engagement and active participation.

The implications of this discussion are clear. To produce pedagogically competent future teachers, UNY needs to develop a *deep learning*-based instructional model that effectively integrates constructivist, humanistic, sociocultural, and instructional design theories into real classroom practices. Such a model must be valid,

practical, and effective in bridging the gap between theoretical knowledge and practical teaching skills. Ultimately, this approach will better prepare pre-service teachers to face the complex realities of the educational environment and to perform as adaptive, reflective, and professional educators.

CONCLUSION AND RECOMMENDATION

This preliminary study successfully provides a comprehensive overview of the instructional conditions that support the development of pedagogical competence among pre-service teachers at Yogyakarta State University (UNY). The analysis shows that, structurally, the curriculum has incorporated relevant courses such as Learner Development, Instructional Strategies, Theories of Learning and Instruction, Instructional Media, Curriculum Development, Educational Evaluation, Educational Research, and Teaching Practice, with credit allocations ranging from 20 to 35 credits in each study program. This finding indicates that the curriculum framework already facilitates the development of pedagogical competence, although variations in the number of credits across programs have resulted in differing levels of pedagogical mastery among students.

In terms of instructional strategies, the study found that most lecturers have implemented discussion-based learning, case studies, and problem-solving approaches. However, the application of these strategies still emphasizes content mastery rather than reflection and authentic practice. The syntactical components of problem-based learning (PBL) and project-based learning (PjBL), which are integral to the Outcome-Based Education (OBE) paradigm, have not been fully implemented. Thus, while the approaches used have the potential to promote deep learning, their classroom practices still tend to reinforce a surface learning pattern.

The forms of assessment used in pedagogical courses are diverse, including individual assignments, class participation, midterm and final examinations, and project-based products. Nevertheless, the evaluation process still focuses primarily on the technical quality of students' work rather than the holistic integration of pedagogical aspects. As a result, students' abilities to understand learner characteristics, select appropriate learning theories, and integrate evaluation strategies have not been adequately documented through existing assessment instruments. Therefore, pre-service teachers must develop strong pedagogical competence, as such competence is not merely an academic requirement but a fundamental prerequisite for becoming professional educators.

Based on these findings, it can be concluded that UNY's instructional practices have provided a solid foundation for strengthening pre-service teachers' pedagogical competence. However, there remains a significant gap between curriculum design, instructional strategies, assessment practices, and students' conceptual understanding. This gap highlights the need to develop a deep learning-based instructional model capable of integrating theory and practice in a more coherent and systematic manner. Such a model should be valid, practical, and effective in fostering pedagogical competence that is applicable, reflective, and contextually grounded, thereby preparing pre-service teachers to face the complex realities of the educational field.

In light of these conclusions, several key recommendations are proposed. First, lecturers teaching pedagogical courses are encouraged to implement PBL and PjBL syntaxes more consistently in alignment with OBE principles, so that students gain authentic learning experiences that promote deep learning. Second, the course evaluation system should be expanded to assess not only the technical quality of products but also the integrated components of pedagogical competence, including understanding learner characteristics, engaging in reflective practice, and applying learning theories. Third, teacher-education programs should harmonize the number and weight of credits allocated to pedagogical courses across departments to ensure equitable opportunities for all students in achieving pedagogical competence. Finally, students should be given more opportunities to engage in collaborative, reflective, and contextual learning activities to help them develop a more comprehensive understanding of pedagogy.

REFERENCES

1. Agyeman Nana Yaw Brenya. (2024). *Deep* learning in high schools: Exploring pedagogical approaches for transformative education. ResearchGate. https://www.researchgate.net/publication/384574662
2. Ausubel, D. P. (1968). Educational psychology: A cognitive view. New York: Holt, Rinehart and Winston.
3. Budiningsih, C. A. (2018). Belajar dan pembelajaran. Jakarta: Rineka Cipta.
4. Berybe, H. 2001. Dilema pelembagaan pendidikan (Dalam Sindhunata, ed.) Pendidikan kegelisahan sepanjang zaman. Yogyakarta: PT Kanisius.
5. Caravello, M. J., Jiménez, J. R., Kahl, L. J., Brachio, B., Ed, D., Morote, E., & Ed, D. (2015). Self-Directed Learning : College Students' Technology Preparedness Change in the Last 10 Years. Journal for Leadership and Instruction, 14(2), 18–25.
6. Dick. W, Carey. L, Caret. J. O. 2015. The systematic design of instruction. New Jersey: Pearson.
7. Dirjen Dikti, 2011. Peningkatan Kualitas pembelajaran. Jakarta: Makalah Diklat (tidak diterbitkan).
8. Freire, P. (2007). Politik pendidikan: Research, education, and dialogue. Yogyakarta: Pustaka Pelajar.

9. Fakih, Mansour. 2001. Ideologi-ideologi Pendidikan. Yogyakarta: Pustaka Pelajar.
10. Goble, F. G. (1993). Mazhab ketiga psikologi humanistik Abraham Maslow. Yogyakarta: Kanisius.
11. Hava, K., & Babayiğit, Ö. (2024). Exploring the relationship between teachers' competencies in AI-TPACK and digital proficiency. Education and Information Technologies. https://doi.org/10.1007/s10639-024-12939-x
12. Husain, H., & Muslim, M. (2021). Peningkatan kompetensi guru melalui Uji Kompetensi Guru (UKG): Analisis hasil dan implikasi. Jakarta: Direktorat Jenderal Pendidikan.
13. Illeris, K. (2009). Contemporary theories of learning: Learning theorists… in their own words. London: Routledge.
14. Joyce, B., Weil, M., & Calhoun, E. (2015). Models of teaching (9th ed.). New York: Pearson.
15. Kementerian Pendidikan dan Kebudayaan Republik Indonesia. (2017). Laporan hasil Uji Kompetensi Guru. Jakarta: Kemdikbud.
16. Mangunwijaya., 2001. Mencari Visi Dasar Pendidikan. Dalam Sindhunata, Pendidikan:Kegelisahan Sepanjang Jaman. Yogyakarta: Kanisius.
17. Mardhatillah, A., & Surjani, S. (2023). Kompetensi pedagogik guru Indonesia: Analisis hasil UKG nasional 2015–2022. Jurnal Pendidikan, 14(2), 45–60
18. Moll, L. C. (Ed.). (1994). Vygotsky and education: Instructional implications and applications of sociohistorical psychology. Cambridge: Cambridge University Press.
19. Osorio Vanegas, H. D., Segovia Cifuentes, Y. d. M., & Sobrino Morrás, A. (2025). Educational technology in teacher training: A systematic review of competencies, skills, models, and methods. Education Sciences, 15(8), 1036. https://doi.org/10.3390/educsci15081036
20. Perkins, D. N. (1991). What constructivism demands of the learner. Educational Technology, 33(9), 19–21.
21. Rahmadonna, S., Budiningsih, C. A., & Sumiyati. (2025). Lecturer readiness in equipping pre-service teachers with pedagogical competence: Insights from a deep learning perspective. In Proceedings of the International Conference on Educational Research and Innovation (ICERI). Universitas Negeri Yogyakarta.
22. Rajapakse, C., Ariyarathna, W., & Selvakan, S. (2024). A self-efficacy theory-based study on the teachers' readiness to teach artificial intelligence in public schools in Sri Lanka. arXiv Preprint. https://arxiv.org/abs/2412.19425
23. Undang-Undang Republik Indonesia Nomor 14 Tahun 2005 tentang Guru dan Dosen. Lembaran Negara Republik Indonesia Tahun 2005 Nomor 157.
24. Weng, C., Guo, M., & Wu, J. (2022). A pedagogical study on promoting students' deep learning: Design-based learning in engineering design education. Frontiers in Psychology, 13, 978745. https://doi.org/10.3389/fpsyg.2022.978745

THE EFFECT OF EXTRACTION METHODS ON THE PHYSICAL PROPERTIES AND CYCLIC VOLTAMOGRAM OF CASTOR OIL (JATROPHA CURCAS L.)

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Abstract. Indonesia is a relatively fertile country and has many varieties of plants, including castor plants with various types, there are Jatropha curcas L, Ricinus communis L, Jatropha gossypiifolia and Jatropha podagrica Hook. Jatropha seeds in general can be processed into castor oil in a very simple way, which can then be processed into biodiesel, as one of the environmentally friendly and renewable biofuels, making it possible to replace fossil fuels whose existence is increasingly depleted. In this study, an attempt has been made to produce jatropha curcas oil, which is a very potential source of fuel oil to be developed in Indonesia. The physical properties and cyclic voltammograms of jatropha curcas oil products have been studied using stainless steel electrode.

The cyclic voltammogram of castor oil products was studied using an eDAQ Echem voltammeter, while the functional groups of components in the products was studied using FTIR. The voltammogram and FTIR spectra data can be used to study the behavior of the system, in this case Jatropha curcas L oil products, which can then be used as a basis for product quality control tests, combined with tests on the physical properties of castor oil products.

The studied the castor oil product has a clear yellowish to clear yellow color, color degradation from the market product (clear yellowish), clear slightly yellow (product with the soxhlet method) and the most yellow is the oil product with the pressing method. The aroma of it is still similar to the aroma of the initial material. The density of the product is around 0.8208-0.9338 g/cm3. The viscosity of the product is around 104-114 mPa.s. The yield of the product is around 41.15-46.39%. The yield of the product with the soxhlet extraction method is relatively higher than the pressing method. The cyclic voltammogram of the product using a stainless steel working electrode, a platinum auxiliary (counter) electrode and an Ag/AgCl reference electrode has a pattern similar to the market castor oil product, which tends to have a complex pattern due to the active components contained in the product. In general, the groups contained in the products include -C-H, -C=O, -C-O, and -C=C, which characterize the presence of ester compounds and unsaturated acids.

Kata kunci: Jatropha curcas L., castor oil product, cyclic voltammogram, quality controll.

INTRODUCTION

Indonesia is one of the countries that has a diversity of plants, which can grow well in Indonesia, including grain plants, for example Jatropha curcas L. and Ricinus communis L. plants. The castor oil plants, besides being used for medicine, can also be processed into oil products, which are renewable energy sources with relatively higher prices and can be used more widely or processed again into environmentally friendly and renewable biofuels because it allows the provision of raw materials through plant cultivation (Wurdack, Hoffmann and Chase, 2005; Swanberg, 2009).

The Jatropha curcas L. plant is a wild plant and is easily found due to its relatively good adaptability (Henning, 2004). It usually grows in vacant lots, coastal areas, forests, and sometimes on plantations because it is cultivated. This wild plant has a myriad of benefits and can produce oil that can be processed into fuel or a substitute for petroleum (Azam, Waris, and Nahar, 2005; Gamal-Fakhry et al., 2016). Its leaves have many health benefits as a traditional medicine for both external and internal diseases. Furthermore, the hard seed coat, which is a waste product, can also be further utilized, for example by making briquettes, a solid fuel.

The plants can grow optimally and fertile if the following conditions are met (Francis, Edinger and Becker, 2005), requiring 350-500 mL of water throughout its growth, a temperature of around 20-30 °C throughout its life, and an altitude of 0-800 meters above sea level. Development will be hampered in hot temperatures, namely at temperatures of 40 °C or more. Based on its taxonomy, it is classified as follows (Dehgan, Webster, 1979):

Kingdom : *Plantae*
Subkingdom : *Viridiplantae*

Infrakingdom	:	*Streptophyta*
Division	:	*Tracheophyta*
Subdivision	:	*Spermatophytina*
Class	:	*Magnoliopsida*
Subclass	:	*Rosidae*
Ordo	:	*Malpighiales*
Family	:	*Euphorbiaceae*
Genus	:	*Jatropha*
Species	:	*Jatropha curcas* L.

The plant has the following characteristics and morphological features (Riyadh, 2002; Pecina-Quintero et al, 2014): a root system capable of retaining water and soil, making it resistant to drought and able to function as a plant to prevent soil erosion. When the seeds germinate, 3–4 secondary roots (lateral roots) and 1 main root (taproot) have formed. The roots formed when the plant is propagated by seed form a taproot system that is longer and penetrates the soil deeper. The stem is cylindrical and secretes sap when injured. The stem acts as a branching system to support expansion during photosynthesis, is the main form of transport for water, air, and organic matter as photosynthates and nutrients. The flowers of the Jatropha plant are panicle-shaped (double inflorescence or compound flower). The flowers are greenish-yellow and unisexual. This type of flower is monoecious, the pistil and stamens are found on the same plant, has 5 oval-shaped petals and is more than 4 mm long. The stamens are located at the base and are bright yellow. The style is shorter and green, while the stigma curves outward and is yellow. There are five purplish petals. Each cluster contains approximately 15 flowers, with female flowers dominating the inflorescence, which are 4-5 times more numerous than male flowers. The female and male flowers are arranged in cup-like clusters and grow in the leaf axils or stem tips. The flowers are unisexual, belonging to the monoecious plant group, although yellowish-green hermaphroditic flowers are sometimes found (Fuelleman & Burlison, 1943).

The plant is a shrub that can grow to a height of 1-7 meters. Its leaves are three- or five-lobed, fairly wide, and round, resembling an egg. The leaves are approximately 5-15 cm long. The leaf veins are palmate, and the leaves are connected by a petiole with a petiole that is approximately 4-15 cm long (Divakara et al., 2010).

The fruit is round and egg-shaped, with a diameter of approximately 2-14 cm. It can reach 2 cm in length and about 1 cm in width. Generally, the color of the fruit varies with the age of the plant. When young, the fruit is green. Ripe fruit is brownish to blackish. The fruit has three chambers, each containing a single seed. The seeds are oval and oblong, blackish-brown in color, measuring approximately 2 cm long and 1 cm thick. Each seed weighs approximately 0.4 to 0.6 grams.

The plant has various benefits, including its leaves, roots, and seeds. The leaves contain many beneficial compounds for health, including those that help repair liver damage due to its hepatoprotective properties. For those suffering from jaundice, Jatropha leaves are very beneficial for early healing. The sap from its leaves can help treat toothaches because they contain phytopharmaceuticals in the form of alkaloids that help relieve toothaches. The anti-inflammatory compounds in the leaf sap help relieve the pain of mouth ulcers. Jatropha curcas leaves are also useful in treating rheumatism. The leaves contain the active compound undecylenic acid, which is useful for treating ringworm. The leaves can relieve constipation and contain antibacterial compounds that are effective in treating skin wounds, especially wounds that have been contaminated by bacteria. Jatropha leaves can treat stubborn dandruff on the scalp, stabilize blood sugar levels, can treat inflammation or bruising on the body, bruises caused by broken capillaries, so that blood is trapped in the skin, because it contain compounds that have anti-inflammatory properties.

The use of the plant as a traditional medicine apparently has side effects that need to be considered (Barceloux, 2008), namely stomach disorders, digestive disorders, intestinal irritation and nausea. Therefore, before consuming it for health, it is better to first consult a doctor or the nearest community health center. In addition to being a traditional medicine, it can be processed into castor oil as a basic ingredient for making lubricants and biodiesel, a relatively environmentally friendly renewable biofuel, which is useful as a substitute for petroleum (Godin and Spensley, 1971; Azam, Waris, and Nahar, 2005; AbouKheira and Atta, 2009; King et al, 2009; Gamal-Fakhry et al, 2016; Gudeta, 2016). It is known as castor oil, has various benefits.

Figure 1. *Jatropha curcas* L. plant

METHOD

The experiment was conducted in the Chemistry laboratory of the Faculty of Mathematics and Natural Sciences, Yogyakarta State University (YSU). Cyclic voltammetry analysis was performed using stainless steel working electrodes due to their good mechanical properties and corrosion resistance (Adawiah et al., 2021). Sweep rates varied between 50 and 100 mV/s. The resulting voltammograms were related to the concentration and type of compounds in the oil, supported by FTIR (Fourier Transform Infrared Spectroscopy) analysis, which provides information on functional groups and changes that occur during the refining and modification processes (Andarini et al., 2022). The samples studied included market products, press products, and soxhlet products (Akpan, Jimoh, and Mohammed, 2006). Analysis of the physical properties of the three oil products included density, viscosity, color, and aroma tests to evaluate their quality, stability, and potential use as industrial raw materials or alternative energy sources such as biodiesel.

RESULTS AND DISCUSSION

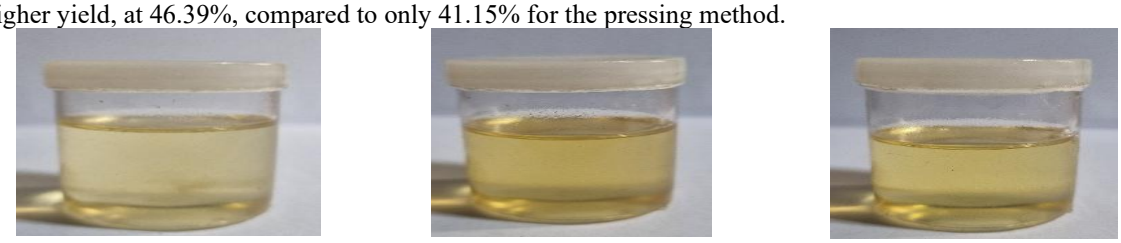
The Jatropha curcas L. oil products, including (a) market product, (b) with the pressing method, and (c) with the soxhlet extraction method, have almost the same color, namely yellowish (Fig. 2). The market product is relatively clearer because it has gone through a purification process, namely through filtering and removing impurities (for example through the adsorption process). If observed closely, it appears that the market product is clear, with the pressing method being clear yellowish and with the soxhlet extraction method being clear pale yellow. This shows that the soxhlet extraction method produces a relatively purer product than the pressing method.

The aroma test, the market product has a distinctive aroma, namely the aroma of its seeds, as does the product with the pressing method, while the product with the soxhlet extraction method still has a slight aroma of the solvent, so it needs a further purification process.

The density test shows that the product with the soxhlet extraction method has the lowest relative density, namely 0.8208 g/cm3, followed by the market product at 0.9179 g/cm3 and the highest relative density is with the pressing method, namely 0.9338 g/cm3.

Viscosity tests showed that the product using the pressing method had the lowest relative viscosity, at 104 mPa.s, followed by the soxhlet extraction method at 105 mPa.s, and the market product at 114 mPa.s.

Yield tests showed that the soxhlet extraction method was more advantageous because it had a relatively higher yield, at 46.39%, compared to only 41.15% for the pressing method.



(a) (b) (c)

Figure 2. The Jatropha curcas L. oil products: (a) market product, (b) pressing method dan (c) soxhlet method

The cyclic voltammograms of market Jatropha curcas L. oil and those made by pressing and soxhlet extraction methods can be seen in Fig. 3, each with scan rate variations of 50 and 100 mV/s, which in general

the greater the scan rate shows an increase in cathodic and anodic peaks. This indicates that the greater the scan rate, the more reduction and oxidation products are formed.

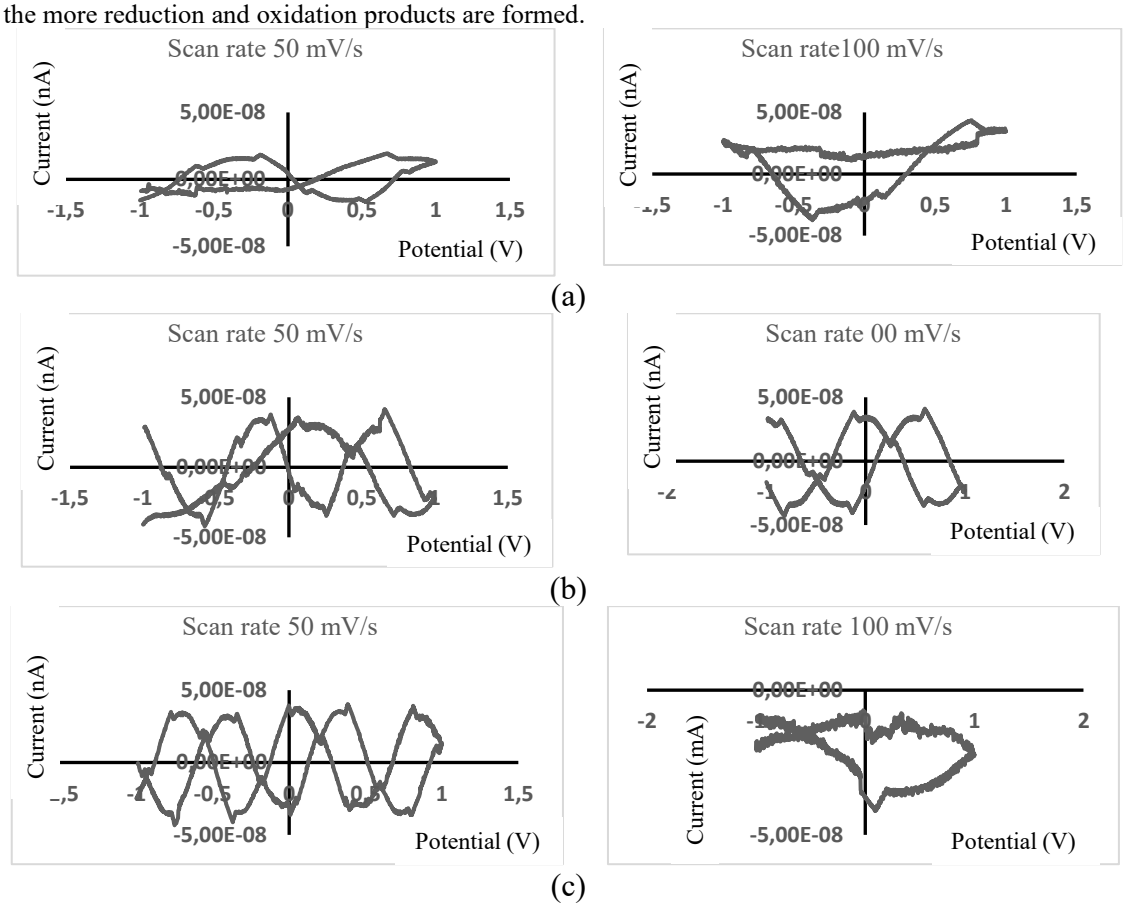


Figure 3. Cyclic voltammogram of castor oil products: (a) market product, (b) pressing method and (c) soxhlet method

Based on the FTIR spectrum of the products (Fig. 4), it is known that in the products there are -C-H, -C=O, and -C-O groups, which can be observed from the FTIR spectrum peaks (Table 2).

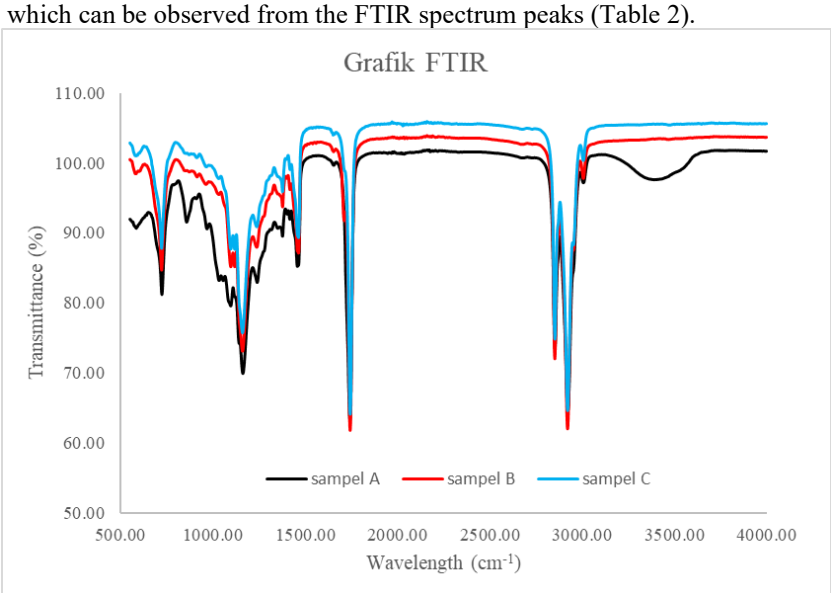


Figure 4. FTIR spectra castor oil products: (a) market product, (b) pressing method dan (c) soxhlet method

Based on Fig. 4 and Table 2, it shows that a strong absorption band occurs at wavenumbers 2852–2926 cm-1. This indicates the presence of stretching vibrations of the –CH2 and –CH3 groups, which are characteristic of long aliphatic chains. In the finished product oil, the absorption band appears sharp and well-defined, indicating an intact aliphatic structure. The absorption band in the oil products from the pressing method and Soxhlet extraction tends to widen, especially in the oil products from the pressing method, which indicates the

possibility of degradation of the aliphatic chain structure due to the influence of heat or pressure during the process.

The absorption band at wavenumber 1740–1744 cm-1 indicates the presence of a carbonyl group (-C=O) from the ester group, which is a characteristic of triglyceride compounds in vegetable oils. In the finished product oil, the absorption band is very strong and sharp, while in the product of the pressing and Soxhlet extraction methods, the band is slightly wider. This indicates that the ester structure is still present, only having undergone slight changes in chemical structure due to the pressing or soxhlet extraction process.

The other bands occur at wave numbers 1461 – 1465 cm-1 which indicate –CH2- bending vibrations, 1160 – 1164 cm-1 which indicate –C–O stretching vibrations of the ester group, and 721 – 724 cm-1 which indicate –(CH2)n– the occurrence of rocking groups in long straight chains. The three bands consistently appear in all samples, this indicates that the basic structure of vegetable oil is maintained, but the intensity and shape of the bands in the finished product oil have a more stable and pure structure than the product oil from the pressing and soxhlet extraction methods, because the purification process has not been carried out, so it is likely that the water content is still relatively high.

The FTIR spectra indicate that all three samples share the same primary component, namely fatty acids in the form of triglycerides. Differences in band width and intensity indicate quality variations due to different processing methods. The finished product oil exhibits relatively higher purity, while the pressed product oil exhibits structural degradation of the triglyceride compounds, likely due to the influence of temperature and pressure during processing.

Table 2. Interpretation of functional groups of FTIR spectrum of Jatropha curcas L. oil products: (a) market product, (b) pressing method and (c) soxhlet method

No	Wave number (cm^{-1})	Functional group	Oil		
			Market product	Pressing method	Soxhlet method
1	2852–2926	-C–H (*stretching,* asim atau sim – CH_2 atau –CH_3)	Sharp and defined	Widening, slightly shifted	Sharp slightly widened
2	1740–1744	-C=O (*stretching,* ester, trigliserida)	Very strong and sharp	Still strong, but widening	Strong, slightly widening
3	1461–1465	-C–H (*bending*, –CH_2–)	Clearly and narrow	Seen wide.	Seen
4	1160–1164	-C–O (*stretching,* ester)	Clearly	Slightly decreased in intensity	Clearly
5	721–724	–C-H (alkena)	Well defined	Wide and descending	Still visible

CONCLUSION

Based on the research results, it can be concluded that the soxhlet extraction method is relatively more advantageous than the pressing method, because it has a relatively higher yield and physical properties that allow it to be further processed into liquid fuels such as biodiesel. The higher the sweep rate, the higher the current peak occurs in the Jatropha curcas oil product with the pressing method, while in the soxhlet extraction method, there is a decrease. This indicates the influence of adsorption kinetics and reaction reversibility on the cyclic voltammogram. The market product oil has the highest diffusion coefficient value, this indicates that the diffusion of active compounds to the electrode surface in the market product Jatropha curcas L. oil is relatively higher than the products with the pressing and soxhlet methods. This indicates that the purification process has contributed to the stability of the structure and ease of diffusion of active compounds.

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REFERENCES

1. AbouKheira, A. A. and Atta, N. M. M. (2009). Response of Jatropha curcas L. to water deficit: yield, water use efficiency and oilseed characteristics. Biomass and Bioenergy. 33 (10):1343–1350.
2. Adawiah, S. R., Sutarno, S., Nur, A., Gani, R., & Andriani, T. (2021). Studi Perbandingan Adsorpsi-Desorpsi Anion Nitrat dan Sulfat pada Bentonit Termodifikasi. *Walisongo Journal of Chemistry*, *4*(1), 23–31. https://doi.org/10.21580/wjc.v4i1.7585.
3. Akpan, U. G., A. Jimoh, and A. D. Mohammed. 2006. Extraction, Characterization and Modification of Castor Seed Oil. *Leonardo Journal of Sciences* 8(1): 43 – 52.
4. Andarini, N. 2011. Studi Aktivitas Katalis Ni(II)/HSNZA dan Co(ll)/H5NZA pada Perengkahan Katalitik Metil Ester Jatropha. *Jurnal Ilmu Dasar*. 12(1),103 – 113.
5. Azam, M. M., Waris, A. and Nahar, N.M. (2005). Prospects and potential of fatty acid methyl esters of some non-traditional seed oils for use as biodiesel in India. Biomass and Bioenergy, 29: 293-302.
6. Barceloux, D. G. (2008). Medical toxicology of natural substances foods, fungi, medicinal herbs, plants, and venomous Animals. John Wiley & Sons, Inc.: Hoboken, NJ, USA. 2008.
7. Dehgan B, Webster, G. L. (1979) Morphology and Intrageneric Relationships of the Genus Jatropha Euphorbiaceae). 74. University of California Publications in Botany.
8. Divakara, B.N., Upadhyaya, H.D., Wani, S.P. and Laxmipathi, G.C.L. (2010). Biology and genetic improvement of Jatropha curcas L.: a review. Appl Energy. 87(3): 732-742.
9. Francis, G., Edinger, R. and Becker, K. (2005). A concept for simultaneous wasteland reclamation, fuel production, and socioeconomic development in degraded areas in India: need, potential and perspectives of Jatropha plantations. Natural Resources Forum, 29(1): 12–24.
10. Fuelleman, R. F. and W. L. Burlison. 1943. *Castor Beans – An Industrial War Crop*. University of Illinois, Chicago.
11. Godin, V. and Spensley, P. (1971). Oils and oilseeds. T J P Crop Product Digest 1971, 1:107–110.
12. Gamal-Fakhry, Azazz, N. A. E., Abdel-Monem, A. and Mohamedin, A. (2016). Use of waste water and treated water for jatropha curcas cultivation and the possibility of oil seed use as a biofuel. Minia J. of Agric. Res. & Develop. Vol. 36(2):245-269.
13. Gudeta, T.B. (2016). Chemical composition, bio–diesel potential and uses of Jatropha curcas L. (Euphorbiaceae). American Journal of Agriculture and Forestry. 6(8): 35-48.
14. Henning, R. K. (2004).The jatropha system: An integrated approach of rural development." Working paper, Bagani GBR, Weissensberg, Germany, 2004.
15. King, A.J., Wei, H., Cuevas, J.A., Freudenberger, M., Ramiaramanana, D. and Graham, I.A. (2009). Potential of Jatropha curcas as a source of renewable oil and animal feed. Journal of Experimental Botany. (http://jxb.oxfordjournals.org).
16. Pecina-Quintero, V., Anaya-López, J. L., Zamarripa-Colmenero, A. and Núñez-Colín, C.A., (2014). Genetic structure of Jatropha curcas L. in Mexico and probable centre of origin. Biomass Energ 60: 147-155 http://dx.doi.org/10.1016/j. biombioe.2013.11.005.
17. Riyadh, M. (2002). The cultivation of Jatropha curcas in Egypt. Undersecretary of State for Forestation, Ministry of Agriculture and Land Reclamation (leaflet).
18. Swanberg, K. (2009). Economic Feasibility of Alternative Crops with Potential for the Reuse of Treated Waste water in Egypt. International Resources Group, Washington DC.
19. Wurdack, K. J., Hoffmann, P. and Chase, M. W. (2005). Molecular phylogenetic analysis of uniovulate euphorbiaceae (*euphorbiaceae sensustricto*) using plastid RBCL and TRNL-F DNA sequences. Am. J. Bot. 92(8):1397-1420.

THE NITROGEN-DOPED ZNO CATALYSTS FOR THE DEGRADATION OF METHYLENE BLUE AND RHODAMINE B

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Abstract. Liquid waste is largely generated from industrial activities and can cause various environmental problems. Among these are dye pollutants such as methylene blue (MB) and rhodamine B (RhB), which are hazardous to living organisms. Therefore, textile dye wastewater treatment is necessary to meet quality standards. One commonly used method is photocatalytic degradation due to its simplicity, environmental friendliness, and energy efficiency. ZnO is a widely used photocatalyst because of its stability and promising properties. However, ZnO has certain drawbacks, such as a wide band gap energy, which reduces its degradation efficiency. To address this limitation, nitrogen doping of ZnO (N/ZnO, N = 0, 1, and 2%) was conducted using glycine as a nitrogen source, which is easy to obtain at an affordable price. The synthesized samples were characterized using XRD, FTIR, UV-Vis DRS, and SEM, followed by photocatalytic activity tests. The XRD results show high crystallinity for all the samples, indicated by sharp diffraction peaks. FTIR analysis revealed the presence of Zn–N bonds, suggesting the substitution of oxygen by nitrogen within the ZnO lattice. UV-Vis DRS analysis showed a decrease in band gap energy for N = 1% and 2% samples. SEM analysis revealed irregular particle morphologies with smooth surfaces. Photodegradation tests demonstrated that N = 1 & 2% samples generally exhibited higher photocatalytic activity compared to N = 0%. The N/ZnO samples showed higher degradation efficiency for MB compared to RhB. In MB degradation, the N = 2% sample achieved a higher efficiency than the N = 1%. Meanwhile, for RhB degradation, the efficiencies of N = 1 and 2% samples were relatively similar. These results indicate that doping ZnO with nitrogen sourced from glycine can enhance its photocatalytic activity.

Keywords: Coprecipitation, Methylene Blue, Photocatalyst, Rhodamine B, Zinc Oxide.

INTRODUCTION

Liquid waste is a hazardous material that poses a significant danger to the environment. It is frequently generated from industrial processes [1]. One most notable sources of liquid waste is the textile industry, which uses synthetic dyes [2]. These dyes are often discarded in high concentrations and are harmful to both humans and the environment [3]. In the aquatic environment, rivers, for example, synthetic dye waste can block sunlight from penetrating the water and cause the death of aquatic organisms, which then leads to foul odors in the water. Methylene blue (MB) and rhodamine B (RhB) are two of many examples of synthetic dyes that are commonly discharged into the water as liquid waste. For MB, it is commonly known to cause gastrointestinal irritation, cyanosis, and irritation to the skin [4]. As for RhB, it is known to cause irritation to the skin, eyes, and stomach; cause poisoning, disturb heart function, and have carcinogenic properties [5]. Because of this, it is necessary to have proper liquid waste treatment to eliminate the harmful effects of liquid wastewater on the environment [2]. Various treatment methods have been developed to treat wastewater. For example: adsorption, filtration, electrolysis [3], electroflotation [2], electrocoagulation, and photocatalytic degradation [6]. Among these methods, photocatalytic degradation is one of the most prominent due to its simplicity, environmental friendliness, and potential use of solar energy [7]. This method involves using semiconductors such as TiO_2, ZnO, CdS, Fe_2O_3, and ZnS [8]. Among these, ZnO is one of the most commonly used as a photocatalyst [9] because it has a broad light absorption range that makes it suitable to be used under UV irradiation [10]. However, ZnO has its limitations, which include a relatively wide bandgap energy of approximately 3,37 eV. This makes ZnO require UV light to activate its photocatalytic activity, which constitutes only 3-5% of the sunlight that reaches Earth's surface [11]. This drawback makes it necessary to modify ZnO to increase its photocatalytic efficiency and make it suitable for operation under solar irradiation.

One common strategy is doping, which introduces foreign atoms such as carbon, sulfur, or nitrogen into the ZnO lattice [12]. Among these, nitrogen doping is especially promising, as it can effectively reduce the bandgap and suppress electron-hole recombination. Nitrogen-doped ZnO (N/ZnO) is thus considered a promising photocatalyst for treating dye-contaminated wastewater [7]. Therefore, this research aims to synthesize N-doped ZnO to compare the photocatalytic efficiency of undoped and doped ZnO in degrading MB and RhB.

MATERIALS AND METHODS

Materials

$ZnCl_2$ (Sigma-Aldrich), $(NH_4)_2CO_3$ (Sigma-Aldrich), glycine (Sigma-Aldrich), NaOH (Sigma-Aldrich), Methylene Blue (MB) (Sigma-Aldrich) and Rhodamine B (Sigma-Aldrich) were employed as received, without any further purification.

Methods

Synthesis of ZnO and N/ZnO Photocatalyst

In this study, N/ZnO (0, 1, & 2%) was synthesized via the co-precipitation method using $ZnCl_2$ as the precursor and glycine as the nitrogen source. A preferred amount of $ZnCl_2$ and glycine was dissolved in water and heated to 65-70 °C. A 1 M NaOH solution was then added dropwise until a $Zn(OH)_2$ precipitate formed. The precipitate was filtered, dried at room temperature, and subsequently calcined at 500 °C for 4 hours in a furnace. The synthesized N/ZnO was characterized using XRD, FTIR, UV-Vis DRS, and SEM.

Preparation of MB and RhB Stock Solutions

MB and RhB stock solutions were prepared by dissolving 0,05 gram of MB or RhB powder in a volumetric flask with 500 mL of water to create a 100 ppm stock solution. This solution is kept away from direct light and will be used to make other solutions.

Preparation of MB and RhB Standard Solutions

MB and RhB standard solutions were made by diluting the stock solution in a 10 mL volumetric flask. Standard solutions were prepared at 1, 2, 3, 4, and 5 ppm. Diluting 0,1 mL of the stock solution in a 10 mL volumetric flask produces 1 ppm standard solution. Then, for the other standard solutions, dilute 0,2, 0,3, 0,4, and 0,5 mL of the stock solution into a 10 mL volumetric flask. These standard solutions will be used to find maximum absorbance and create a standard curve using UV-Vis.

Preparation of MB and RhB Sample Solutions

To make the MB and RhB sample solutions, 50 mL of the stock solution was added to a 500 mL volumetric flask before diluting it with water. This procedure produces 500 mL of sample solution with a 10 ppm concentration. It will be used as a wastewater model for MB and RhB.

Preliminary Adsorption Removal and Photocatalytic Activity Test

Photocatalytic degradation tests were performed using the N/ZnO catalyst with MB and RhB dye solutions as model wastewater. A 0.2 g amount of N/ZnO was added to 150 mL of sample solution in the Erlenmeyer flask before wrapping it with aluminum foil. The flask was then shaken at 200 rpm for 24 hours. After that, the flask was exposed to solar irradiation for 200 minutes and shaken at 200 rpm to conduct the photocatalytic activity test.

Photocatalytic Degradation Efficiency

Degradation efficiency means the percentage amount of MB or RhB that has been degraded during the photocatalytic activity test. It will be calculated using:

$$\% D = \frac{C_0 - C_t}{C_0} 100\%$$

% D = Degradation percentage
C_0 = initial wastewater concentration
C_t = current wastewater concentration

RESULT AND DISCUSSIONS

X-Ray Diffraction (XRD)

The XRD results are shown in Figure 1. The diffraction patterns are compared to JCPDS card No. 36-1451, which can be seen to correspond closely. It indicates that the synthesized material has a hexagonal wurtzite structure. The observed peaks represent hkl planes of (100), (002), (101), (102), (110), (103), (200), (112), and

(201). Other than that, the peaks for all the samples (N=0, 1, & 2%) have sharp characteristics, which indicate high crystallinity. This suggests that the nitrogen doping does not affect the crystallite structure within N=1 & 2%. No additional peaks are observed for all the samples, indicating that the crystal lattice is mostly unchanged after doping. This result is in agreement with Chen et al. (2024), who reported that nitrogen doping doesn't cause the appearance of new diffraction peaks; the dopant doesn't significantly alter the crystal lattice within ZnO [13].

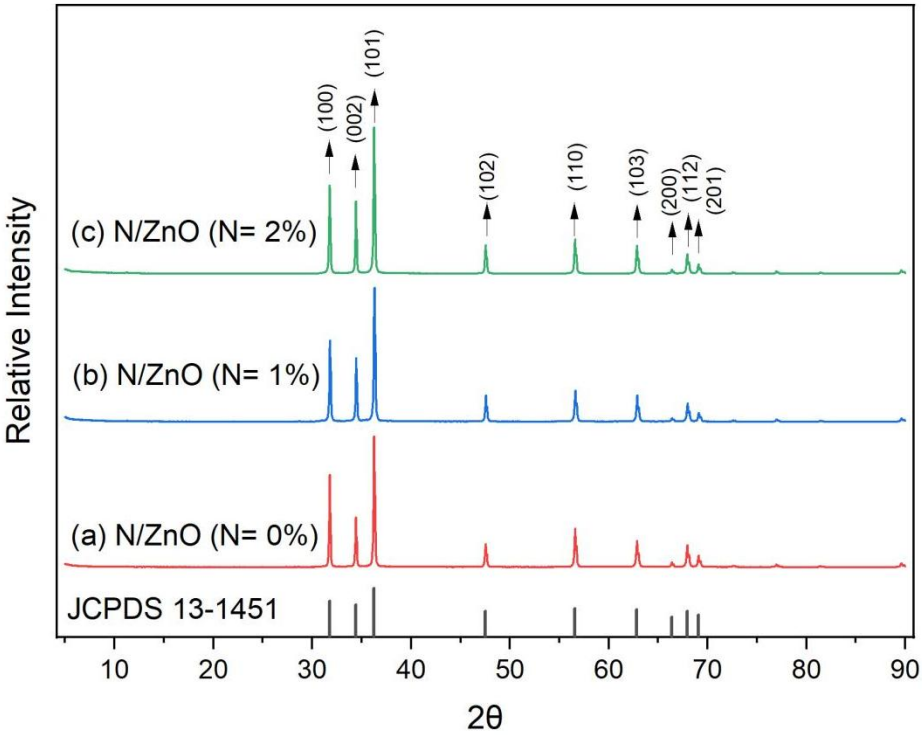

Figure 1. The XRD pattern of N/ZnO (N= 0, 1, and 2%) compared to JCPDS 13-1451 standard

Nitrogen doping can cause peak shifts toward higher angles (rightward) due to the substitution of oxygen by nitrogen. This substitution induces tensile strain, as the ionic radius of nitrogen is larger than that of oxygen. Conversely, compressive strain would cause the peaks to shift to lower angles (leftward). It is also reported that at low dopant concentrations, diffraction peaks may not shift significantly, as the amount of dopant is insufficient to alter the crystal lattice structure [14]. Other than that, nitrogen ions may enter the interior of the ZnO lattice and replace oxygen ions without causing a significant distortion [15]. In addition to peak position shifts, the width of the diffraction peaks also provides valuable information regarding the crystallite size of N/ZnO. An increase in peak broadening typically indicates a reduction in crystallite size due to doping [14], while sharper peaks are associated with larger crystallites [16]. To analyze the crystallite size further, the Debye–Scherrer equation is used:

$$D = \frac{K\lambda}{\beta\cos(\theta)}$$

Explanation,

D = crystallite size (nm)
K = Scherrer constant (0,9)
λ = wavelength used in XRD (1,5406 Å)
β = full width half maximum (FWHM)
θ = Bragg angle

The lattice parameters a, b, and c, as well as the unit cell volume, were obtained using Rietica software. The average crystallite size, lattice parameters, and unit cell volume are summarized in Table 1.

Table. 1 Lattice parameters of N/ZnO (N= 0, 1, and 2%)

Sample	a= b (Å)	c (Å)	Average crystallite size (nm)	Cell volume ($Å^3$)
ZnO	3.2499(3)	5.2174(4)	29.8905	47.724(7)
N/ZnO N=1%	3.2499(3)	5.2180(5)	29.2170	47.729(7)
N/ZnO N=2%	3.2493(3)	5.2178(4)	30.0375	47.709(7)

As shown in Table 1, the synthesized N/ZnO samples exhibit no significant changes in lattice parameters or unit cell volume. A structural illustration of ZnO based on the parameters listed in Table 1 is presented in Figure 2, which was generated using VESTA software.

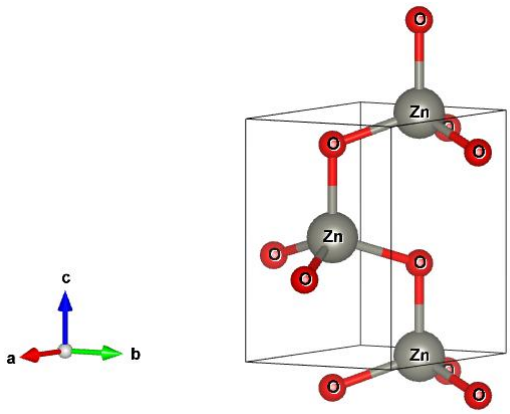

Figure 2. Illustration of ZnO obtained using VESTA

Fourier Transform Infrared (FTIR)

FTIR characterization was performed to identify the presence of Zn, O, and N bonds in the synthesized N/ZnO. The resulting FTIR spectra are presented in Figure 3.

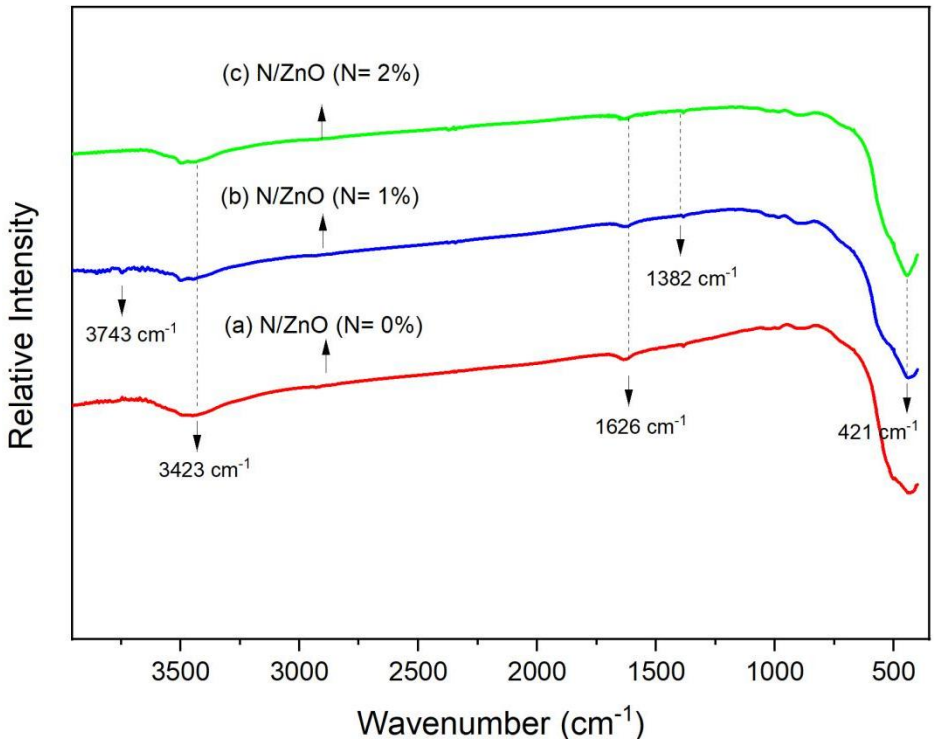

Figure 3. FTIR spectra of N/ZnO (N= 0, 1, and 2%)

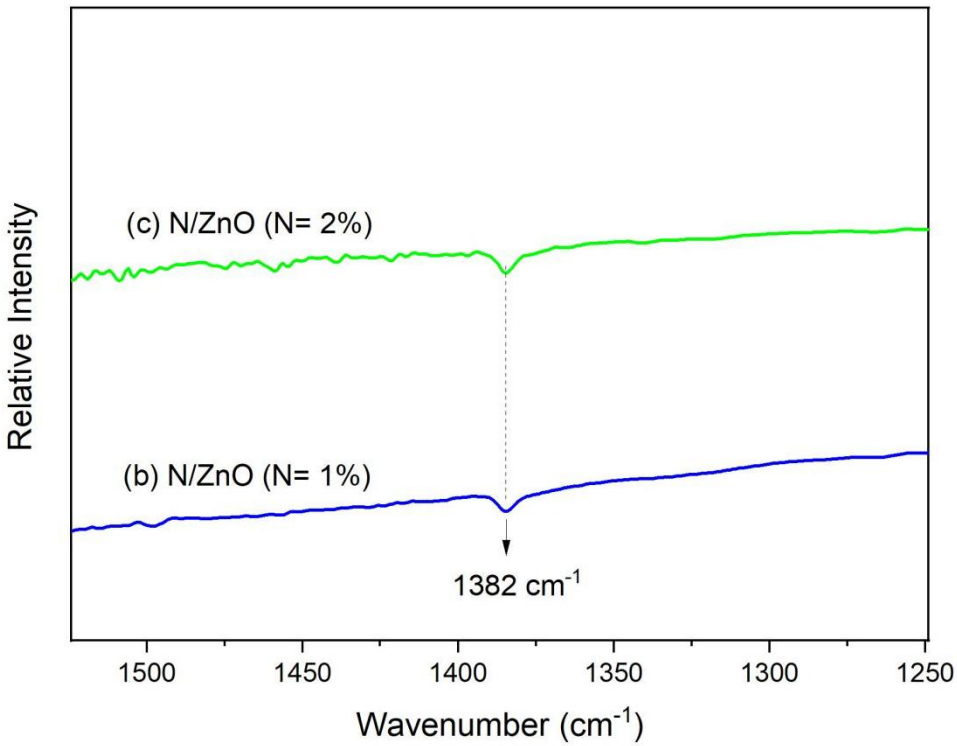

Figure 4. Zoom in FTIR spectra of N/ZnO (N= 0, 1, and 2%)

Based on Figure 3, a peak appears around 400-600 cm^{-1}, which corresponds to the Zn–O stretching vibration in ZnO. Peaks observed at 1626 cm^{-1} and 3423 cm^{-1} are attributed to H–O–H bending and –OH stretching vibrations, respectively. These peaks likely originate from water molecules adsorbed from the atmosphere onto the N/ZnO surface. Additionally, a peak at 2348 cm^{-1} is commonly associated with C=O stretching vibrations from CO_2, which may also be adsorbed from the atmosphere [17]. In the N/ZnO samples of N=1 & 2%, a peak is observed around 1382 cm^{-1}, which may indicate the presence of C–N bonds (Figure 4). At 421 cm-1, this peak represents the Zn-N bond [20]. Furthermore, in the N/ZnO (1%) sample, a distinct peak around 3743 cm^{-1} may be attributed to N–H bond [18], further supporting the presence of nitrogen in the material.

UV-Vis Diffuse Reflectance (DRS)

The UV-Vis DRS characterization was conducted to investigate changes in the optical properties of N/ZnO (0%, 1%, and 2%) as a result of nitrogen incorporation. These changes are reflected in the differences in light absorption between doped and undoped ZnO. The UV-Vis DRS spectra are shown in Figure. 5

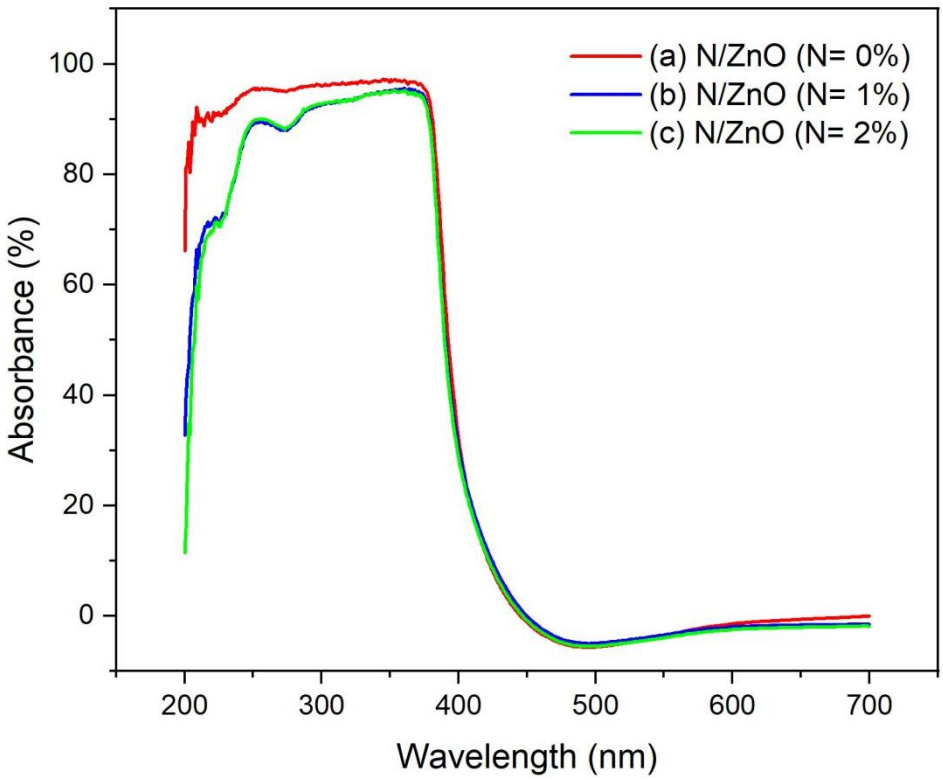

Figure 5. UV-Vis Diffuse Reflectance Spectra of N/ZnO (N= 0, 1, 2%)

Based on Figure 5, a decrease in absorbance around 400 nm is observed for all synthesized N/ZnO samples. However, a slight redshift is evident in the spectra of N/ZnO with 1% and 2% nitrogen doping in the range of 400–700 nm. This redshift indicates a narrowing of the band gap. Mondal et al. (2023) suggest that nitrogen doping effectively modifies the optical properties of ZnO. To further analyze the band gap, the Tauc plot method was applied. Figure 6 shows the corresponding Tauc plot curves. Based on the analysis, the N=0% sample has a slightly wider bandgap of 3.255 eV while the N=1 & 2% have 3.238 eV. The difference between them is 0.017 eV, which may be caused by nitrogen doping that successfully narrows the bandgap. This result is similar to Mondal et al. (2023), who reported that nitrogen doping could reduce the bandgap by introducing a new electron acceptor level near the valence band. This may happen because the oxygen is substituted by the nitrogen inside the crystal lattice of ZnO [19].

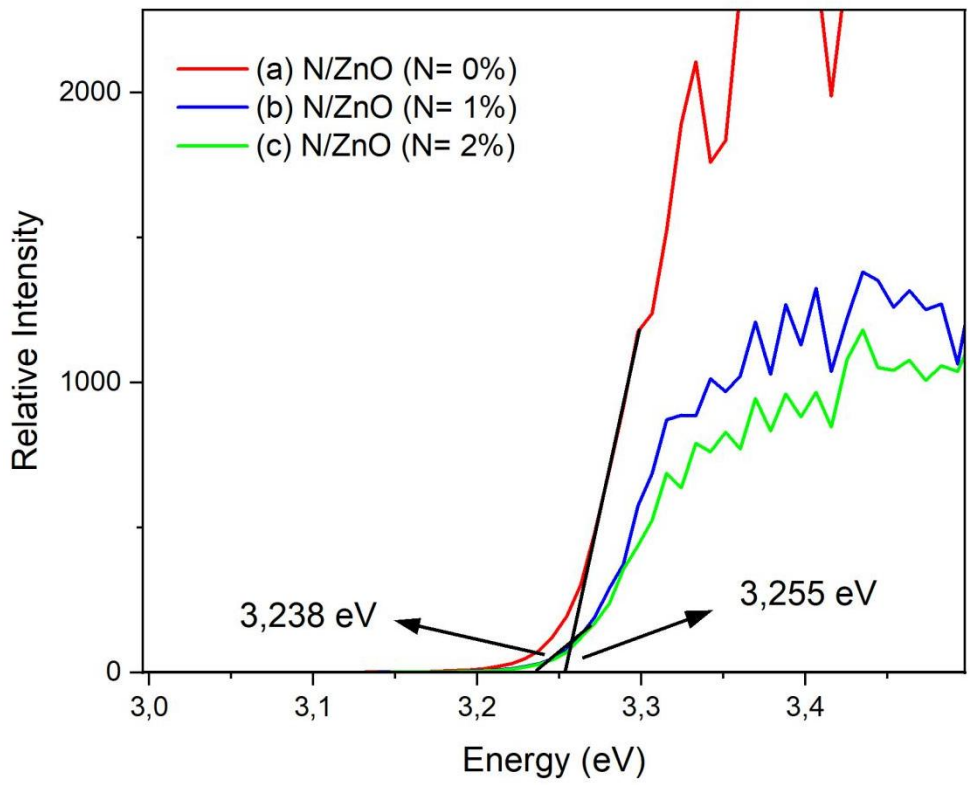

Figure 6. Tauc Plot Result of N/ZnO (N= 0, 1, and 2%)

Preliminary Adsorption and Photocatalytic Activity Result

Photodegradation experiments were conducted under solar irradiation between 10:00 and 13:20. All N/ZnO (N=0, 1, & 2%) were tested on the same day to maintain consistent sunlight exposure. Before the photodegradation process, adsorption tests were carried out using a shaker at 200 rpm for 24 hours in the absence of light. This step was performed to eliminate the effect of physical adsorption from N/ZnO on the degradation of MB and RhB wastewater models (10 ppm). Other than that, the results of the photodegradation experiment are presented in Figures 7 and 8.

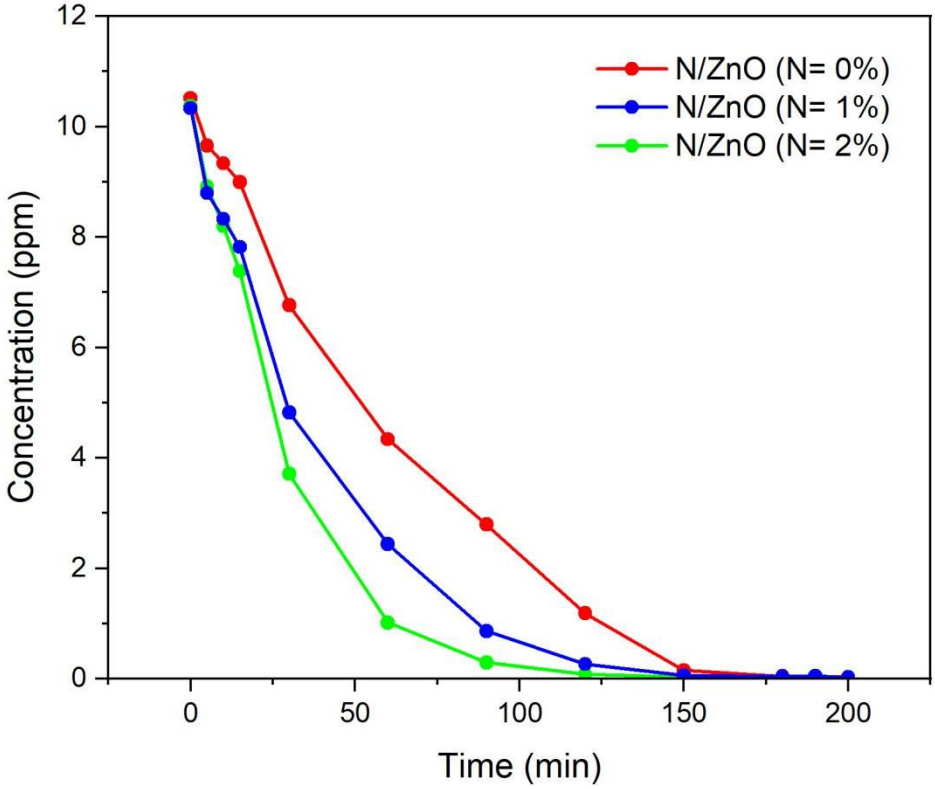

Figure 7. Photodegradation of MB

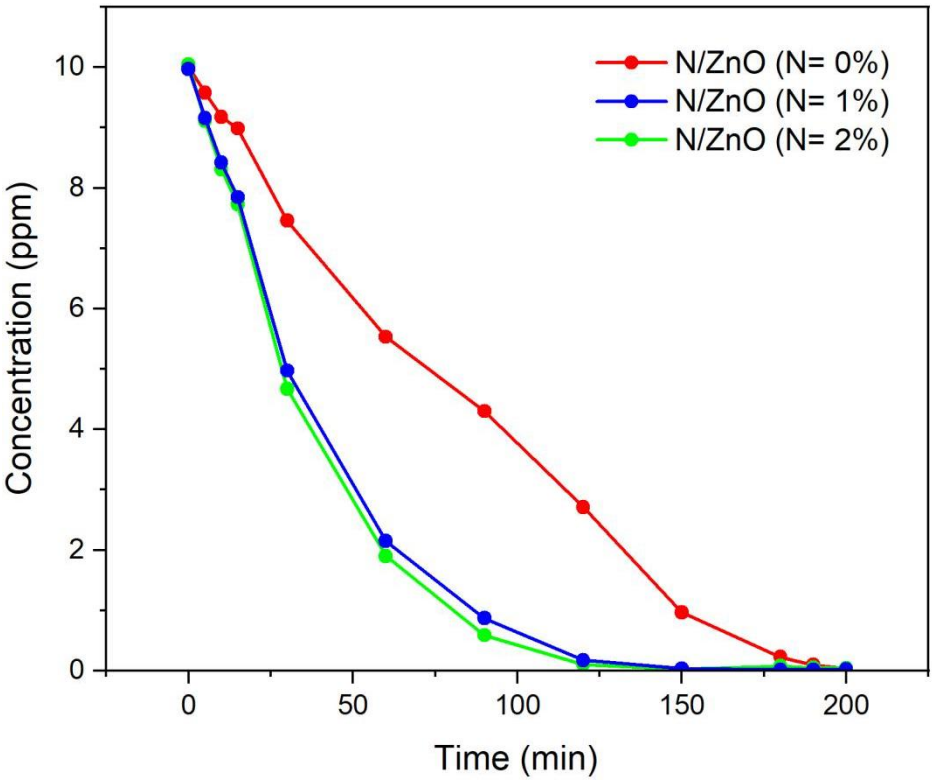

Figure 8. Photodegradation of RhB

Adsorption tests, before the photocatalytic degradation tests, result in little to no significant reduction of the wastewater models. This result suggests that the synthesized N/ZnO samples did not significantly adsorb the dye molecules. This may happen due to several factors, such as unintentional light exposure during pipetting and sample preparation before UV-Vis analysis. Other than that, minor solvent evaporation during centrifugation could also contribute to the observed variations. Figures 7 & 8 illustrate the photocatalytic degradation performance of N/ZnO samples (0%, 1%, and 2% nitrogen doping) under solar irradiation. A continuous

decrease in dye concentration over the 200 minutes confirms that the synthesized N/ZnO materials are capable of degrading MB and RhB via photocatalysis under sunlight.

Based on Figures 9 & 10, N/ZnO (N=1 & 2%) exhibits significantly higher degradation efficiency compared to N=0%. This result indicates that nitrogen doping enhances the photocatalytic activity of ZnO. However, there is no substantial difference in degradation efficiency between the 1% and 2% doping levels. Table 2 summarizes the degradation efficiency of all samples (0%, 1%, & 2%) at 150 and 200 minutes for both MB and RhB wastewater models. The improved photocatalytic activity of N-doped ZnO is likely due to the introduction of nitrogen atoms, which promote the formation of additional electron–hole pairs and create new electron acceptor levels near the Fermi level. As a result, electron transitions from the valence band to the conduction band require less energy, effectively narrowing the band gap and enabling absorption of lower-energy (visible) light [15].

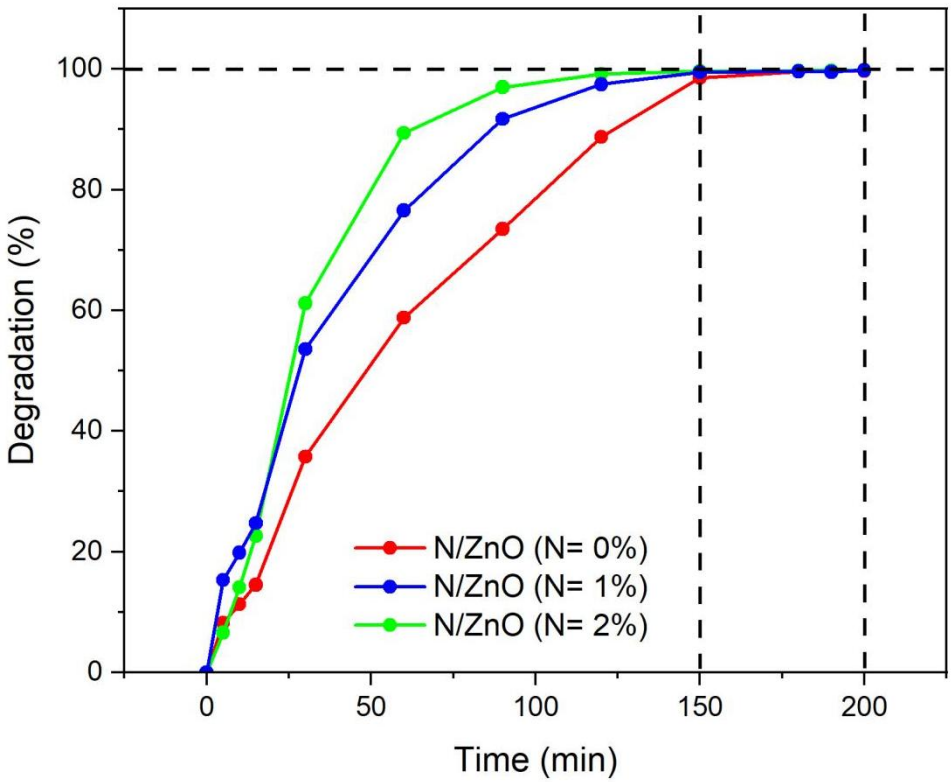

Figure 9. MB photodegradation efficiency

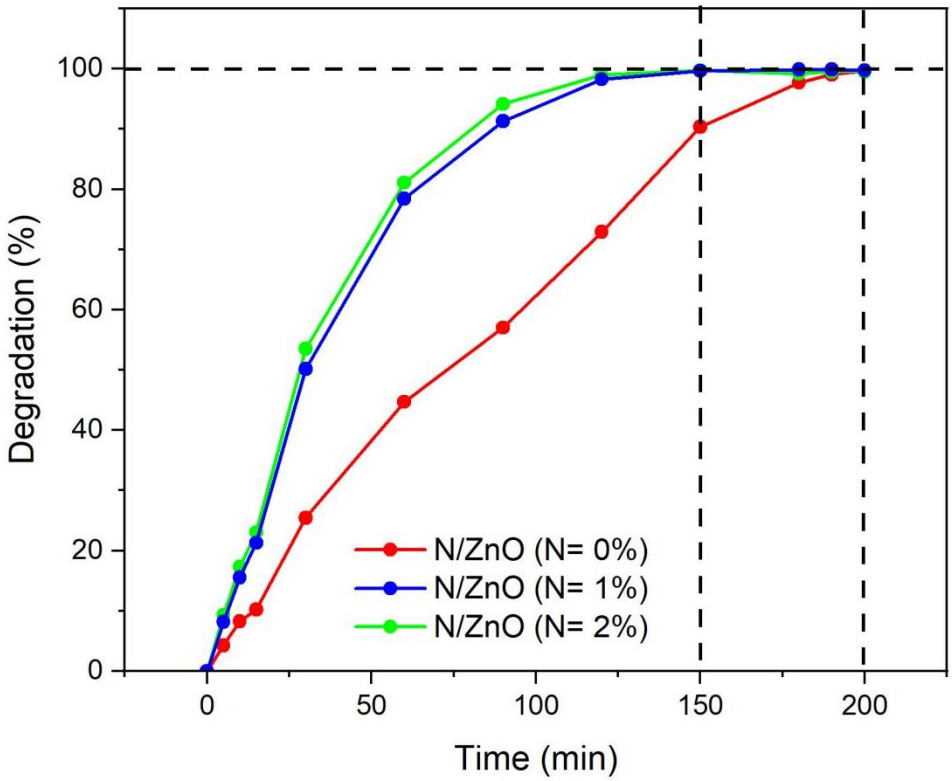

Figure 10. RhB photodegradation efficiency

Scanning Electron Microscope (SEM)

The SEM results for N/ZnO with 0% and 2% nitrogen doping are shown in Figures 11 and 12, at a magnification of 25,000×. As seen in the figures, the synthesized N/ZnO particles exhibit a non-uniform size distribution. Additionally, there is no significant size difference between N=0 & 2%. However, N=0% tends to form larger clusters compared to N=2% ZnO. This phenomenon may be attributed to the disturbance of crystal growth caused by nitrogen doping, which results in smaller particle aggregation. Furthermore, both N= 0 & 2% samples appear to have smooth surfaces without visible pores and have non-uniform morphologies. From this result, it suggests that nitrogen doping could slightly influence the crystal growth and morphology of ZnO, though not drastically.

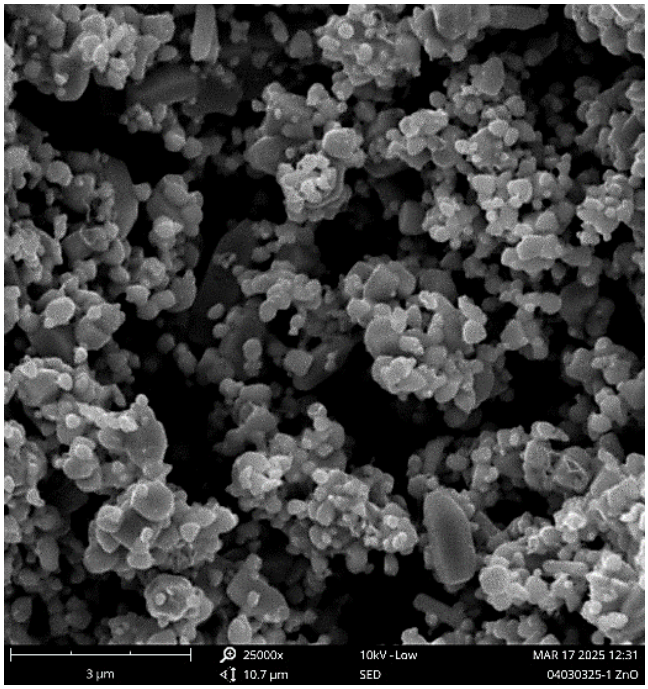

Figure 11. SEM of N/ZnO (N= 0%)

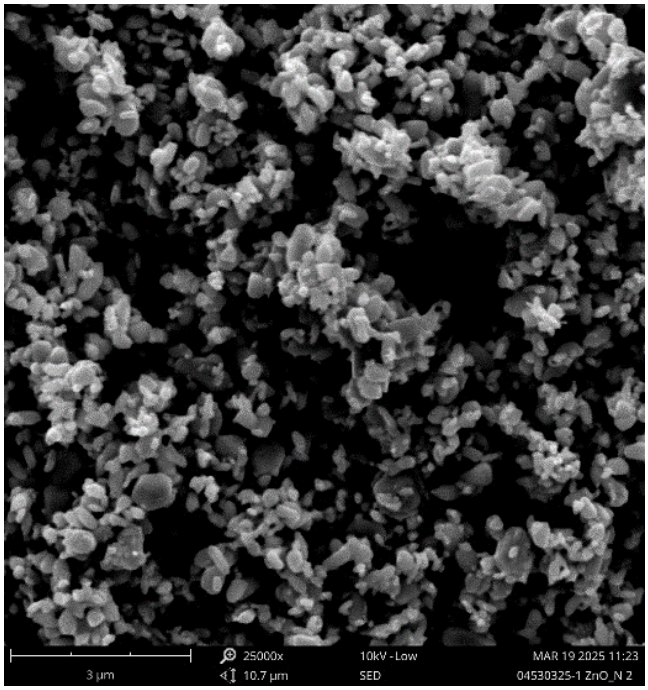

Figure 12. SEM of N/ZnO (N= 2%)

CONCLUSIONS

The synthesized N/ZnO photocatalysts exhibit several notable characteristics: high crystallinity and the retention of the hexagonal wurtzite structure after doping; the successful incorporation of nitrogen into the ZnO lattice, as evidenced by the presence of Zn–N and Zn–O bond vibrations; the samples have non-uniform sizes, smooth surfaces without porosity, and irregular shapes; and a slight enhancement in visible light absorption and a narrowed band gap due to nitrogen doping.

The N/ZnO samples of N= 1 and 2% demonstrated higher photocatalytic degradation efficiency of MB and RhB compared to undoped ZnO: At 150 minutes, MB degradation efficiencies were approximately 98.5% for undoped ZnO and 99.4% for both N= 1% and 2%. At 200 minutes, MB degradation efficiencies further increased to 99.6% and 99.7% for the N= 1% and 2% samples, respectively; and for RhB, the degradation efficiency at 150 minutes was 90.0% for N= 0% and 99.5% for both N= 1 & 2%. At 200 minutes, RhB degradation efficiencies reached 99.5% and 99.6%, respectively, for N= 1 and 2%; sampel with N= 2% exhibit higher photocatalytic activity than N= 1% at MB degradation, but in cases of N= 1% and 2%, exhibit relatively the same photocatalytic activity for RhB degradation.

REFERENCES

[1] Fitriyanti, R. (2020). Karakteristik limbah domestik di lingkungan mess karyawan pertambangan batubara. *Jurnal Redoks*, **5**(2):72-77.

[2] Haryono, H., Faizal, D. M., Liamita, N. C., & Rostika, A. (2018). Pengolahan limbah zat warna tekstil terdispersi dengan metode elektroflotasi. *Educhemia Jurnal Kimia dan Pendidikan*, **3**(1):94-105.

[3] Sausan, F. W., Puspitasari, A. R., & Yanuarita, D. P. (2021). Studi literatur pengolahan warna pada limbah cair industri tekstil menggunakan metode proses adsorpsi, filtrasi, dan elektrolisis. *Tecnoscienza*, **5**(2):213-230.

[4] Hamdaoi, O. & Chiha, M. (2006). Removal of methylene blue from aqueous solution by wheat bran. *Acta Chimica Slovenia*, **54**(2): 407-418.

[5] Kumalasari, E. (2015). Identifikasi dan penetapan kadar rhodamin B dalam kerupuk berwarna merah yang beredar di pasar antasari kota banjarmasin. *Jurnal Ilmiah Manuntung*, **1**: 85-89.

[6] Widiyandari, H, Prilita, O., Al Ja'farawy, M. S., Nurosyid, F., Arutanti, O., Astuti, Y., & Mufti, N. (2023). Nitrogen-doped carbon quantum dots supported zinc oxide (ZnO/N-CQD) nanoflower photocatalyst for methylene blue photodegradation. *Results in Engineering*, **17**:100814.

[7] Ayu, D. G. A., Gea, S., Andriayani, Telaumbanua, D. J., Piliang, A. F. R., Harahap, M., Yen, Z., Goei, R., & Tok, A. I. Y. (2023). Photocatalytic degradation of methylene blue using n-doped ZnO/carbon dot (n-ZnO/CD) nanocomposites derived from organic soybean. *ACS Omega*, **8**:14965 - 14984.

[8] Mandor, H., Amin, N. K., Abdelwahab, O., & El-Ashtoukhy, E. S. Z. (2022). Preparation and characterization of n-doped ZnO and n-doped TiO_2 beads for photocatalytic degradation of phenol and ammonia. *Environmental Science and Pollution Research*, **29**:56845-56862.

[9] Jamjoum, H. A. A., Umar, K., Adnan, R., Razali, M. R., & Ibrahim, M. N. M. (2021). Synthesis, characterization, and photocatalytic activities of graphene oxide/metal oxide nanocomposites: a review. *Frontiers in Chemistry*, **9**.

[10] Chan, S. H. S., Wu, T. Y., Juan, J. C., & Teh, C. Y. (2011). Recent developments of metal oxide semiconductors as photocatalysts in advanced oxidation processes (AOPs) for treatment of dye waste-water. *Journal of Chemical Technology and Biotechnology*, **86**:1130–1158.

[11] Song, S., Wu, K., Wu, H., Guo, J., & Zhang, L. (2019). Multi-shelled ZnO decorated with nitrogen and phosphorus co-doped carbon quantum dots: synthesis and enhanced photodegradation activity of methylene blue in aqueous solutions. *Royal Society of Chemistry Advances*, **9:**7362.

[12] Ahn, K. S., Yan, Y., Shet, Y., Jones, K., Deutsch, T., Turner, J., & Al-Jasim, M. (2008). ZnO nanocoral structure for photoelectrochemical cells. *Applied Physics Letter*, **98**:163117-163119.

[13] Chen, S., Kumar Thakur, V., & Skordos, A. A. (2024). Fluorine and nitrogen doping of zinc oxide to enhance dielectric storage of PVDF-based particulate composites. *Materials Science and Engineering: B*, **302:**117244.

[14] Kumari, R., Sahai, A., & Goswami, N. (2015). Effect of nitrogen doping on structural and optical properties of ZnO nanoparticles. *Progress in Natural Science: Materials Internationals*, **25**:300-309.

[15] Tang, C., Chen, C., Zhang, H., Zhang, J., & Li, Z. (2020). Enhancement of degradation for nitrogen doped zinc oxide to degrade methylene blue. *Physica B: Condensed Matter*, **583**(43), 412029.

[16] Chen, X., Lou, Y., Anna, C. S., Samia, Burda, C., & Gole, J. L. (2005). Formation of oxynitride as the photocatalytic enhancing site in nitrogen-doped titania nanocatalysts: comparison to a commercial nanopowder. *Advanced Functional Materials*, **15**(1):41-49.

[17] Hanif, M. A., Kim, Y. S., Ameen, S., Kim, H. G., & Kwac, L. K. (2022). Boosting the visible light photocatalytic activity of ZnO through the incorporation of N-doped for wastewater treatment. *Coatings*, **12:**579.

[18] Joy, A., Viswanathan, M. R., Vijayan, B. K., Silva, C. G., Basheer, I., Sugathan, S., Mohamed, P. A., Solaiappan, A., & Shereef, A. (2024). Solar photocatalysts: Non-metal (C, N, and S)-doped ZnO synthesized through an industrially sustainable in situ approach for environmental remediation applications. *RSC Advances*, **14:**21655.

[19] Mondal, S., Ayon, S. A., Islam, M. S., Rana, M. S., & Billah, M. M. (2023). Morphological evaluation and boosted photocatalytic activity of n-doped ZnO nanoparticles prepared via the co-precipitation method. *Heliyon*, **9:**20948.

[20] Nadjib, M., Ediati, R., Sulitiyo, Y. A. & Nadifah, L. (2016). Sintesis zeolitic imidazolate framework-8 (Zif-8) secara solvotermal: pengaruh perbandingan logam-ligan. *Jurnal Ilmu Dasar*, **17**(1):53-58.

A BIBLIOMETRIC VISUALIZATION OF GLOBAL TRENDS IN TAX EDUCATION LITERATURE USING VOSVIEWER

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Abstract. This study aims to map and visualise the intellectual structure and global trends in tax education literature from 2000 to 2024. This bibliometric study uses data extracted from the Scopus database. Literature searches were conducted using keywords related to 'tax education' and its variations. A total of 1,489 documents that met the inclusion criteria were analysed using VOSviewer software to perform performance analysis, co-authorship analysis, and co-occurrence analysis to identify the main themes and research clusters. The findings show that the number of publications on tax education has increased significantly, especially in the last ten years. The United States is recorded as the most productive contributor with 484 documents as the dominant publication. This study provides a comprehensive and up-to-date bibliometric review, which visually maps the landscape of tax education research. These results fill a gap in the literature by presenting an objective quantitative analysis of a body of knowledge that was previously only reviewed narratively. The findings of this study provide a valuable roadmap for academics to identify collaboration networks, current trends, and potential research gaps. For educators and professional institutions, these results can be used as a reference in developing relevant curricula in the digital age and in dealing with the complexities of global tax regulations.

Keywords: Bibliometrics, VOSviewer, Tax Education, Literature Analysis, Scopus, Science Visualisation.

INTRODUCTION

The development of the global taxation system over the past two decades has been marked by increasing regulatory complexity, cross-border economic integration, and increasingly massive digital transformation. These changes require individuals and organisations to not only comply administratively, but also have a deep understanding of the role and function of taxation in sustainable development. In this context, tax education has emerged as a strategic instrument for improving tax literacy, fostering awareness of obligations, and building a culture of compliance in society [1], [2].

Along with the increasing complexity of regulations and the digitalisation of tax administration, the need for innovation in tax education is becoming more urgent. Research on tax education is not only related to pedagogical aspects, but also to how tax literacy can improve voluntary compliance, fiscal governance, and professional skills relevant to industry demands [3]. Recent phenomena show a shift in research attention towards practical and pedagogical issues in higher education (the introduction of tax subjects in non-accounting curricula) and the application of innovative teaching techniques in tax education [4], [5]. On the other hand, the digital transformation of tax administration opens up new needs: digital tax literacy relevant to e-tax systems and administrative information technology [6].

Although a number of empirical and regional/national policy studies have been conducted, a review of the literature reveals several important gaps. Most studies are still case studies, evaluative surveys, or pedagogical research focused on the local context, so that quantitative descriptions, global thematic maps, and scientific collaboration networks on tax education have not been thoroughly documented [1], [7]. In addition, many bibliometric analyses in the field of taxation focus on tax evasion, tax avoidance, or tax compliance, while the domain of tax education has not been the focus of a separate bibliometric study.

LITERATURE REVIEW

Tax education has become a strategic instrument in building voluntary compliance and strengthening fiscal legitimacy. OECD (2021) emphasises that taxpayer education serves not only to improve understanding of tax administration, but also to foster fiscal citizenship. Empirical studies show that good tax literacy is associated with increased compliance and healthier financial management [2]. In this context, tax education in higher

education and public programmes is considered essential to equip the younger generation with sustainable fiscal skills.

From a pedagogical perspective, the literature highlights the importance of innovative teaching methods in tax education. Barieyah Mat Bahari & Ming Ling (2009) [5] finds that integrating tax courses into non-accounting programmes can broaden cross-disciplinary fiscal understanding, while demonstrating the effectiveness of using graphical organisers in improving students' understanding of complex tax concepts [8]. This study emphasises that the approach to tax education should not be limited to the transfer of technical knowledge, but should also involve active learning strategies relevant to practical and professional needs.

Beyond pedagogical aspects, digital tax literacy has begun to receive attention in contemporary research alongside the transformation of tax administration technology. It has been proven that the implementation of an information technology-based taxation system in Ethiopia can improve compliance, although it requires digital literacy readiness from taxpayers [6]. However, most studies are still fragmented in their local context, while comprehensive bibliometric studies on global trends in tax education and digital tax literacy are still limited. This indicates a research gap that can be bridged through systematic and global literature mapping.

RESEARCH METHOD

This study uses a quantitative bibliometric approach to map the development of tax education literature globally during the period 2000–2024. Bibliometric analysis was chosen because it provides a comprehensive overview of publication trends, author and institutional collaboration, and the thematic evolution of a field of study [9]. The research data was obtained from Elsevier's Scopus database, which is recognised as one of the most comprehensive scientific publication indexes for bibliometric analysis. The literature search was conducted on 24 September 2025 using relevant keywords, including ‘tax education’, ‘tax literacy’, ‘tax knowledge’, and ‘tax curriculum’, in the title, abstract, and keywords fields. The filters applied included article, review, and conference paper document types with a publication range from 2000 to 2024.

The analysis process was carried out in several stages. First, the data obtained was exported from Scopus in CSV format (full record and cited references) for cleaning. This stage included removing duplicate documents, standardising author names, unifying variations in institution names, and normalising keywords to reduce terminology redundancy [10]. Second, the cleaned data was analysed using VOSviewer software to visualise the knowledge network [11]. The types of analysis used included performance analysis and science mapping.

Performance analysis was conducted to assess the distribution of publications, citations, and major contributions based on authors, institutions, countries, and publication sources. Meanwhile, science mapping includes co-authorship to identify collaboration patterns, co-citation to see the intellectual links between authors and journals, and keyword co-occurrence to find thematic clusters and current publication trends [10], [12]. All analysis results are visualised in the form of network maps, which are then interpreted qualitatively to give meaning to the clusters formed. This approach enables research to not only measure academic productivity, but also understand the intellectual dynamics and direction of tax education literature development in the digital era.

RESULTS AND DISCUSSION

Results

Bibliometric analysis shows that the number of publications related to tax education and similar topics in the period 2000–2024 reached 1,489 documents. Publications increased significantly since 2018, with the highest peak in 2024 at 134 documents. In the period 2000–2007, research was relatively stable with an average of less than 30 articles per year, then entered a growth phase since 2008. These findings are in line with the global phenomenon of increased attention to tax reform, tax literacy, and the increasingly massive digitisation of the taxation system [9].

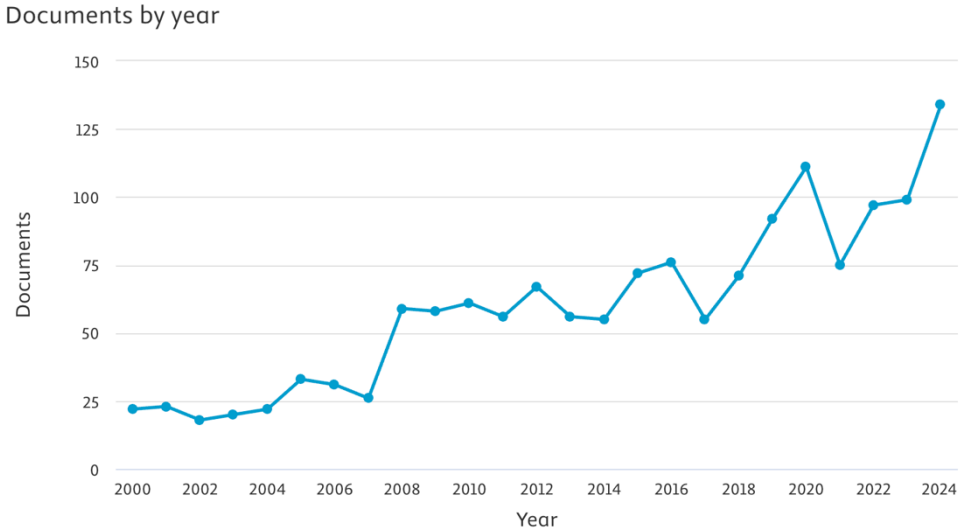


Figure 2 Publication of documents per year

Several reputable journals are listed as the main sources of publication. The journals with the highest contributions are the Journal of Public Economics (31 documents), International Tax and Public Finance (29 documents), Journal of Education Finance (29 documents), Public Finance Review (26 documents), and Economics of Education Review (25 documents). This confirms that taxation and education issues are widely discussed in scientific outlets focusing on public policy, public finance, and education.

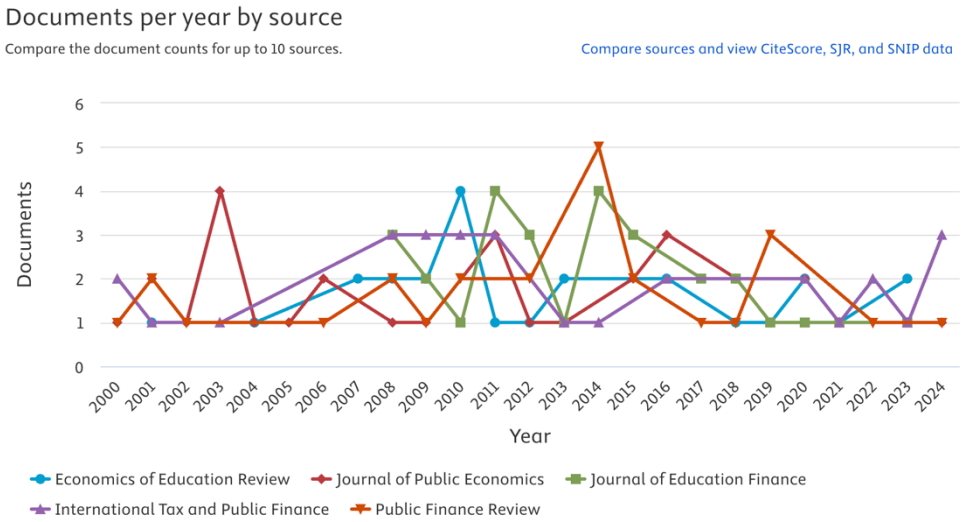


Figure 3 Publication based on source

The most prolific author on this topic is Jacobs, B. with 11 publications, followed by Poutvaara, P. (10 publications), and Del Rey, E., Glomm, G., and Lustig, N. (7 publications each). This distribution indicates the existence of a core group of authors who consistently research the theme of taxation and education, in accordance with Lotka's law in bibliometrics [13].

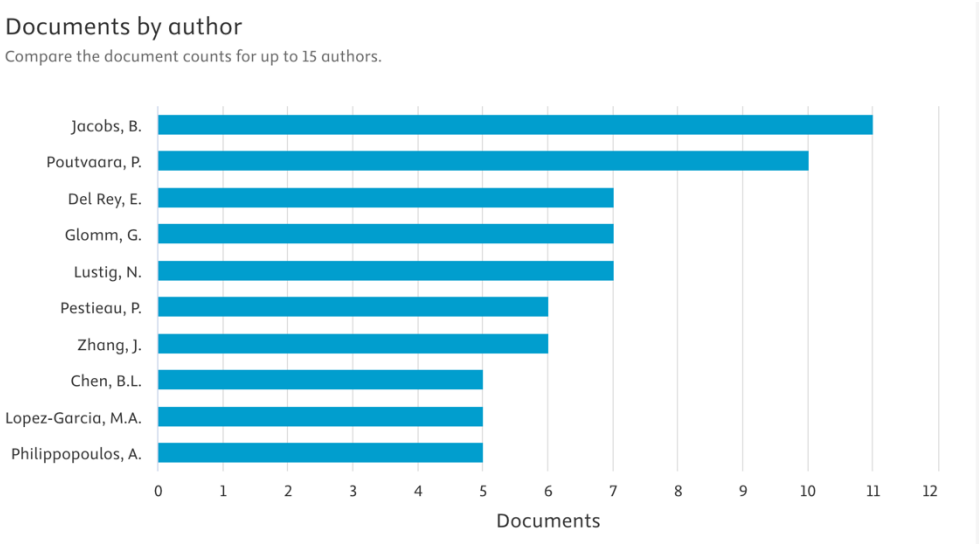


Figure 4 Publications by Author

Geographically, the most publications came from the United States (483 documents), followed by the United Kingdom (119), Germany (110), Australia (76), and China (70). The dominance of developed countries indicates a research gap between developed and developing countries. This shows that the contribution of developing countries, including Indonesia, is still relatively low and requires strengthening of research capacity.

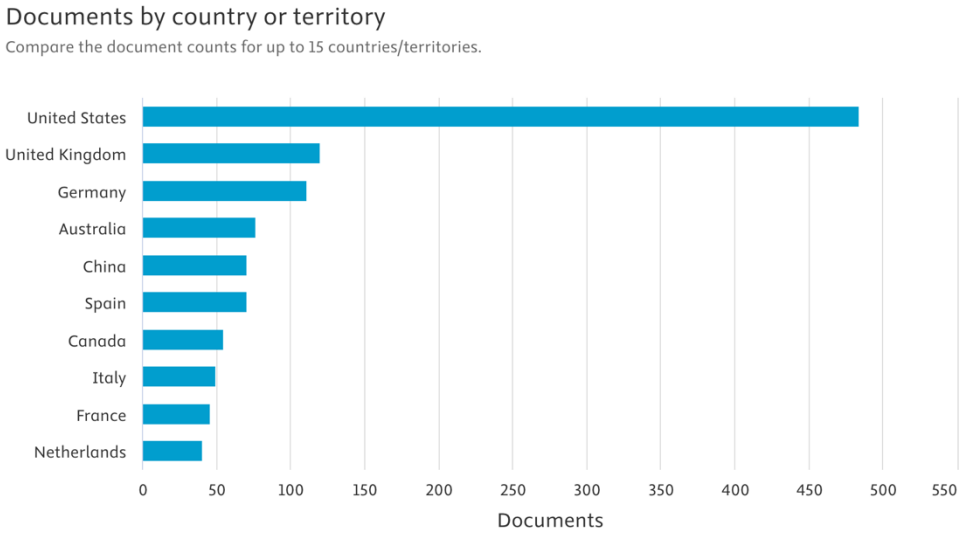
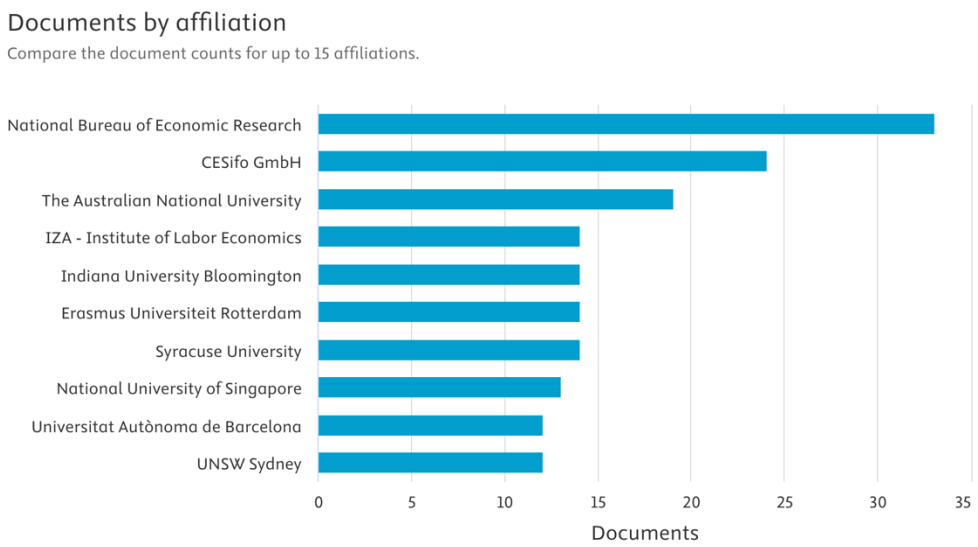


Figure 5 Publications by country

The institutions with the largest contributions were the National Bureau of Economic Research (NBER) (33 documents), CESifo GmbH (24), and the Australian National University (19). These institutions are public economic research centres that have had a significant influence on the development of taxation and education literature.



Gambar 6 Dokumen berdasarkan Afiliasi

Keyword analysis of *co-occurrence network visualisation* with VOSviewer produced four main clusters:

1. Red Cluster: focused on *fiscal policy, economic growth, poverty, inequality, welfare*, emphasising the relationship between taxation, welfare distribution, and economic growth.
2. Green Cluster: displays keywords such as *factor, income, tax compliance*, which are related to tax literacy and taxpayer compliance.
3. Blue Cluster: highlights *economy, development, firm, implication*, which are related to public policy and economic development.
4. Yellow Cluster: highlights *student, human capital, higher education*, which are closely related to the role of individual behaviour in higher education.

The most central keywords are *study*, *factor*, *income*, *student*, and *country*. The heatmap visualisation shows that the main focus of global research is still on the topics of education, taxation, and public policy.

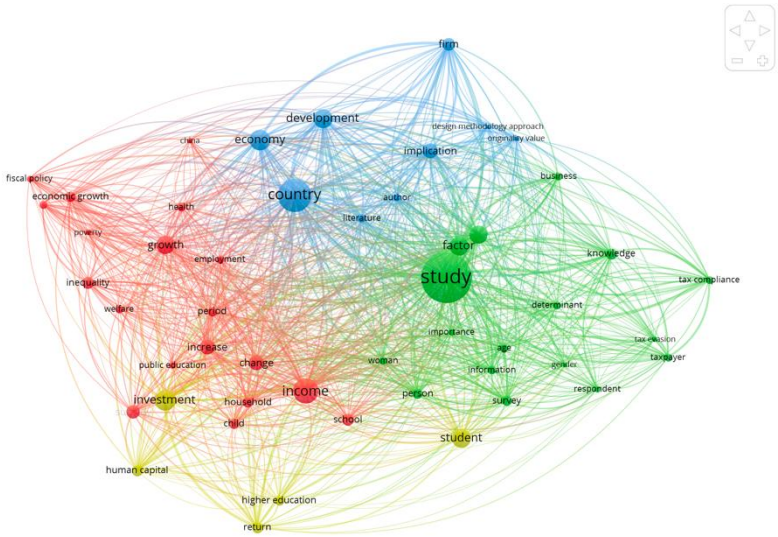


Figure 7 Network Visualization VOSViewer

Bibliometric analysis using VOSviewer with overlay visualisation shows that the dominant keywords in tax literature are study, country, income, and student, indicating a research focus on cross-country analysis, income, and the role of higher education. Keywords such as tax compliance, tax evasion, and knowledge form important clusters that demonstrate the close relationship between tax literacy and compliance behaviour. Temporally, early research themes (2012–2016) mostly discussed economic development, investment, and

higher education, while the 2016–2018 period began to shift to issues of tax literacy and taxpayer compliance. This shift reflects the growing global attention to fiscal governance and individual behaviour [9].

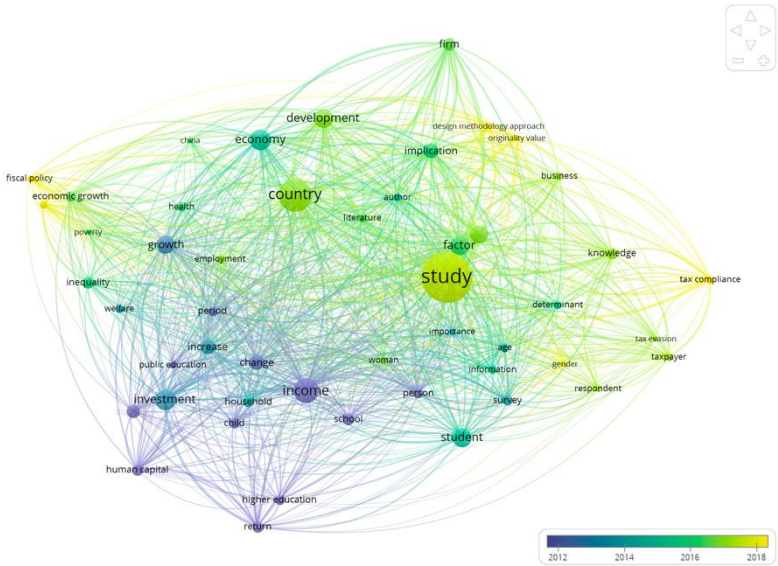


Figure 8 Overlay Visualization VOSViewer

Discussion

The results of the analysis show that research on tax education and taxation has accelerated significantly since the 2010s. The surge in publications since 2018 indicates a renewed interest in tax literacy, higher education, and tax digitalisation. This is in line with findings emphasising that integrating tax literacy into higher education curricula can increase voluntary taxpayer compliance in the future [15]. Tax education, especially among students, plays an important role in shaping a culture of compliance.

The United States and Western European countries dominate research contributions, in line with general trends in public economics literature. This dominance is inseparable from the greater research capacity, data availability, and research funding in developed countries. Therefore, future research directions need to strengthen regional representation and integrate issues of digitalisation and technology-based learning in tax education.

This gap opens up opportunities for developing countries to strengthen their contributions, especially in the context of tax literacy and SME compliance [6]. The four keyword clusters reveal the integration between fiscal, education, and economic development issues. First, taxes are positioned as an instrument of welfare distribution. Second, education is seen as a key factor in shaping tax compliance. Third, the interaction between public policy and the business world is an important focus for promoting economic development. Fourth, higher education related to taxation is important for improving individual behaviour. The practical implication of these findings is the need for an integrative strategy between the government, educational institutions, and the business world in designing tax education that is adaptive to the digital era [5], [8].

CONCLUSION

This study aims to map the development of research related to tax compliance and entrepreneurship using a bibliometric approach. The results of the analysis show that publications on this topic have increased significantly in the last two decades, in line with growing global attention to tax governance, tax avoidance, and the role of entrepreneurship in sustainable economic development. Leading research centres are found in developed countries, particularly the United States, the Netherlands, and the United Kingdom, while contributions from developing countries, including Indonesia, are beginning to show an upward trend.

Thematically, there are four main clusters in the literature: (1) tax compliance and its determining factors, (2) the influence of entrepreneurship on the tax base, (3) public policy innovation in encouraging compliance and business growth, and (4) the role of higher education. Co-citation and keyword co-occurrence analyses indicate that the concept of tax education is the most dominant and continuously developing topic. Methodologically, this bibliometric study emphasises the importance of the science mapping approach in providing a comprehensive overview of the research landscape.

Thus, this study contributes to the literature by providing a global research map that can be used as a reference for future researchers, especially in the context of Indonesia, which still needs more reputable international publications related to taxation and entrepreneurship. Theoretically, this study enriches the understanding of the relationship between tax compliance and entrepreneurship through a bibliometric approach and reveals research gaps in the context of developing countries.

Practically, the results of this study can be used by policymakers to design regulations that are more conducive to business tax compliance, while also encouraging a healthy entrepreneurial ecosystem. In addition, these findings can be used as a basis for universities and research institutions in Indonesia to increase Scopus-indexed publications focusing on taxation and entrepreneurship.

This study has several limitations. First, data was only taken from the Scopus database, so publications from other sources such as Web of Science or Google Scholar were not included. Second, the analysis was limited to English-language publications, so the potential for local research in other languages, including Indonesian, was not accommodated. Third, the bibliometric approach did not delve into the content or quality of the research arguments, but only into the structure of the publications.

Based on these limitations, further research is recommended to 1) expand the database by combining Scopus so that the analysis results are more comprehensive. 2) Integrate bibliometric analysis with a systematic literature review (SLR) to explore in greater depth the theoretical and methodological contributions of each publication. 3) Further examine the Indonesian context with a focus on MSME taxation policy, tax digitalisation, and the role of entrepreneurship in encouraging tax compliance. 4) Encourage international research collaboration to strengthen Indonesia's position in the global research map related to tax compliance.

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REFERENCES

[1] OECD, “Building Tax Culture, Compliance and Citizenship,” OECD Publishing, Paris, 2021. Accessed: Sep. 24, 2025. [Online]. Available: https://doi.org/10.1787/18585eb1-en

[2] B. De Clercq, “Tax literacy: what does it mean?,” Meditari Accountancy Research, vol. 31, no. 3, pp. 501–523, Dec. 2021, doi: 10.1108/MEDAR-04-2020-0847.

[3] J. Slemrod, “Tax Compliance and Enforcement,” J Econ Lit, vol. 57, no. 4, pp. 904–954, 2019, [Online]. Available: https://www.jstor.org/stable/26856208

[4] N. Adkins and R. R. Radtke, “Students’ and Faculty Members’ Perceptions of the Importance of Business Ethics and Accounting Ethics Education: Is There an Expectations Gap?,” Journal of Business Ethics, vol. 51, no. 3, pp. 279–300, 2004, [Online]. Available: http://www.jstor.org/stable/25075212

[5] A. Barieyah Mat Bahari and L. Ming Ling, “Introducing Tax Education in Non-Accounting Curriculum in Higher Education: Survey Evidence,” Journal of Financial Reporting and Accounting, vol. 7, no. 1, pp. 37–51, Dec. 2009, doi: 10.1108/19852510980000640.

[6] G. Mascagni, A. T. Mengistu, and F. B. Woldeyes, “Can ICTs increase tax compliance? Evidence on taxpayer responses to technological innovation in Ethiopia,” J Econ Behav Organ, vol. 189, pp. 172–193, 2021, doi: https://doi.org/10.1016/j.jebo.2021.06.007.

[7] Taxpayer Advocate Service, “Annual Report to Congress 2024: Most Serious Problem #8 Tax and Financial Literacy Limited Tax and Financial Knowledge Is Causing Serious Consequences for Taxpayers,” 2024. [Online]. Available: https://www.eitc.irs.gov/eitc-central/participation-rate-by-

[8] N. Adkins, B. Charlene Henderson, and K. G. Key, “Graphical organizers in tax education,” Journal of Accounting Education, vol. 30, no. 1, pp. 2–21, 2012, doi: https://doi.org/10.1016/j.jaccedu.2012.06.011.

[9] N. Donthu, S. Kumar, D. Mukherjee, N. Pandey, and W. M. Lim, “How to conduct a bibliometric analysis: An overview and guidelines,” J Bus Res, vol. 133, pp. 285–296, 2021, doi: https://doi.org/10.1016/j.jbusres.2021.04.070.

[10] Ivan Zupic and Tomaž Čater, “Bibliometric Methods in Management and Organization,” Organ Res Methods, vol. 18, no. 3, pp. 429–472, Dec. 2014, doi: 10.1177/1094428114562629.

[11] N. J. van Eck and L. Waltman, "Software survey: VOSviewer, a computer program for bibliometric mapping," Scientometrics, vol. 84, no. 2, pp. 523–538, 2010, doi: 10.1007/s11192-009-0146-3.
[12] Michel Callon, Jean-Pierre Courtial, William A Turner, and Serge Bauin, "From translations to problematic networks: An introduction to co-word analysis," Social Science Information, vol. 22, no. 2, pp. 191–235, Mar. 1983, doi: 10.1177/053901883022002003.
[13] M. Aria and C. Cuccurullo, "bibliometrix: An R-tool for comprehensive science mapping analysis," J Informetr, vol. 11, no. 4, pp. 959–975, 2017, doi: https://doi.org/10.1016/j.joi.2017.08.007.
[14] F. Fauzan, M. Ibrahim, and A. S. Jahja, "A Scholarly Examination of Tax Compliance: A Bibliometric Analysis (1960-2021)," Journal of Indonesian Economy and Business, vol. 37, no. 1, Jan. 2022, doi: 10.22146/jieb.v37i1.2718.

THE ROLE AND EXISTENCE OF WOMEN WOODCARVERS IN JEPARA'S CARVING INDUSTRY

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Abstract. This study aims to explain the role of women in Jepara's woodcarving industry, particularly their participation in the transmission of carving skills, their contribution to the production process, and the challenges they face in achieving equality and sustainability. The research employed a qualitative descriptive approach using field observations, interviews, and documentation in several woodcarving centers in Jepara, including Petekeyan, Mantingan, and Senenan. The results show that women play an important role in sustaining Jepara's carving tradition through informal learning in families and communities. Despite their significant technical skills, gender-based wage disparities persist, and women often occupy positions considered secondary within the production structure. The research concludes that the survival of Jepara's carving tradition is strongly supported by women's active participation in skill transmission and daily production, although social recognition and economic equality remain issues that require continuous advocacy.

Keywords: Jepara woodcarving, women woodcarvers, existence, carving industry.

INTRODUCTION

Jepara, a regency located on the northern coast of Central Java, Indonesia, has long been recognized as the heart of the nation's woodcarving tradition. The city's artistic identity is deeply rooted in its history, craftsmanship, and social life, making Jepara synonymous with the excellence of Indonesian carving art. Jepara's carving tradition developed from small family workshops into a large-scale industry that contributes significantly to the local economy while maintaining strong ties to cultural heritage.

Historically, the carving profession in Jepara has been dominated by men, as it was considered physically demanding and requiring technical mastery. However, over time, women began to participate actively in the carving process, both as helpers within family workshops and as independent artisans. Initially, women were assigned lighter or supporting tasks, such as sanding, smoothing, and decorating, which were viewed as extensions of their domestic roles. Nevertheless, as skills and experience grew, many women became proficient carvers, demonstrating artistic sensitivity and technical precision equal to that of their male counterparts.

Women's involvement in Jepara's woodcarving industry has important social and cultural implications. On one hand, it represents economic participation and family contribution; on the other, it symbolizes a form of cultural continuity and self-actualization. For many women in Jepara, carving is not merely an occupation but an inherited tradition that connects them to their community's identity. Through the carving process, women help preserve traditional motifs, transmit local aesthetics, and sustain the intangible cultural heritage that defines Jepara's uniqueness.

However, despite these significant contributions, gender inequality remains an ongoing issue. Women artisans often face disparities in wages and recognition, even when performing work of equal complexity and quality as men. Their roles are sometimes confined to "secondary" production stages, leading to undervaluation of their contribution to the overall creative process. Moreover, the regeneration of young female carvers is declining, as many younger generations choose to pursue employment in modern industries rather than traditional crafts.

These realities highlight the importance of studying women's participation in Jepara's carving industry — not only as workers but as cultural transmitters and innovators. Understanding their role in sustaining this heritage can offer new perspectives on how traditional arts survive amid social transformation and gendered labor divisions. This research therefore aims to analyze the role of women in Jepara's woodcarving industry, focusing on their participation in production, their contribution to cultural transmission, the challenges they face, and the strategies needed to strengthen regeneration and gender equality within the craft sector.

LITERATURE REVIEW

The Jepara woodcarving tradition has been widely recognized as one of Indonesia's most distinguished cultural heritages. Its development is not only a reflection of the region's artistic excellence but also a manifestation of collective craftsmanship that integrates aesthetic values, local wisdom, and social identity. Previous studies have shown that women's involvement in this tradition has long existed, even though their participation was initially limited to supporting roles within family-based workshops.

According to Hayati (1997), the Jepara carving industry evolved significantly from the 1970s to the 1990s, during which women began contributing to the production process as assistants and finishers. Their participation expanded the household economy and gradually challenged the gendered division of labor. Hayati observed that women's persistence and precision became defining characteristics in the decorative detailing of Jepara's carving products.

Sosan (2015) emphasized the dual role of women in Jepara's carving community: as homemakers and as contributors to the creative economy. Her study identified that many women perform tasks such as sanding, finishing, and applying polish, which, although often regarded as secondary, are crucial in achieving the final aesthetic quality demanded by customers. This stage, requiring patience and attention to detail, is closely associated with the feminine sensibility embedded in Jepara's artistic tradition.

In a more recent study, Saidah (2017) discussed the ongoing crisis of regeneration among young artisans in Jepara. She found that younger generations, particularly women, are increasingly reluctant to pursue carving as a livelihood due to perceptions of low wages, unstable income, and the physically demanding nature of the work. This trend poses a serious threat to the sustainability of Jepara's woodcarving heritage, which traditionally relies on intergenerational knowledge transfer within families and local communities.

The Kompas.id (2021) feature article on women carvers in Petekeyan village similarly reported that women play an essential role in maintaining carving traditions within domestic settings. Many of them learn informally from parents or husbands, continuing the craft despite economic limitations and social undervaluation. Their perseverance has become the backbone of Jepara's carving continuity, even as industrial competition and mechanization intensify.

On a broader theoretical level, Rogers (2010) introduces the concept of gendered craft transmission, which views women artisans as key agents in maintaining and adapting traditional knowledge within changing socio-economic contexts. This framework aligns with the Jepara experience, where women's participation not only ensures technical preservation but also fosters creative innovation in design and motif development.

From an international perspective, the UNESCO (2003) Convention for the Safeguarding of the Intangible Cultural Heritage underscores that traditional craftsmanship is a vital component of intangible heritage, emphasizing community involvement and intergenerational learning. Within this framework, women's roles as artisans, educators, and cultural transmitters become indispensable in ensuring that traditional arts remain dynamic and relevant to modern society.

Collectively, these studies suggest that women's participation in Jepara's carving tradition extends beyond manual labor; it embodies a process of cultural reproduction and innovation. Their involvement bridges the economic, social, and symbolic dimensions of craftsmanship, positioning women not only as contributors but as custodians of Jepara's enduring artistic identity.

RESEARCH METHOD

This study applied a qualitative descriptive approach to examine women's participation in Jepara's woodcarving industry, focusing on gender relations and the cultural meanings embedded in traditional craftsmanship. The research was conducted from March to August 2024 across key carving villages — Petekeyan, Mantingan, Senenan, and Mulyoharjo — known for their active artisan communities.

Data Collection and Analysis

Data were obtained through field observations, in-depth interviews, and documentation.

Five informants participated, including female woodcarvers, senior male artisans, workshop owners, and community figures. The key informant, Rumini, Chairperson of Paguyuban Pengukir Wanita "Kartini", provided deep insights into women's labor experiences and leadership.

The data were analyzed thematically, focusing on (1) women's participation in carving, (2) gender-based challenges, and (3) their contribution to cultural transmission. Triangulation among observation, interview, and documentation enhanced validity.

Ethical Considerations

All participants gave informed consent, and their anonymity and perspectives were respected. Collaboration with Paguyuban Pengukir Wanita "Kartini" facilitated trust and authentic access to community experiences.

RESULTS AND DISCUSSION

Women's Participation in the Jepara Carving Industry

Field observations revealed that women's participation in Jepara's woodcarving industry occurs at multiple levels of production — from initial design sketches to finishing and quality control. While carving has traditionally been perceived as a masculine occupation requiring physical strength, many women have successfully mastered the techniques of shallow carving, floral ornamentation, and surface detailing, which are essential in maintaining the aesthetic harmony of Jepara's products. In most workshops, the division of labor follows a gender-based pattern: men typically handle heavy reliefs, deep carvings, or structural components, while women focus on lighter decorative motifs.

Figure 1. Light decorative motifs

This distribution is not purely based on skill but also serves as a strategy to increase productivity. When women work on detailed finishing tasks, men can concentrate on complex reliefs, enabling faster production turnover. Despite this efficiency, women's work often receives less recognition and financial reward.

Figure 2. Female woodcarvers are working on a floral motif in a Jepara workshop (Antaranew's documentation, 2025).

In Jepara's carving villages such as Petekeyan and Mantingan, many women artisans learn informally within their families. Mothers teach their daughters to draw and carve floral motifs, which are then refined through daily practice. This process of informal and intergenerational learning ensures the continuity of carving traditions and transmits local aesthetic sensibilities embedded in motifs such as lung-lungan, daun jumbai, and wuni.

The Case of Rumini: Resistance Against Gender Wage Disparity

Interviews with Rumini, a senior female woodcarver who has received recognition from the Jepara local government for her contributions to preserving traditional craftsmanship, produced a particularly illuminating case. Rumini speaks for all women artisans when she advocates for equitable pay and recognition as the chairperson of Paguyuban Pengukir Wanita "Kartini."

Figure 3. Rumini, a female woodcarver with skills equivalent to those of her male counterparts (Author's documentation, 2025).

Despite her mastery in both relief carving and fine decorative work, Rumini experiences gender-based wage discrimination. For the same carving assignment, male artisans typically receive Rp 150,000 per day, whereas women are paid only Rp 90,000. Rumini once refused to accept a job with such unequal pay, stating:"If my work and results are the same, why should I be paid less? I would rather stay home and take care of my family than work hard but be undervalued." (Rumini, 2024).

Her refusal serves as a symbolic act of resistance against systemic gender inequality. Through her leadership, Rumini encourages other women carvers to assert their professional worth, fostering a spirit of solidarity and empowerment within the community. Rumini's experience reflects a broader pattern in Jepara's craft industry, where traditional gender norms still influence wage systems and job hierarchies. However, it also highlights women's growing awareness of their rights and their capacity to negotiate for equity within cultural industries.

Women as Finishers and Quality Controllers

Observation data and interviews in several workshops indicate that women are often positioned in finishing roles, including smoothing. Although finishing work is frequently considered secondary, it is in fact decisive in determining the product's aesthetic appeal and commercial value. Workshop owners frequently acknowledge that female finishers bring a distinct refinement to the final outcome. As one craftsman stated: "When the finishing is done by women, the surface looks softer and the patterns more alive — that's what buyers appreciate."

This phase requires patience, meticulousness, and sensitivity — traits often associated with feminine craftsmanship. In this way, women contribute not only to the physical creation of products but also to the artistic identity that defines Jepara's global reputation.

Regeneration and the Transmission of Skills

Five informants, including community leaders, youth representatives, and artisans, were interviewed. The results showed that young women's interest in carving as a career was on the decline. Only two of the artisans in one workshop were younger than 25, and the majority were over 40. Young women typically look for jobs in factories or online companies that offer more modern working conditions and a more steady income.

Nonetheless, carving is still a family custom in Petekeyan village. Older women still teach their daughters and daughters-in-law the fundamentals of finishing, chiseling, and sketching. Even as labor preferences change due to contemporary economic pressures, these informal learning processes are crucial to preserving Jepara's cultural identity. Supporting regeneration has also been greatly aided by the presence of Paguyuban Pengukir Wanita "Kartini." Local exhibitions are organized by the group, and peer,

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Motifs and the Aesthetic Contribution of Women

Women most frequently carve floral and realistic motifs, which stand for continuity, growth, and fertility. Daun jumbai (leaf garlands), wuni (clustered fruits), and lung-lungan (tendrils) are typical patterns. The artisans' aesthetic sensibility and emotional expression are reflected in these motifs, which highlight curved lines, rhythmic balance, and delicate proportions.

By adding softer lines and well-balanced compositions that appeal to both domestic and foreign markets, women's contributions to the refinement of these motifs have enhanced Jepara's visual lexicon. Their work shows how women's creative agency continuously reshapes the aesthetic quality of Jepara's carving tradition, rather than just passing it down through the generations.

Table 1. Characteristics and Roles of Female Woodcarvers in Jepara's Carving Tradition

Aspect	Description
Background of Involvement	Originated from women's desire to participate in Jepara's carving culture, motivated by economic needs and self-actualization within a male-dominated craft environment.
Type of Work	Women generally perform light and shallow carving tasks such as decorative fillers (*isen-isen*) and ornamental details, while men handle deeper, heavier reliefs and structural elements.
Motifs Commonly Carved	Dominated by floral patterns — leaves, flowers, *lung-lungan*, and vine motifs — characterized by soft, rhythmic, and detailed lines.
vision of Labor in Production	ı informal division of labor exists: men undertake heavy and complex tasks, while women handle fine and light details, increasing overall production efficiency.
:chnical Skills	:perienced female carvers possess technical abilities equal to men, capable of executing both relief and shallow carvings with high precision.
Social and Cultural Role	Women play a vital role in preserving traditional carving knowledge through informal family and community-based learning.
Meaning and Contribution	Women's participation represents not only economic contribution but also empowerment and cultural preservation, enriching the aesthetic identity of Jepara's woodcarving.

Challenges and Strategies for Sustainability

The main challenges identified in this study include:

- Persistent wage disparities between male and female artisans,
- Limited access for women to professional carving training,
- The double burden of balancing domestic and professional responsibilities, and
- Regeneration decline, as fewer young women enter the craft industry.

To address these challenges, several strategies are recommended:

- Community-based training programs that integrate gender equality principles and skill upgrading.
- Collaborative exhibitions and product branding highlighting women's craftsmanship to increase visibility and market value.
- Government-supported incentives and fair wage policies to ensure economic justice.
- Inclusion of woodcarving in local education curricula, especially for girls, to foster early appreciation and learning.

These efforts can strengthen the role of women as both economic actors and cultural transmitters, ensuring that Jepara's carving tradition continues to thrive amid social and industrial transformations.

CONCLUSION

The cultural and economic vitality of Jepara's woodcarving tradition is maintained in large part by women, who are frequently overlooked. They participate in many phases of the production process, from shallow carving and motif design to finishing and quality assurance. Even though their contributions have been crucial to the improvement and unique style of Jepara's products, ongoing gender inequality—particularly with regard to compensation and recognition—continues to restrict their ability to advance in the craft sector.

The survival of this custom is seriously threatened by the drop in young women's interest in carving. The intergenerational transmission of skills is one of the most important aspects of Jepara's carving heritage that could be lost without adequate regeneration. The sector must advance gender equality, improve training opportunities for women, and foster greater acknowledgment of their cultural and creative contributions if it hopes to remain sustainable.

Finally, women are more than just participants in the Jepara woodcarving industry; they are stewards of tradition, innovators of form, and carriers of cultural memory whose work links Jepara's artistic past with its creative future..

REFERENCES

1. Hayati, S., Sutopo, S., & Haryono, T. *Perkembangan peranan wanita dalam industri ukir Jepara tahun 1970–1997*. Semarang: Universitas Diponegoro. (1997).
2. Rogers, M. F. *Gender and Craft: Cultural Transmission in Traditional Art*. London: Routledge. (2010).
3. Saidah, S. *Krisis regenerasi pengukir muda dan eksistensi kearifan budaya ukir Jepara*. Semarang: Universitas Negeri Semarang. (2017).
4. Sosan, I. *Peran ganda ibu rumah tangga sebagai tukang amplas dalam industri ukir Jepara*. Semarang: Universitas Negeri Semarang. (2015).
5. UNESCO. *Convention for the Safeguarding of the Intangible Cultural Heritage*. Paris: United Nations Educational, Scientific and Cultural Organization. (2003).
6. Wahyono, W., Muhajirin, M., & Ambarwati, D. R. S. *The Role of Women in the Transmission of Jepara Woodcarving Skills*. Yogyakarta: Universitas Negeri Yogyakarta (PPM Research Report). (2025).
7. Kompas.id. *Perempuan tangguh pelestari ukir Jepara dari Petekeyan*. Retrieved from https://www.kompas.id (November 7.2021)

REVITALIZATION OF LOCAL WISDOM TO IMPROVE THE WELFARE OF THE BROSOT GALUR KULON PROGO COMMUNITY

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Abstract. This study aims to analyze the revitalization of local wisdom in cultural villages to preserve local culture in the Brosot Village area, Galur Subdistrict, Kulon Progo Regency, Yogyakarta Special Region. This research was conducted because Brosot Village was one of 32 villages designated as Cultural Villages by the Yogyakarta Special Region government in 1995 due to its cultural potential that must be preserved. This study used a naturalistic qualitative. This study used a purposeful sampling technique. Data collection was conducted using three techniques: observation, interviews, and documentation, followed by triangulation to validate the data. This research data analysis employed the Miles and Huberman interactive model. The results of this study indicate that the Brosot Cultural Village Institution has programs to preserve three aspects of culture: 1) Customs and Traditions. The Cultural Village has a Merti Dusun and Merti Desa program, held annually with a series of activities involving the entire village community. 2) Arts: To preserve local arts such as Reog, Angguk, Ketoprak, Sendratari (Sendratari), and so on. The Brosot Cultural Village Institution has a cultural parade program participated in by each hamlet. In addition, these arts are performed at potential exhibitions, performances at YIA airport, and the Seloso Wagen event. 3) Crafts: Brosot's arts include batik, knitting, coconut fiber processing, plastic waste processing, and local culinary delights such as geblek (rice cake), tempe benguk, chips, and buntil. The preservation program includes holding exhibitions and writing articles for publication in the Cultural Village bulletin.

INTRODUCTION

On each island in Indonesia, communities develop their own cultures according to their environmental conditions, resulting in a diversity of ethnicities, cultures, beliefs, customs, histories, and so on. This diversity can be both a strength and a weakness of the Indonesian state. If the community can respond to cultural diversity well, it will form a strong nation. However, if the community ignores it, this will threaten the nation. As good citizens, we should share responsibility for preserving the nation's culture. Article 32 paragraph 1 of the 1945 Constitution states, "The state advances Indonesian national culture among world civilizations by guaranteeing the freedom of the community to maintain and develop its cultural values." This means that the preservation of national culture is a continuous responsibility of the community and the state. This collaboration between citizens and the state is expected to strengthen efforts to preserve Indonesian national culture, which refers to local cultural values in Indonesia. Every citizen has the right to uphold their culture. The younger generation, as future cultural custodians, is required to possess the ability to preserve Indonesia's cultural diversity 1. This is because the younger generation is the successor to a nation. They are the ones who will carry on the cultures inherited from their ancestors. As cultural custodians, they will undoubtedly face significant challenges. In reality, the actualization of local culture within society has not been going well. The easy access of foreign cultures into society has led to local communities neglecting the values and elements of local culture that stem from their own local wisdom. This is because the younger generation is the future of a nation. They will be the ones to carry on the cultural heritage inherited from our ancestors. As cultural custodians, they will undoubtedly face significant challenges. The actualization of local culture within society has not been going well. The easy access of foreign cultures to society has led to local communities neglecting the values and elements of local culture rooted in their own local wisdom. For example, the phenomenon of K-Pop is more popular among teenagers than local dances. Furthermore, traditional games are losing popularity to digital games like Mobile

Legends, COC, Free Fire, and others. Even local wisdom values such as mutual cooperation (gotong royong), tepa slira (community service), and hospitality are fading due to a society's individualistic tendencies. As a result, many local cultures are fading and decaying2. Yet, many large and advanced nations seek identity by exploring their local culture. Yet, Indonesia, with its thousands of cultural assets, sometimes neglects the existence of this invaluable culture1.

Brosot Village is located in the southeastern part of Kulon Progo Regency. More precisely, it is located in Galur District, Kulon Progo Regency, Special Region of Yogyakarta. The designation of Brosot Village as a Cultural Village by the Governor of the Special Region of Yogyakarta through Decree Number 325/KPTS/1995, concerning the Establishment of Cultural Development Villages, makes Brosot Village one of 32 cultural villages, playing an important role in the process of fostering the village's cultural potential 3. The Cultural Village Institution for Brosot Village is a vehicle for fostering, developing, and preserving all existing cultural potential, so that it is hoped that a harmonious social order will be realized that is willing and able to appreciate the cultural values that grow and develop in Brosot Village 3. This is a responsibility for Brosot Village, both residents and the government to continue to maintain its culture. Along the way, of course, the implementation of the Cultural Village policy, especially in Brosot Village, faces various obstacles. Among them are human resources, infrastructure, and institutions. The lack of human resources in managing the cultural village institutions in Brosot Village will also have an impact on the lack of preservation of local culture itself. In addition, the regeneration of cultural actors and general knowledge about the culture in Brosot Village is very necessary4. In fact, there are many cultures that must be preserved in Brosot Village. In the field of arts, Brosot has the performing arts of reog, gejog lesung, jathilan, and angguk with their traditional ceremonies namely merti dusun, sedekah progo, genduren, and so on. Brosot Village also has a cultural heritage of the former Dutch office and folklore that must be preserved. Based on the background of the problem that has been described above, we will conduct a study with the title "REVITALIZATION OF LOCAL WISDOM TO IMPROVE THE WELFARE OF THE BROSOT GALUR KULON PROGO COMMUNITY". The purpose of this study is to find a form or pattern of revitalization of Local Wisdom to improve the welfare of the Brosot Galur community, Kulon Progo.

LITERATURE REVIEW

Revitalization theory refers to various approaches to restoring, renewing, and improving specific areas or aspects, whether from an economic, social, cultural, or environmental perspective. Economic revitalization focuses on the economic recovery of a previously underdeveloped or neglected area. This approach aims to revitalize the industrial sector, increase employment opportunities, and attract investment5. Social revitalization emphasizes the role of the community in the revitalization process. This involves empowering communities through increased access to social, educational, and health services, and community participation in revitalization planning5. Revitalization based on sustainable development principles prioritizes the integration of social, economic, and environmental aspects to ensure that renewal does not undermine the sustainability of natural resources and the long-term quality of life6 . A cultural heritage approach to revitalization prioritizes the preservation of cultural heritage as an integral part of revitalization. This can take the form of restoring historic buildings or implementing cultural activities that support local identity 7.

In the Regulation of the Governor of the Special Region of Yogyakarta Number 36 of 2014, it is explained that Cultural Villages/Sub-districts are villages or sub-districts that actualize, develop, and conserve the richness of their cultural potential that is evident in customs and traditions, arts, traditional games, language, literature, script, crafts, culinary, traditional medicine, spatial planning, and cultural heritage. In the Governor's decision, it is also explained that Cultural Villages are defined as villages and regions that grow and develop all creative arts and cultural activities supported by cultural officials and community awareness to promote cultural awareness. Then, the Ministry of Education and Culture also explains, Cultural Villages are a vehicle for a group of people who carry out cultural activities that express belief systems, art systems, livelihood systems, technology systems, communication systems, social systems and environmental systems, spatial planning, and architecture by actualizing the richness of potential and conserving it in a comprehensive manner for the cultural wealth they have, especially those that are evident in traditional customs, performing arts, crafts, spatial planning and architecture 8. According to the definitions above, a Cultural Village is an institution that encompasses a group of people living in an area who uphold the existing local culture, supported by synergy between the government and the local community.

According to Regulation of the Governor of the Special Region of Yogyakarta Number 36 of 2014, the purpose of establishing a Cultural Village/Sub-district is to support cultural development in order to achieve the following:

a. To foster cultural values that strengthen the nation's character, strengthen self-esteem, and strengthen unity;

b. To foster the community's ability to absorb and absorb positive cultural values;

c. To instill discipline, patriotism, and national pride to encourage the ability to develop independently and strengthen national resilience.

The establishment of a Cultural Village is also intended as an effort to accommodate those at the village level. This is done to strengthen the presence of regional culture and to increase public appreciation of culture. Given that Indonesia is an archipelagic nation with abundant cultural riches, the establishment of Cultural Villages is intended to facilitate the government's efforts to preserve local culture, especially in remote areas. The existence of Cultural Villages is also expected to explore and promote traditions and customs that are not widely known to the wider community in other regions. This allows the community to collectively participate in preserving and maintaining Indonesian culture.

Local wisdom refers to knowledge, values, or policies passed down from generation to generation within a community and related to how they manage the environment, social life, or culture. Local wisdom can take the form of traditions, social rules, or ways of life that have proven effective and relevant to the local conditions of a community. For example, in indigenous communities in Indonesia, there are many traditions related to nature management and community life that embody sustainable values8.

Characteristics of Local Wisdom: 1) Traditional and Hereditary. Local wisdom usually develops and is learned over a long period of time. This knowledge is passed down from generation to generation in the form of stories, customs, and rituals. 2) Related to Nature and the Environment. Much local wisdom focuses on the management of nature and natural resources, such as irrigation systems, farming patterns, or the use of medicinal plants that have been proven to maintain environmental sustainability. 3) Functions to Maintain Social Life and Community Harmony. Local wisdom also plays a role in maintaining social relations within the community. Customary rules and traditions are often used to maintain peace, harmony, and social welfare. 4) Based on Experience and Observation of Nature. Local wisdom usually arises from the community's direct experience of the surrounding nature and how they manage the environment to maintain sustainability. 5) Sustainability Oriented. Local wisdom often focuses on sustainability, both in social, cultural, and environmental terms. This is seen in how communities use natural resources wisely so as not to damage or deplete them2.

RESEACH METHOD

The research used was naturalistic qualitative research. Qualitative research is a research method used to examine natural objects, where the researcher serves as the key instrument. Data collection techniques are triangulated (combined), data analysis is inductive, and qualitative research results emphasize meaning over generalization. Qualitative research is also called naturalistic because the collected data is qualitative rather than quantitative, as it does not use measuring instruments. Furthermore, it is called naturalistic because the research field situation is natural or natural as it is, without manipulation, controlled by experiments or tests. This study used a naturalistic qualitative method because it examines the natural and natural field conditions regarding the implementation of the Cultural Village policy in an effort to preserve local culture in Brosot Village. The results will then be presented as a descriptive narrative history. This research was conducted in Brosot Village, Galur District, Kulon Progo Regency, Yogyakarta Special Region.

The research subjects were the Brosot Village community, the Brosot Village Government, in this case the Head of the Brosot Cultural Village, the Cultural Village Facilitator, and cultural actors in Brosot Village. These parties are part of the Cultural Village and are, of course, involved in the preservation of local culture. The selection of the Cultural Village Head, Cultural Village Facilitators, and Cultural Actors was carried out to determine the implementation of Cultural Village policies on local cultural preservation using a purposeful sampling technique. Purposeful sampling is a sampling technique that considers parties with knowledge and direct involvement, thus determining the implementation of Cultural Village policies on local cultural preservation in Brosot Village. Data collection techniques included in-depth interviews, observation, and documentation.

The data analysis technique used in this study employed the interactive model of Miles and Hubberman. Miles and Hubberman's data analysis model suggests that qualitative data analysis activities are conducted interactively and continuously until complete, thus achieving data saturation. Several activities are carried out in data analysis, namely: data reduction, data display, and conclusion drawing/verification. These steps are outlined as follows:

1. Data Collection

In qualitative research, data is collected through observation, interviews, and documentation. This data collection can take days or even months, resulting in a significant amount of data. In this case, the researcher will collect data from what has been seen and heard, thus obtaining a wealth of data in Brosot Village.

2. Data Reduction

Data reduction involves summarizing, selecting the main points, focusing on important points, and identifying themes and patterns. This reduced data will provide a clearer picture and facilitate further data

collection and further research, if necessary. In this study, data reduction was carried out by focusing on data related to the implementation of the Cultural Village policy. Data collected through observation, interviews, and documentation were grouped and categorized.

3. Data Display

Data presentation facilitates understanding of the research results. The data presentation in this study consists of narrative descriptions of the implementation of the Cultural Village policy in preserving local culture in Brosot Village.

4. Conclusion Drawing/Verification

Conclusions in this study were drawn based on field data and valid sources. The final conclusion drawn from this study is a description of the new findings that can support the answer.

The following are the components of the Miles and Hubberman interactive data analysis model.

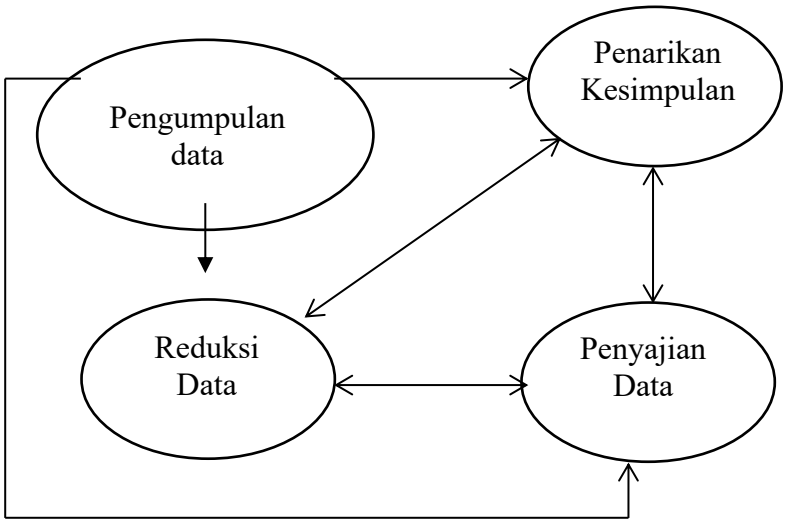

Figure 9. Model Miles and Huberman (2018)

RESULT AND DISCUSSION

Based on Decree (SK) of the Governor of the Special Region of Yogyakarta No. 454/Kep/2023, Brosot Village remains a Cultural Village, and this decree is valid for five years from the date of its issuance. A Cultural Village is an institution established by the Yogyakarta Special Region Government under the Village or Sub-district Government. This Cultural Village institution was established to preserve local culture and potential, especially in village areas. The Cultural Village is expected to create a harmonious society capable of appreciating and upholding existing cultural values and structures. The Brosot Cultural Village institution originated from a Cultural Development Village training program in Sindumartani, Sleman, Yogyakarta, along with 32 other villages in the region. Brosot Village was chosen because of its history as the capital of Karang Kemuning Regency, now known as Kulon Progo Regency.

Customs and traditions are also influenced by location. Brosot Village is located west of the Progo River. Therefore, a tradition is practiced, namely the Sedekah Progo tradition. A respondent named Mr. S stated:

> "Brosot Village itself is located near the Progo River. There's also a hamlet, Kutan Hamlet, located on the riverbank. The residents depend on the river for their livelihood, so they hold the Progo alms tradition. The activity involves holding a feast, a celebration, asking for blessings and prayers from God, and then floating some uborampe (a kind of ritual offering) into the Progo River. This is usually held annually, though I'm not sure when it will be held."

Figure 2. Progo Alms Ceremony

Preserving and sustaining these customs and traditions requires collaboration between the government and the community. The Brosot Village Government, through the Brosot Cultural Village Institution, has several preservation programs, as explained by Mr. S:

> "The first is the Merti Dusun program. All hamlets are required to hold a demonstration of their respective hamlet potential. This activity usually begins with women working together to cook food for a feast. During this feast, residents pray to God Almighty for the safety of their hamlet. After the feast, they parade around the hamlet. It concludes with an arts performance. The second is the Merti Desa program. The activities are almost identical to the Merti Dusun program, but the entire village, usually with representatives, participates. A mountain of food is paraded from the village hall to the Brosot monument."

Figure 3: Jathilan Klampok during the Merti Dusun event

The explanation explains that to preserve cultural potential in the aspects of customs and traditions, the Brosot Cultural Village Institution has two programs: the Merti Dusun program and the Merti Desa program. These programs are being implemented well and are held annually. In the Merti Dusun program, each hamlet is required to hold activities that include social and artistic activities funded by special funds. The next activity is the Merti Desa activity, a manifestation of gratitude from the residents to God Almighty for the abundant blessings, such as abundant harvests, and a series of prayers for the safety of the village. Residents gather in a village hall to pray together, then parade a mountain of agricultural produce from the village office to the Brosot monument. The mountain is then contested for by residents. This is emphasized by Mr. ER's explanation:

"As part of the village government's efforts, we have implemented several programs to preserve these traditions, including the Merti Dusun program. In this program, we invite 10 hamlets to hold activities to showcase the potential of their respective hamlets. We also support this activity by providing capital in the form of funds from the special funds allocated to each hamlet. After the Merti Dusun series concludes, the highlight of the event is the Merti Desa and the cultural parade."

Art is an expressive human behavior that produces works of beauty to satisfy one's desire for beauty or aesthetic value, both in performances and non-performances. As a Cultural Village, Brosot naturally boasts various art forms. The most famous art form in Brosot is the Reog Dance. Mrs. R explained this as follows:

"Brosot Village has long been famous for its reog wayang (wayang) performance. It has been preserved since the time of our ancestors (in ancient times). Some of the performers are still alive and passed down to their descendants. Reog itself is usually performed by the village, and is performed around the village, known as mbarang."

Figure 4. Reog Wayang Mrs. R also explained:

"The artistic potential of Brosot Village is reog, its mainstay. Then there's classic angguk, sweet angguk, and trengginas angguk, then there's sendratari, ketoprak, and karawitan—more or less. Most of the performers are from Brosot, but unfortunately, the number of performers is limited. If there aren't enough, we recruit performers from other villages."

According to Mr. S and DS, reog has been a favorite since ancient times. The community supports reog; some enjoy performing, others enjoy watching, making it a legendary form of community entertainment to this day. Besides reog, there are also other arts, such as angguk. It's worth noting that angguk is a traditional dance from Kulon Progo Regency. In addition to dance, Brosot also incorporates collaborations with role-playing. Mr. ER explained:

"Brosot also frequently presents dance dramas that tell legends or folktales from the village. For example, the legend of the origins of the village. We recently performed the Adikarta dance drama. We also sometimes present wayang stories in the form of dance drama performances."

Figure 5: Adikarta Dance Drama, Brosot Village

To preserve these programs, the Brosot Cultural Village Institution has several programs, as explained by Mrs. R:

"The Cultural Village program to preserve these arts includes the Gelar Potensi (Potential Exhibition), which is actually organized by the Central Cultural Village Government, and we participate. Then there's the Selasa Wagen (Tuesday Wagen) program, which we also participate in, which is also organized by the central government. There's also a cultural parade program organized by us for the 10 hamlets in Brosot to participate in. They must showcase their potential through performing arts. The parade circles the village area for viewing by the entire community, especially the residents themselves. This activity used to be held annually but was suspended due to COVID-19. There are also regular gamelan (karawitan) practice sessions on the second floor of the village hall."

Picture of the front of the Brosot District Office, Galur, Kulon Progo

Picture of the Research Team with Respondents

Picture of the Research Team with Respondents

Picture of the Research Team with Respondents

Image of the Research Team with Respondents

Picture of the Research Team with Respondents

CONCLUSION

1. To preserve the various traditional and cultural potentials, the government has implemented the Merti Dusun and Merti Desa programs, which are held around September. In the morning, residents work together to perform a reawangan (a traditional ceremony) and kenduri (a feast), followed by a parade around the hamlet. This is followed by a local arts performance from that hamlet. After the Merti Dusun (a traditional ceremony) is completed, the Merti Desa (village) event is held. The community prays together and then parades the gunungan (mountain) from the village hall around Brosot village, dressed in traditional Javanese attire. This is followed by a cultural parade, where each hamlet in Brosot Village showcases its regional potential through dances or engaging performances. This event is supported by special funds and usually receives voluntary donations from residents.

2. The Brosot Cultural Village Institution has several preservation programs to facilitate residents with artistic talents, including the Cultural Parade, Potential Exhibition, Tuesday Wagen, and Airport Performance. The cultural parade is held annually and is attended by participants from all 10 hamlets in Brosot Village. This activity was held in conjunction with the Merti Dusun event.

3. The Village Cultural Institution also participates in cultural exhibitions to promote village crafts and potential. For example, during the Tuesday Wagen (Tuesday Wagen), Cultural Parade, and Potential Exhibition, Brosot Village had a dedicated booth to display local products.

ACKNOWLEDGMENTS

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REFERENCES

1 G. Tri Sambodo, and U. Pribadi, "Pelaksanaan Collaborative Governance di Desa Budaya Brosot, Galur, Kulonprogo, DI. Yogyakarta," J. Gov. Public Policy 3(1), (2016).
2 G.R. Wibawanto, "SIPKADES (Sistem Informasi Potensi Kreatif Desa) Merintis Institusi Menjadi Mandiri : Belajar Mengelola Potensi Desa Bersama Teman Muda," J. Stud. Pemuda 4(2), 342 (2018).
3"skgub454-2023.pdf," (n.d.).
4 B.L. Paramita, "Pengembangan desa budaya dan pembuatan pupuk cair sabut kelapa di Desa Brosot, Galur, Kulon Progo," J. Atma Inovasia 2(5), 544–548 (2022).
5 A.I. K, W. Setyaningsih, and T.Y. Iswati, "Penerapan Arsitektur Kontekstual Pada Revitalisasi Stasiun Lempuyangan Di Yogyakarta," Senthong I(1), 1–8 (2018).
6 A. Sultan, I. Ekonomi, S. Pembangunan, and F. Ekonomi, "Revitalisasi Pasar Tradisional Sebagai Upaya Meningkatkan Kualitas Hidup Masyarakat di Kecamatan Pasimarannu Kabupaten Kepulauan Selayar Provinsi Sulawesi Selatan Andi Sultan , 2018 . Title , " Revitalization of Traditional Markets as an Effort to Improve," J. Ekon. Balanc. Fak. Ekon. Dan Bisnis 2192, 132–146 (2019).
7 I.G.A. Agra Adiaya, N.L. Diana, K.P. Piaska Yanti, and N.K. Widya Kusumaningsih, "Pelestarian Budaya Bali Melalui Seni Arja Menjadi Desa Budaya Di Desa Keramas, Gianyar," J. Locus Penelit. Dan Pengabdi. 3(11), 919–926 (2024).
8 Pusdatin, Kebudayaan 2021-2021 (2021).

THE EFFECT OF WEIGHT TRAINING THERAPY ON INCREASING MUSCLE STRENGTH AND ENDURANCE IN ATHLETES

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Abstract. Muscle strength and endurance are important components for athletes. To improve muscle strength and endurance in athletes, weight training can be used. This study aims to determine the effect of weight training therapy on increasing muscle strength and endurance in athletes. This type of research uses a quasi-experimental approach with a One Group Pretest-Posttest Design. Data collection techniques use tests and measurement of exercise results. The population in this study amounted to 150 people with a sample of 20 people based on certain criteria. The results showed a significant effect on the average increase in muscle strength of 34.6 with a significance value of 0.001 and an increase in muscle endurance of 10.2 with a significance value of 0.000. Thus, it can be concluded that there is an effect of weight training therapy on increasing muscle strength and endurance in athletes.

INTRODUCTION

Currently, sports are experiencing rapid development and attracting a growing number of enthusiasts. Sport is a physical activity involving specific techniques, incorporating elements of play, enjoyment, and satisfaction, designed to improve performance and allow for activities without excessive fatigue.(Masrun, 2022)Regular physical activity can improve your quality of life and enhance muscle performance.

Sports and physical activities can be done for fun, relaxation, competition, socialization, as well as to maintain and improve fitness, both physical and mental health.(Suhendra, 2021). Physical activity carried out regularly is beneficial for maintaining physical fitness for every individual who does it. Physical fitness hasseveral elements of fitness related to health, of which there are four components, including cardiovascular endurance, flexibility and body composition, muscle strength and muscle endurance(Kurnia, 2013).

Muscle strength and endurance are important components of physical fitness, especially for athletes. Muscle strength is the ability of a muscle or group of muscles to perform a single maximal contraction against resistance or a load.(Schoenfeld et al., 2021). Muscle endurance is the ability of a muscle to repeat contractions a certain number of times.(Schoenfeld et al., 2021). Increased muscle strength can enhance muscle capacity, helping you master training techniques. Increased muscle strength goes hand in hand with increased muscle endurance.

Muscle strength and endurance can be improved through exercise. One exercise that can be used to increase muscle strength and endurance, especially in athletes, is weight training, both using body weight and using external weights.(Nasrulloh & Prasetyo, 2021)Weight training can increase muscle strength and endurance due to the increased muscle performance that results from exercise, which physiologically changes the neuromuscular system. These changes are caused by muscle hypertrophy, which can strengthen muscles.

Weight training is a systematic, programmed, progressive physical activity according to each individual's condition to increase muscle strength, muscle endurance and the occurrence of muscle hypertrophy.(Nasution et al., 2015)By training according to training principles and doing it regularly, it is hoped that athletes can achieve maximum results, thereby achieving their desired training goals.

The programmed weight training therapy aims to determine the effects of therapy on muscle strength and endurance in athletes. The urgency of this research is to provide knowledge to the general public, especially athletes, regarding physical fitness, as examined in terms of increased muscle strength and endurance.

METHOD

Procedure

This type of research uses a quasi-experimental approach with a research design that includes one group in which there is a pretest before treatment is given to measure initial abilities and a posttest after treatment is given to measure final abilities after applying the therapy.(Hastjarjo, 2019). Exercise therapy is given for 6 weeks with a frequency of 4 exercises per week or 24 sessions.

Sample

The population in this study was 150 people. The research sample consisted of 20 people determined by the purposive sampling method, with the following criteria: 1) athletes or sports practitioners aged 20-30 years, 2) in good health, 3) willing to follow all the training provided.

Data Analysis Instruments and Techniques

The instruments used in this study were a leg dynamometer to measure muscle strength and lunges to measure muscle endurance. Data collection techniques used were pretest-posttest data and a questionnaire compiled in Google Form. Data analysis used descriptive analysis, statistical analysis, and paired t-tests.

RESULTS AND DISCUSSION

Data was collected based on the results of weight training therapy interventions, followed by measurements of muscle strength and endurance. The following is a record of the measurement results:

1. Descriptive Analysis

Muscle Strength

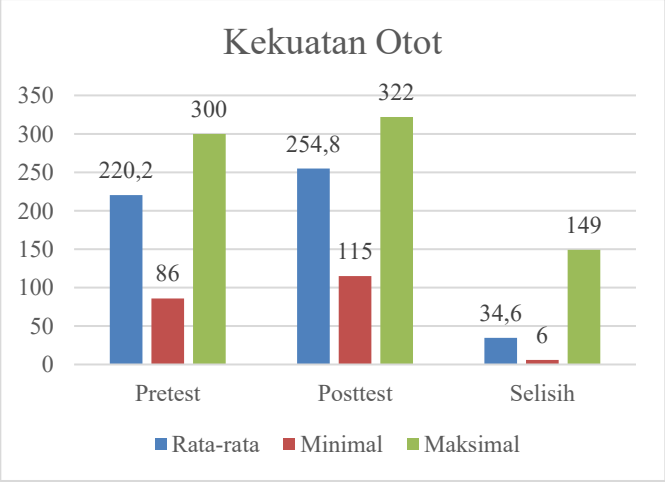
Muscle strength data was obtained using a leg dynamometer. The following are pretest and posttest data from the leg dynamometer muscle strength measurements, along with the average, minimum, and maximum values:

Table6. Pretest Posttest Score for Muscle Strength

	Pretest	Posttest	Difference
Average	220.2	254.8	34.6
Min	86	115	6
Max	300	322	149

Table 1 shows that the results of the pretest and posttest measurements of muscle strength in athletes undergoing weight training therapy showed an average difference of 34.6. Based on the results and average pretest and posttest values of muscle strength, it can be concluded that there was an increase in muscle strength in athletes after being given weight training therapy.

The results of the pretest and posttest muscle strength measurements can be more clearly presented in the following bar chart.



Picture10. Pretest Posttest Muscle Strength

Muscle Endurance

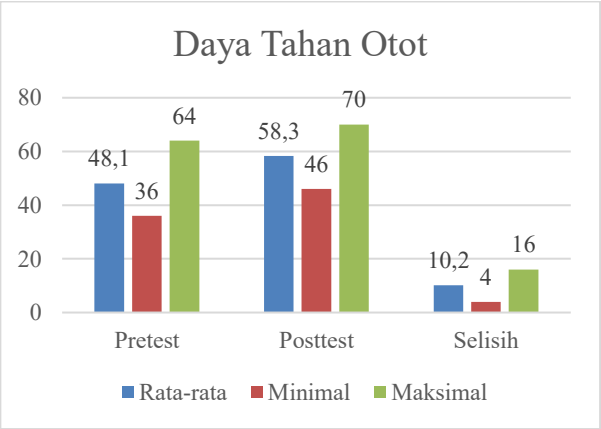
Muscular endurance data was obtained based on measurements using lunges. The following are the pretest and posttest measurements using lunges:

Table7. Pretest Posttest Value of Muscle Endurance

	Pretest	Posttest	Difference
Average	48.1	58.3	10.2
Min	36	46	4
Max	64	70	16

Table 2 shows that the results of the pretest and posttest measurements of muscle endurance in athletes undergoing weight training therapy showed an average difference of 10.2. Based on the results and average pretest and posttest values of muscle endurance, it can be concluded that there was an increase in muscle endurance in athletes after being given weight training therapy.

The results of the pretest and posttest measurements of muscle endurance can be more clearly presented in the following bar chart.



Picture11. Pretest Posttest Muscle Endurance

2. Paired Sample t-test

A paired sample t-test was conducted to determine whether there was an increase in muscle endurance after 24 sessions of treatment on the research sample. The results of the paired sample t-test can be declared significant if the calculated t-value is greater than the table t-value and the sig. value is <0.05.

Muscle strength and endurance data were calculated based on pretest and posttest data from weight training therapy. The following is the paired sample t-test data:

Table8. Paired T-Test

Paired t-test					
Data	**Mean**	**t Count**	**t Table**	**df**	**Sig.**
Muscle Strength Pretest	-34,600	-3,960	1.72913	19	0.001
Muscle Strength Posttest					
Muscle Endurance Pretest	-10,200	-12,910	1.72913	19	0,000
Muscle Endurance Posttest					

Table 3 shows the results of the pretest-posttest data analysis of muscle strength, with a calculated t-value of 3.960 > t-table of 1.72913 and a significance value of 0.001 <0.05. For the pretest-posttest data of muscle endurance, the calculated t-value of 12.910 > t-table of 1.72913 and a significance value of 0.000 <0.05. From the overall results of the paired sample t-test, it can be concluded that the weight training therapy program for athletes has proven effective in increasing muscle strength and muscle endurance.

Based on the research results obtained, weight training therapy has been proven to have an effect on increasing muscle strength and muscle endurance in athletes. This can be seen from the average pretest and posttest results on muscle strength and muscle endurance. The average pretest results for muscle strength were 220.2 and the posttest was 254.8, indicating an increase in muscle strength, while for

muscle endurance, the average pretest value was 48.1 and the posttest was 58.3, indicating an increase in muscle endurance in athletes. The results of the study through paired sample t-test showed that there was a difference in the effect of weight training therapy on increasing muscle strength and muscle endurance with a sig value <0.05. These results prove that weight training therapy is effective in providing an effect of increasing muscle strength and muscle endurance in athletes.

Weight training is exercise using weights to increase a person's ability to exert force with the goal of increasing strength, muscular endurance, hypertrophy, athletic performance or a combination of these goals.(Baechle & Earle, 2012). Weight training is widely used by athletes or sportspeople, because weight training is an activity that can be achieved in a short time, but can dramatically change body shape.(Baechle & Earle, 2014)Weight training is a program designed to increase muscle strength and endurance through a progressive exercise program that loads the muscular system and causes physiological changes. In addition to focusing the load on the muscles, it also puts stress on the bones, strengthening and densifying them and preventing long-term bone injuries.(Nasrulloh & Prasetyo, 2021).

Weight training therapy using external weights and your own body weight can increase muscle strength and endurance. Weight training performed according to specific rules and intensities can cause injury to muscle fibers and connective tissue. This injury leads to muscle fatigue, which triggers the body's protective mechanisms to prevent further damage, allowing for recovery and the growth of new muscle fibers.

Muscle strength and endurance increase due to the enlargement of muscle fibers and increased muscle energy. This occurs due to structural changes resulting from physical exercise, both at the neuromuscular junction and in the muscle fibers.(Brahmin Rangga et al., 2022). Good muscle strength and endurance can have a positive impact on the performance of every athlete.(Hughes et al., 2018). Greater muscle strength and endurance can improve the ability to perform general sports skills.(Suchomel et al., 2016).

CONCLUSION

Exercise therapy using external weights and body weight has been shown to increase muscle strength and endurance in athletes. The study showed a 34.6% increase in muscle strength and 10.2% increase in muscle endurance, with a significance level of <0.05. Weight training therapy can be recommended for athletes and the general public to improve physical fitness by increasing muscle strength and endurance.

This study can serve as a reference for further research using larger samples, multiple sample groups, and a control group to determine the accuracy of the results. Weight training therapy can serve as a reference for sports therapy for therapists and the healthcare sector.

BIBLIOGRAPHY

1. Baechle, T. R., & Earle, R. W. (2012). Fitness Weight Training. United States: Human Kinetics.
2. Baechle, T. R., & Earle, R. W. (2014). Weight Training Steps to Success. United States: Human Kinetics.
3. Brahmana Rangga, P., Mulyono, S., & Hanafi, M. (2022). Pengembangan Fitness. Samudra Biru.
4. Hastjarjo, T. D. (2019). Rancangan Eksperimen-Kuasi. Buletin Psikologi, 27(2), 187–203. https://doi.org/10.22146/buletinpsikologi.38619
5. Hughes, D. C., Ellefsen, S., & Baar, K. (2018). Adaptations to Endurance and Strength Training. Cold Spring Harbor Perspectives in Medicine, 8(6). https://doi.org/10.1101/cshperspect.a029769
6. Kurnia, M. (2013). Dan Lari Di Lapangan Terhadap Daya Tahan Kardiorespirasi the Effect of Fartlek Exercise With Treadmill and Running. Jurnal Wahana, 3, 1–13.
7. Masrun. (2022). Pengaruh Latihan Plyometrix Terhadap Kemampuan Daya Ledak Otot Tungkai Pemain Bolavoli. Jurnal Gladiator, 2(1), 25–34.
8. Nasrulloh, A., & Prasetyo, K. D. A. (2021). Dasar-Dasar Latihan Beban. Uny Press, August 2018, 1–140. https://docplayer.info/163394993-Dasar-dasar-latihan-beban-ahmad-nasrulloh-yudik-prasetyo-krisnanda-dwi-apriyanto.html
9. Nasution, A. I. V., Nusri, A., Hasibuan, N., Ginting, A. A., & Ratno, P. (2015). Pengaruh Latihan Beban Terhadap Kekuatan Otot Tungkai. Jurnal E-Biomedik, 3(1), 13–21. https://doi.org/10.35790/ebm.3.1.2015.8075
10. Schoenfeld, B. J., Grgic, J., Van Every, D. W., & Plotkin, D. L. (2021). Loading Recommendations for Muscle Strength, Hypertrophy, and Local Endurance: A Re-Examination of the Repetition Continuum. Sports, 9(2), 1–25.

11. Suchomel, T. J., Nimphius, S., & Stone, M. H. (2016). The Importance of Muscular Strength in Athletic Performance. Sports Medicine (Auckland, N.Z.), 46(10), 1419–1449. https://doi.org/10.1007/s40279-016-0486-0
12. Suhendra, Y. (2021). Efektivitas Manipulasi Topurak Terhadap ROM, Nyeri, Dan Skala Fungsi Sendi Ankle Pada Tlet Garuda Projomansari Sport (GPS) Futsal Batul. Skripsi UNY.

PREPARATION OF CELLULOSE-GLYCEROL-BETEL EXTRACT AS AN ECO FRIENDLY AND ANTIBACTERIAL MEMBRANE

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Abstract. The utilization of liquid waste from tofu production has not been maximized to produce useful materials. This study aims to utilize liquid waste from tofu production to produce environmentally friendly membranes with the addition of glycerol plasticizers and betel leaf extract and to determine the characteristics of the resulting membranes. Soya nata de soya cellulose was fermented for 10 days by acetobacter xylinum bacteria from tofu wastewater with the addition of glycerol plasticizer at various concentrations, namely 3%, 6%, 9%, and 12% (v/v), then the product was soaked in betel leaf extract for 1 and 3 days to obtain an antibacterial composite. Degradation tests were conducted using the weight reduction method. The characteristics of the resulting composites were determined based on mechanical tests, hydrophobicity, antibacterial properties, and degradability.The antimicrobial test on the cellulose composite is in the moderate category, with a moderate inhibition zone of 5.25 mm for a maximum of 9 hours for E. coli bacteria and a weak category of 4 mm for S. aureus. The cellulose-6% glycerol-betel leaf extract membrane coated in 1 day is very environmentally friendly because it can degrade up to 90% if stored in the soil for 4 weeks.

INTRODUCTION

Wastewater from tofu production is one type of wastewater that has a negative impact on the environment (Viogenta et al., 2022), because it has high BOD and COD levels. This waste does not yet have significant economic value, even though it still contains around 40–60% protein, 25–50% carbohydrates, and around 10% fat (Putri et al., 2022). Therefore, this waste needs to be processed into a more useful product, even one with high economic value, one of which is to make it into an antibacterial and environmentally friendly membrane. This membrane could potentially be used as a substitute for plastic packaging, paper, or other environmentally unfriendly materials.

Cellulose is a renewable material, but cellulose derived from plants requires a long time to process. Waste liquid from tofu production can be converted into cellulose through a fermentation process. In addition, the cellulose produced is environmentally friendly because it is easily decomposed by nature (biodegradable). Nata De Soya contains one hundred percent cellulose (Rahadi et al., 2020). Fermented cellulose still needs to be modified to have the characteristics suitable for its intended use. The cellulose base made from nata is still rigid, so plasticizers need to be added to make the cellulose more elastic, flexible, and water-resistant. In addition, for use in the health sector, it is sometimes necessary to add

The increase in glycerol concentration in composite manufacturing affects moisture content, thickness, elongation, and tensile strength (Kalsum et al., 2020). Packaging made from cellulose composites also needs to be supplemented with antibacterial agents to inhibit the growth of microorganisms when used as packaging. The antibacterial agents used can be derived from natural materials that have high antibacterial activity, one of which is green betel leaf. Natural phenols have an antiseptic power five times stronger than ordinary phenols because they can be toxic in protoplasm, precipitate cell proteins in bacteria, and penetrate bacterial walls (Azmi et al., 2023). The essential oil content in green betel leaves consists mostly of betephenol, which acts as an antibacterial agent (Dwi anggraini et al., 2013). In addition to being an antibacterial agent, the combination of essential oil content in betel leaves can act as an antioxidant and antifungal agent (Anggraini & Masfuatun 2017, Setiari et al., 2019). Several studies have discussed the synthesis of cellulose from tofu liquid waste, but studies on cellulose composites with added antibacterial agents are still limited. In addition, variations in glycerol concentration, the ratio of glycerol to antibacterial agents, and the duration of immersion in betel leaf extract often result in different cellulose characteristics, so further research is needed.

METHODE

Production of Cellulose–Glycerol – betel extract membranes

Cellulose-glycerol membranes are produced through a fermentation method, where a mixture of waste water from tofu production and glycerol in certain concentrations of 0%, 3%, 6%, 9% (v/v) are fermented using Acetobacter Xylinum bacteria at pH 4. Glacial acetic acid is used as a pH regulator. Sucrose and ammonium sulphate are also added during the fermentation process as sources of carbon and nitrogen. The bacterial cellulose film will form after 14 days. While the membrane of cellulose- glycerol- betel extract was made by coating method. The soaking time was varied at 1 and 3days.

Characterization of Cellulose–Glycerol – betel extract membrane

Characterization of the functional groups of sorbitol-cellulose-lemongrass oil films includes mechanical properties, film functional groups, water resistance, vapor absorption capacity, contact angle, and antibacterial activity and biodegradablity. The mechanical properties of the membrane was carried out using mechanical testing machine and the functional group analysis using an FTIR spectrophotometer at the FKG and Chemistry Research Laboratory UGM.

Characterization of Mechanical Properties

Mechanical properties of cellulose films which include tensile strength, percent elongation. Afterward, Young's modulus was calculated using the equation:

$$E = \frac{\varepsilon}{\sigma} \qquad (1)$$

Note:
E = Young's modulus
σ = tensile strength
ε= percent elongation

Hydrophobicity Determination of Membrane

The hydrophobicity of the film is determined through 3 tests, namely water resistance, water vapor absorption capacity and contact angle. Contact angle test used sessile drop method.

Water resistance was determined by immersing the dry film in distilled water for 1 minute. The amount of water absorbed was calculated by comparing the weight of the film before and after absorption, while water resistance was the difference between the initial percentage and the percentage of water absorbed.

The film's ability to absorb water vapor is done by hanging the film 5 cm from the water surface in a closed container. Then left for a certain time. Weighing is done after 24 hours. The amount of water vapor absorbed is calculated from the difference in weight before and after treatment.

Antibacterial Activity testing

Antibacterial activity testing was performed using the agar diffusion method against Escherichia coli and Staphylococcus aureus bacteria. Test samples measuring ± 5 mm in diameter were inoculated with 100 µl of bacteria in the medium, then incubated at 37ºC for 24 hours. The diameter of the inhibition zone was measured every 3 hours by measuring the length of the clear zone vertically (v), horizontally (h), and diagonally (d). Statistical testing was performed using the oneway ANOVA test.

$$restriction\ zone = \frac{v+h+d}{3} \qquad (2)$$

RESULT AND DISCUSSION

A. Physical and Mechanical Properties

The formation of cellulose with the addition of varying concentrations of glycerol as plasticizer through fermentation results in differences in colour appearance after the drying process. Cellulose produced from the fermentation of liquid waste from tofu production without the addition of glycerol is bright yellow and transparent, as shown in Figure 1. Figure 2 shows cellulose membranes after the addition of 3%, 6%, and 9% glycerol. It can be seen that the colour of the membrane darkens with increasing glycerol concentration. It is suspected that the addition of glycerol plasticizer causes the polymers in the cellulose structure to undergo gelatinization.

Figure 1. Cellulose

Figure 2. Apparition of a).Cellulose-3%glycerol; b). Cellulose- 6%glycerol c). Cellulose-9 % glycerol

Figure 3. Cellulose-6% Glycerol -betel extract 1days

The appearance of the modified membrane with betel leaf extract, which was soaked for one day, is shown in Figure 3. The color of the membrane became more evenly brown.

The addition of glycerol as a plasticizer is expected to improve the mechanical properties of cellulose. The effect of adding fermented glycerol plasticizer on tensile strength, elongation, and Young's modulus can be seen in Figure 4. Based on Figure 4, varying amounts of fermented glycerol plasticizer added to cellulose produce inconsistent tensile strength values. In 3% and 9% glycerol cellulose composites, there was a decrease in tensile strength, which could be caused by low hydrogen bonding, resulting in lower intermolecular bonds in the cellulose structure (Selpiana et al., 2016). The addition of glycerol plasticizer also affects the elongation percentage of cellulose. Figure 4 also shows that varying amounts of glycerol added as a plasticizer produce different elongation values. The highest elongation percentages were observed at glycerol concentrations of 6% and 9%, with nearly identical values of 19.05% and 19.25%. It can therefore be concluded that the best mechanical properties are produced by cellulose-6% glycerol.

Theoretically, the addition of plasticizers will increase the elongation value because glycerol has properties as a plasticizer that can increase the flexibility of cellulose (Fatnasari et al., 2018).

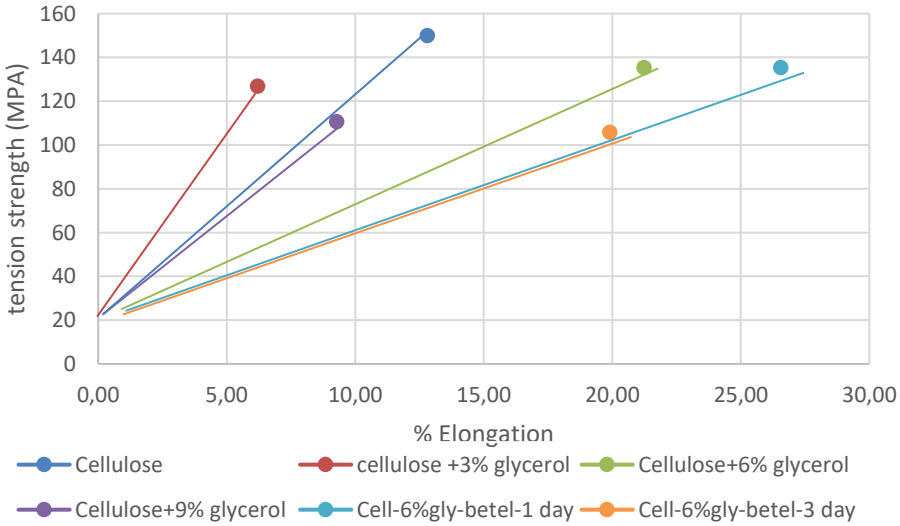


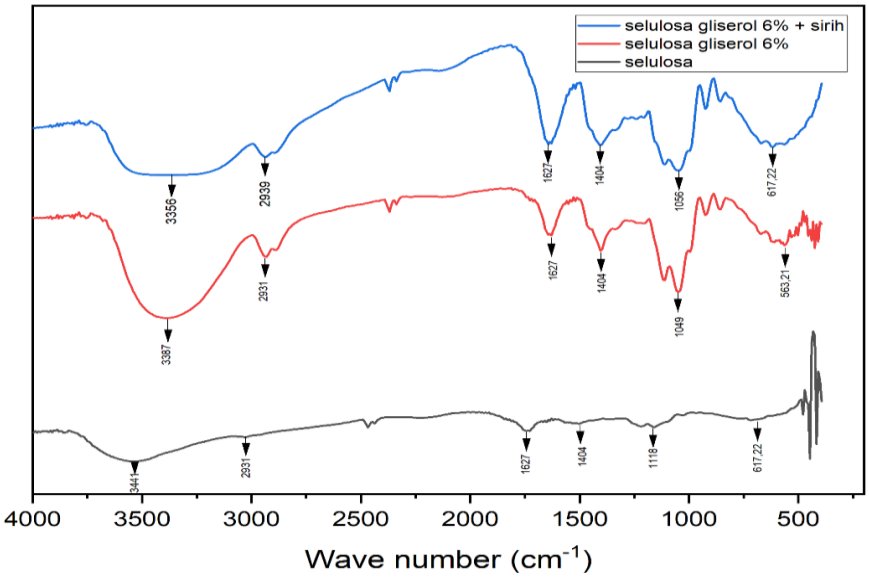
Figure 4. Mechanical properties of cellulose with the addition of glycerol at various concentrations and after immersing in betel extract for 1 and 3 days

Immersed cellulose-glycerol membranes in betel leaf extract for 1 and 3 days showed that the highest tensile strength was produced by the 6% cellulose glycerol-betel extract sample as shown in Figure 4 too . Overall, the tensile strength of cellulose-glycerol composites soaked in betel leaf extract decreased. This is like due to phenolic compounds and hydroxyl groups that are polar in nature, thereby reducing the strength and flexibility of the cellulose composite structure. But the percentage of elongation value is increased, but then decreased again, which may be due to an excess of matrix filler material, thereby reducing the flexibility of the cellulose. These results are supported by the research of Lesti et al. (2020), which states that the addition of antibacterial compounds can increase tensile strength, but at certain concentrations, tensile strength will decrease due to an excess of filler material in the cellulose matrix, thereby reducing the elasticity of the film.

This is likely due to phenolic compounds and hydroxyl groups being polar, thereby reducing the strength and flexibility of the cellulose composite structure. The percentage elongation value also increased at certain concentrations, but then decreased again, possibly due to an excess of matrix filler, thereby reducing the flexibility of the cellulose. These results are supported by research by Lesti et al. (2020), which states that the addition of antibacterial compounds can increase tensile strength, but at certain concentrations, tensile strength will decrease due to an excess of filler material in the cellulose matrix, thereby reducing the elasticity of the film. Figure 5 shows the mechanical test graph of the cellulose-glycerol betel leaf composite using the coating method. The mechanical test results of the coating method with a mixture of glycerol and betel leaf extract show

the effect on the mechanical properties of the cellulose film. The increase is likely due to the formation of hydrogen bonds between glycerol and the active compounds in betel leaf extract, thereby strengthening the interactions within the polymer matrix (Winarti et al., 2012; Nurlita et al., 2017).

B. FTIR Properties



FTIR spectrum analysis shows that the three samples, namely pure cellulose, 6% glycerol cellulose, and 6% glycerol cellulose + betel leaf, have similar absorption patterns. The main characteristic peaks of cellulose are the O–H group (around 3441–3356 cm-1), aliphatic C–H (2931–2939 cm -1), aromatic C=C (1627 cm-1), C–H bending (1404 cm-1), and glycosidic C–O–C (1049–1118 cm-1). The addition of glycerol causes a slight shift in the spectrum, especially in the O-H group, which is hydrophilic or easily absorbs water. Immersion in betel leaf extract also showed a similar spectrum, but the peak in the O-H group widened due to the presence of phenolic compounds in the betel leaf extract and more glycerol functional groups, resulting in a broader spectrum.

C. Hydrophobicity properties

The hydrophobicity of cellulose composites was analysed through three types of tests, namely water resistance, water vapor resistance, and contact angle.

The resistance of cellulose to water can be determined through a swelling test, which is the percentage of swelling of a polymer by water. The lower the water absorption, the higher the water resistance value, which means an increase in the quality of cellulose as a packaging material. Table 1 shows data related to the membrane's ability to absorb water or water vapor, which is determined by its resistance to water, water vapor and the size of the contact angle.

Sample	Water resistance (%)	Water vapor resistance (%)	Angle of contact
Cellulose	67,00	70,25	52,305 ^{O}
Cellulose- 6% glycerol	68,93	78,52	30,997 ^{O}
Cellulose- 6% glycerol -betel extract coating for 1 day	68,33	76,92	33,780 ^{O}

Table 1. Hydrophobicity properties of sample

Based on the table 1, the decrease in water resistance is related to the hydrophilic nature of glycerol, which contains hydroxyl groups and tends to increase water absorption due to the formation of spaces between polymer chains (Kalsum et al., 2020). Furthermore, soaking in betel extract also reduces water resistance due to

the hydrophilic nature of polyphenols. This is supported by research by Wijaya (2022), who found that the addition of certain antibacterial compounds can affect film solubility and depends on the chemical properties of the materials used.

Water vapor absorption was measured to determine the ability of cellulose composites to absorb water vapor. The lower the water vapor absorption, the higher the cellulose's resistance to water vapor, thus improving the quality of the cellulose composite as a packaging material.

The addition of 6% glycerol and soaking in betel extract increased water vapor absorption, thereby reducing cellulose's resistance to water vapor because glycerol contains hydrophilic hydroxyl groups, which readily absorb water. This can lead to reduced hydrogen bonds and the formation of intermolecular spaces within the polymer chains, allowing water vapor to easily diffuse into the cellulose. Furthermore, the extracted polyphenol compounds in betel leaves (Owu et al., 2020) are hydrophilic.

The contact angle is used to determine the contact strength between the cellulose surface and water. The contact angle value is related to the hydrophobicity of cellulose. The higher the contact angle value, the higher the hydrophobicity of the cellulose. Contact angle testing uses the sessile drop method, which is then analyzed using the ImageJ application, as can be seen in Table.1

D. Antibacterial Activity

This study used two types of pathogens: Staphylococcus aureus (gram-positive bacteria) and Escherichia coli (gram-negative bacteria). Antibacterial activity was determined by measuring the clear zone around the sample sphere. Chloramphenicol is an effective antibacterial against various pathogens, including both gram-positive and gram-negative bacteria, by eradicating the infection-causing bacteria and inhibiting their regrowth (Fitriana et al., 2020).

Tabel 2. Anti Bacterial Activity

E. coli bacteria	**Inhibition zone after**					
Sample	**0 hour**	**3 hours**	**6 hours**	**9 hours**	**12 hours**	**15 hours**
Positive control	0	0	19.3	**21.4**	22.2	21
Negative control	0	0	0	**0**	0	0
Cellulose-6% glycerol- 1 day coating betel extract	0	0	3.2	**5.25**	4.3	1.3
S aurus bacteria						
Positive control	0	0	19,5	19,5	21,3	20,75
Negative control	0	0	0	0	0	0
Cellulose-6% glycerol- 1 day coating betel extract	0	0	2,4	**4**	2,5	1,2

Antibacterial activity in 6% glycerol cellulose-betel leaf extract can be stated from the formation of a clear zone. The three samples have a clear zone diameter of approximately 5,25 mm. The classification of inhibition responses according to (Pan et al., 2009) shows that sample is in the medium category at 9 hours. Theoretically, betel leaf extract is more effective against gram-positive bacteria (S. aureus) than gram-negative bacteria (E. coli) because the cell wall of gram-positive bacteria is composed of several layers of peptidoglycan so that antibacterials are easy to damage the cell wall. However, in this study, the inhibition zone of E. coli bacteria was relatively larger than that of S. aureus. This may be due to the density factor of the bacteria used in the test medium. Supported by the study of Marfu'ah et al., (2021) green betel leaf extract against antibacterial S. aureus produced an average inhibition zone diameter that was classified as weak.

E. Degradation test

The degradation test was conducted using a weight reduction method, which involved burying the membrane in the soil to a depth of 5 to 10 cm. The membrane was then reweighed after a specified time. The weight loss was considered to be the membrane's degradation.

The degradation test was conducted using a weight reduction method, namely by burying the membrane in the soil, to a depth of 5 to 10 cm. Then the membrane was reweighed after a certain time. The lost weight was considered as the membrane degradation. Based on the results of the degradation test calculation on the cellulose-6% glycerol sample coated with betel extract for 1 consecutive day, it was 71.67% for week 1; 78.33% in the second week; 90.42% for week 4; and 95.83% for week 6. This shows that the resulting membrane degrades in a relatively short time. Therefore, it can be said that the resulting membrane is environmentally friendly.

CONCLUSION

The results showed that the addition of glycerol increased elasticity and elongation but reduced tensile strength in the cellulose composite. The 6% glycerol cellulose membrane soaked in betel leaf extract for 1 day exhibited maximum mechanical and hydrophobic properties. The antimicrobial test on the cellulose composite is in the moderate category, with a moderate inhibition zone of 5.25 mm for a maximum of 9 hours for E. coli bacteria and a weak category of 4 mm for S. aureus. The cellulose-6% glycerol-betel leaf extract membrane coated in 1 day is very environmentally friendly because it can degrade up to 90% if stored in the soil for 4 weeks.

REFERENCES

1. Anggraini, V., & Masfufatun, M. (2017). Efektivitas Kombinasi Ekstrak Daun Sirih Merah (Piper Crocatum) dan Ekstrak Biji Alpukat DAN EKSTRAK BIJI ALPUKAT (Persea americana) dalam Menghambat Pertumbuhan Candida albicans. Jurnal Kimia Riset, 2(2), 86. https://doi.org/10.20473/jkr.v2i2.6196
2. Azmi, A. F., Kamil, I., Fahiratunnisa, N. A., Pramita, J., Maulidia, Y., & Sari, R. (2023). Efektivitas Edible Coating Spray Gel Lidah Buaya (Aloe vera) dan Daun Sirih (Piper betle) Sebagai Sanitizer Pangan. PHARMACEUTICAL JOURNAL OF INDONESIA, 8(2), 157–164.
3. Bustanussalam, B., Apriasi, D., Suhardi, E., & Jaenudin, D. (2015). Efektifitas antibakteri Ekstrak Daun sirih (Piper betle Linn) terhadap Staphylococcus aureus ATCC 25923. FITOFARMAKA: Jurnal Ilmiah Farmasi, 5(2), 58–64. https://doi.org/10.33751/jf.v5i2.409
4. Drelich, J., Chibowski, E., Meng, D. D., & Terpilowski, K. (2011). Hydrophilic and superhydrophilic surfaces and materials. Soft Matter, 7(21), 9804–9828. https://doi.org/10.1039/c1sm05849e
5. Ekawati, L., Amri, A., & Bahruddin. (2018). Pengaruh Penambahan Graphene Oxide Terhadap Sifat Bioplastik Berbasis Pati Singkong. Jom Fteknik, 5(1), 1–4.
6. Fatnasari, A., Nocianitri, K. A., & Suparthana, I. P. (2018). The Effect of Glycerol Concentration on The Characteristic Edible Film Sweet Potato Starch (Ipomoea batatas L.). Scientific Journal of Food Technology), 5(1), 27–35.
7. Fitriana, Y. A. N., Fatimah, V. A. N., & Fitri, A. S. (2020). Aktivitas Anti Bakteri Daun Sirih: Uji Ekstrak KHM (Kadar Hambat Minimum) dan KBM (Kadar Bakterisidal Minimum). Sainteks, 16(2), 101–108. https://doi.org/10.30595/st.v16i2.7126
8. Fitriyanti, R. (2018). Penerapan Produksi Bersih Pada Industri Pulp Dan Kertas. Jurnal Redoks, 1(2), 16. https://doi.org/10.31851/redoks.v1i2.2025
9. Fuadi, A., Harismah, K., & Setiawan, A. (2015). Pengaruh Suhu dan pH Terhadap Banyaknya Yield (Kadar Glukosa) Yang Dihasilkan Pada Proses Hidrolisis Enzimatis Dari Limbah Kertas. Simposium Nasional RAPI, 179–185.
10. Hanifa, R., Amri, A., & Utami, S. P. (2018). Pengaruh Penambahan Graphene Oxide Terhadap Sifat Bioplastik Berbasis Sagu. Jom FTEKNIK, 5(1), 1–5.
11. Kalsum, U., & Robiah, Y. (2020). Pembuatan Bioplastik dari Ampas Tahu dan Ampas Tebu dengan Pengaruh Penambahan Gliserol dan Tepung Maizena. Distilasi, 5(2), 34–37.
12. Kusuma, M., Susilorini, T., & Surjowardojo, P. (2017). Pengaruh Lama Dan Suhu Penyimpanan Ekstrak Daun Sirih Hijau (Piper Betle Linn) Dengan Aquades Terhadap Daya Hambat Bakteri Streptococcus Agalactiae Penyebab Mastitis Pada Sapi Perah. TERNAK TROPIKA Journal of Tropical Animal Production, 18(2), 14–21. https://doi.org/10.21776/ub.jtapro.2017.018.02.3
13. Marfu'ah, N., Sha'sha, Luthfiana, & Ichwanuddin. (2021). Uji Potensi Antibakteri Staphylococcus aureus dari Ekstrak Etanol Daun Sirih Hijau (Piper betle L.). Pharmaceutical Journal of Islamic Pharmacy, 5(2), 1–10. https://doi.org/10.21111/pharmasipha.v5i1
14. Lesti, A., Cristy, G., Agustina, S., & Nata, I. F. (2020). Synthesis and Characterization of Starch-Based Functional Edible Film. Konversi, 9(2), 92–97. https://doi.org/10.20527/k.v9i2.9320
15. Lumempow, N. J., Ahmad, M., Usman, A. N., Stang, & Idrus, H. H. (2025). Comparison Of The Effectiveness Of Green Betel Leaf (Piper Betle L) And Red Betel Leaf (Piper Crocatum) Decoction Water Against Pseudomonas Aeruginosa Bacteria , One Of The Causes Of Vaginal Discharge In Vitro. Journal of Neonatal Surgery, 14(20), 166–174.
16. Nasution, H., Julianti, E., Dalimunthe, N. F., & Wulandari, G. (2021). The role of betel (Piper betle) leaf extract and glycerol on physical properties of bioplastic based on sago starch. IOP Conference Series: Earth and Environmental Science, 912(1). https://doi.org/10.1088/1755-1315/912/1/012042
17. Nurlita, D., Wikanastri, & Yusuf, M. (2017). Karakteristik Plastik Biodegradable Berbasis Onggok dan Kitosan Dengan Plastisizer Gliserol. Kajian Pangan Dan Gizi, 7(2), 1–12.

18. Owu, N. M., Fatimawali, ., & Jayanti, M. (2020). Uji Efektivitas Penghambatan Dari Ekstrak Daun Sirih (Piper Betle L.) Terhadap Bakteri Streptococcus mutans. Jurnal Biomedik:JBM, 12(3), 145. https://doi.org/10.35790/jbm.12.3.2020.29185
19. Pan, X., Chen, F., Wu, T., Tang, H., & Zhao, Z. (2009). The acid, bile tolerance and antimicrobial property of Lactobacillus acidophilus NIT. Food Control, 20(6), 598–602. https://doi.org/10.1016/j.foodcont.2008.08.019
20. Puthera, A. A. M. D., Agung, I. G. N., & Duniaji, A. S. (2013). Mempelajari Pengaruh Konsentrasi Ekstrak Rimpang Lengkuas (Alpinia galanga) Terhadap Pertumbuhan Aspergillus flavus Pada Kacang Tanah (Arachis hypogaea L.). Jurnal ITEPA, 2(1), 131–136.
21. Putri, Y. E., Nggina, A. S., Tanul, T. T., Alus, A. H., & Rofita, D. (2022). Pemanfaatan Limbah Cair Tahu Menjadi Pupuk Organik Cair (POC) di Ruteng, Kecamatan Langke Rembong Kabupaten Manggarai. Jurnal Pendidikan Dan Konseling, 4(5), 145–149.
22. Selpiana, Patricia, & Anggraeni, C. P. (2016). Pengaruh Penambahan Gliserol pada Pembuatan Bioplastik dari Ampas Tebu dan Ampas Tahu. Jurnal Teknik Kimia, 22(1), 18–24.
23. Setiari, N. M. N., Ristiati, N. P., & Warpala, I. W. S. (2019). Aktivitas Antifungi Kombinasi Ekstrak Daun Sirih (Piper betle) dan Ekstrak Kulit Buah Jeruk (Citrus reticulata) Untuk Menghambat Pertumbuhan Candida Albicans. Jurnal Pendidikan Biologi Undiksha, 6(2), 72–82.
24. Vifta, rissa laila, Wansyah, M. A., & Hati, A. K. (2019). Perbandingan Total Rendemen dan Skrining Antibakteri Ekstrak Etanol Daun Sirih Hijau (Piper Betle L.) secara Mikrodilusi. Journal of Science and Application Technology, 2(1), 87–93. https://doi.org/10.35472/281450
25. Viogenta, P., Khairunnisa, A., & Hadi, S. (2022). Pengolahan Limbah Cair Tahu sebagai Nata de Soya di Kalimantan Selatan. Jurnal Bakti Untuk Negeri, 2(1), 21–27.
26. Wijaya, A. R. (2022). Karakteristik dan Aktivitas Antibakteri pada Edible Film Berbasis Pati Ubi Kayu dengan Penambahan Minyak Cengkeh. IJCA (Indonesian Journal of Chemical Analysis), 5(2), 111–119. https://doi.org/10.20885/ijca.vol5.iss2.art6
27. Winarti, C., Miskiyah, & Widaningrum. (2012). Teknologi produksi dan aplikasi pengemas edible antimikroba berbasis pati. Jurnal Litbang Pertanian, 31(3), 85–93.
28. Wisnianti, D., Nasir, N., & Ode, W. (2024). Uji Aktivitas Antijamur Fraksi N - Heksan , Etil Asetat dan Air Daun Rambutan Aceh (Nephelium Lappaceum L .) Terhadap Pertumbuhan Candida Albicans. Jurnal Pharmacia Mandala Waluya, 3(6), 352–363.

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ECOLOGICAL REPRESENTATION IN A GERMAN LANGUAGE TEXTBOOK

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Abstract. The climate crisis has become a critical global issue, emphasizing the importance of incorporating ecological themes into education. This study investigates how ecological representation is manifested in the German language textbook Deutsch echt einfach A1.1, which is widely used in Indonesian senior high schools. Drawing on a qualitative approach and content analysis procedures, the study identifies and categorizes environmental themes that appear in textual and task-based activities. The findings reveal that ecological themes are present in reading (10 instances), speaking (6), writing (3), listening (3), and vocabulary recognition exercises (10). These results indicate that while the textbook integrates environmental issues, the representation remains limited to surface-level awareness without deeper critical engagement or action-oriented learning. The discussion highlights that ecological discourse tends to appear descriptively, reflecting a "weak sustainability" orientation. This study concludes that although Deutsch echt einfach A1.1 contributes to learners' initial exposure to ecological knowledge, it provides limited support for developing ecological literacy or critical reflection. Therefore, textbook developers and educators are encouraged to design and implement language learning materials that promote stronger ecological consciousness and foster learners' participation in sustainability efforts within and beyond the classroom.

Keywords: ecological, German language textbook, language learning

INTRODUCTION

The climate crisis has become an urgent topic in global discourse. As environmental degradation, biodiversity loss, and extreme weather events increase, there is a pressing need for pedagogical practitioners to engage in environmental issues, both to foster knowledge and to encourage responsible action. Education plays a central role in this endeavor: incorporating environmental themes in textbooks can develop learners' environmental awareness and attitude toward sustainability (Basya & Maulidia, 2024; Seli et al., 2025).

In Indonesia, such concerns are especially relevant, as the country is among the most biodiverse in the world yet faces severe environmental challenges, including deforestation, pollution, and climate change. Education systems must respond by embedding ecological themes into curricula and learning materials, thereby supporting students' growth as globally aware citizens committed to preserving the natural environment for all (Made Adi Andayani, Laelani Marda, & Fitriani, 2025).

This study examines how ecological representation appears in a selected German language textbook in Indonesia, Deutsch echt einfach A1.1. Specifically, the investigation focuses on the percentage of ecological themes in the textbook, as manifested in texts/utterances, in the context of classes for senior high school (SMA). By analyzing how often and in what manner ecology appears in the textbook, this research aims to assess whether and how the material contributes to global citizenship and environmental stewardship among learners.

The importance of this kind of study is threefold. First, it offers insights for textbook designers and curriculum developers about how well environmental concerns are integrated in foreign-language (FL) teaching resources (Ekasiwi & Bram, 2023). Second, it provides educators with evidence-based alternatives for motivating learners to become environmentally conscious and active participants in sustainability efforts (Basya & Maulidia, 2024). Third, in the context of the global climate crisis, such representational impacts are essential — they help cultivate an informed, engaged populace capable of involvement in ecological preservation at local and global scales.

Studies of Ecocritical Discourse Analysis (ECDA) in foreign-language textbooks have shown varying degrees of environmental messaging. For instance, Basya & Maulidia (2024) found in ELT textbooks for secondary schools that environmental issues are represented both in visual and verbal content, though with varying degrees of emphasis. In the Indonesian context, research on ELT textbooks examined how environmental values are framed (Made Adi Andayani et al., 2025) or how ecolinguistic topics occur in terms of topics and vocabulary (Ekasiwi & Bram, 2023). Scholars argue that educational materials in Indonesia sometimes still face constraints such as underqualified teachers, traditional pedagogical methods, and

examination-driven curricula, which limit opportunities for meaningful engagement with ecological issues (Seli et al., 2025; Made Adi Andayani et al., 2025).

These studies suggest a gap in the foreign language textbook domain: there is relatively little published about ecological representation in German FL textbooks in Indonesia. This study aims to fill that gap by providing empirical data concerning the selected textbook, thereby contributing to theory, practice, and policy in environmental education.

LITERATURE REVIEW

Ecology in contemporary scholarship transcends purely biological definitions and encompasses the study of interrelations among living organisms, non-living environment, social systems, and human ethical-political responsibility toward environmental sustainability. In educational contexts, environmental/ecological literacy is understood as integrating knowledge of ecological systems, affective awareness, and action / behaviour oriented toward preserving natural systems. Textbooks serve not only as carriers of factual content but also as mediators of value systems: they shape what themes become salient, how agency is allocated (human vs non-human), what metaphors are used to talk about nature, and what kinds of environmental action are rendered feasible or desirable.

The role of textbooks in fostering environmental awareness has been explored in multiple studies. For example, Triyono, Sahayu & Margana (2023) conducted a multimodal ecocritical discourse analysis on English textbooks used in Indonesian senior high schools and found that while eco-beneficial discourse is frequent, higher-order environmental skills (e.g. ability to critically evaluate environmental issues, propose creative solutions) are relatively rare; visual representations tend similarly toward environmentally positive imagery but often lack depth in prompting action or sustained responsibility.

Similarly, Ekasiwi & Bram (2023) in their "Ecolinguistic Topics in Indonesian English Textbooks" study found that only some official ELT textbooks include ecolinguistic themes in topics, words, or sentences, and that not all do. In "Ecological Literacy Values in Indonesian Language Textbook for Senior High …", Suwandi, Zainnuri & Yunus (2019) show that textbooks under the Indonesian curriculum 2013 emphasize ecological knowledge and environmental issues more than affective, behavioural, or cognitive-skill components of ecological literacy.

From a theoretical lens, the discipline of ecolinguistics, particularly following Stibbe (2014/2015), offers tools such as analysis of salience, agency, transitivity, metaphor, and framing to uncover how discourses in educational texts may either reproduce anthropocentric or shallow environmental thinking, or alternatively foster ecological consciousness and action. Although many existing textbook analyses (both in Indonesia and globally) report presence of environmental themes, they often find that the framing is informational or descriptive rather than action-oriented; non-human nature tends to be background rather than actor; and tasks in textbooks frequently lack the pedagogical design that encourages learner agency or critical reflection.

Indonesian case studies especially indicate institutional, curricular, and teacher-preparation constraints. How does Indonesian Secondary-ELT Textbook Shape Environmental Consciousness? by Basya & Maulidia (2024) uses ECDA to examine verbal and visual content in ELT textbooks and concludes that while environmental representation exists, its depth is limited and opportunities for integrating environmental awareness through activities are underutilized.

Another example, Analisis Ekolinguistik dalam Buku Teks Bahasa Indonesia for SMP/MTS class VII (2025) by Farahiba, Laksono & Nurhadi shows that ecolexicon is present and diverse in vocabulary, but discourse that could foster ecological intelligence is still weak in terms of action or transformation.

These findings suggest that in studying a German FL textbook with respect to ecological themes, both quantitative measures (percentage of texts/utterances/images containing ecology content) and qualitative/discourse analytic dimensions (agency, metaphor, policy of action vs description, visual as well as verbal framing) are necessary. Moreover, anchoring the analysis in the Indonesian socio-environmental context (e.g. issues such as deforestation, pollution, climate change, biodiversity) and educational policy constraints (examination focus, teacher preparation) would enhance relevance and potential for impact.

METHOD

This study employed a qualitative content analysis approach (Miles, Huberman, & Saldaña, 2014) to investigate the representation of environmental issues in the German textbook Deutsch echt einfach A1.1. The qualitative approach was chosen to allow a detailed and interpretative exploration of how ecological themes are integrated into the linguistic and pedagogical components of the textbook, rather than relying on numerical frequency alone. This method is particularly suitable for examining educational materials where meaning, context, and discourse are central to understanding (Creswell & Poth, 2018; Schreier, 2012).

Data Source

The primary data source in this study was the textbook Deutsch echt einfach A1.1, which is widely used in Indonesian senior high schools as a core instructional material for teaching German as a foreign language. The textbook was selected because of its alignment with the A1 level of the Common European Framework of Reference for Languages (CEFR), and its widespread adoption provides a representative sample of German learning materials in Indonesian secondary education contexts. The textbook includes multiple thematic units integrating vocabulary, grammar exercises, reading texts, and communicative tasks, which were systematically analyzed for environmental content.

Data Collection Technique

Data were collected through systematic observation and documentation techniques (Bowen, 2009). The researcher conducted a close reading of all textual and visual materials in the textbook to identify explicit and implicit references to environmental themes. The process involved four main steps: (1) observing the overall structure and thematic organization of the textbook, (2) examining each unit to locate environmentally related content, (3) recording excerpts and images representing ecological issues, and (4) categorizing these findings into thematic clusters. This process ensured that all environmental aspects were captured comprehensively and consistently across all language skills (listening, speaking, reading, and writing).

Data Analysis

The data analysis followed the framework proposed by Belgrave (1993) and Grave & Rein (1990), adapted to the context of textbook content analysis. The analysis proceeded in three stages. First, each unit of the textbook was examined to identify and count the occurrences of environmental issues (e.g., pollution, recycling, sustainable living, energy use). Second, the identified content was analyzed in terms of its relevance to language skills and communicative activities, determining whether environmental topics were presented through reading passages, dialogues, grammar exercises, or writing tasks. Finally, the findings were categorized according to the depth and type of environmental engagement—whether the content merely mentioned environmental issues superficially or encouraged critical reflection and behavioral awareness among learners.

This analytical framework was supported by the qualitative coding techniques described by Miles et al. (2014), including data condensation, data display, and conclusion drawing/verification. Through iterative coding, the researcher refined categories and identified patterns of environmental integration within the linguistic and cultural components of the textbook. Triangulation was achieved through repeated reading and peer debriefing to enhance the credibility and reliability of the analysis (Lincoln & Guba, 1985).

RESULTS

The analysis of Deutsch echt einfach A1.1—a German language textbook widely used in Indonesian senior high schools—revealed a selective yet noticeable presence of ecological themes throughout its chapters. Ecological topics were identified in reading activities (10 instances), speaking activities (6 instances), writing tasks (3 instances), listening exercises (3 instances), and vocabulary recognition activities (10 instances). These findings suggest that while ecological elements are integrated into the material, their representation is uneven across language skills, with a clear predominance in receptive and lexical domains rather than productive communicative contexts.

The high frequency of ecological content in reading texts indicates that the textbook primarily uses reading passages as a vehicle for environmental education. Many of these texts introduce fundamental environmental issues, such as Umweltschutz (environmental protection), Recycling, Natur und Tiere (nature and animals), and Energie sparen (energy saving). These topics are presented in simple, descriptive narratives that suit the cognitive and linguistic level of A1 learners. Reading passages often depict daily actions—such as turning off lights, separating waste, or appreciating natural beauty—which help students relate environmental awareness to real-life behavior. However, the analysis also found that most of these texts are informative rather than critical: they transmit knowledge and vocabulary but seldom invite learners to reflect on environmental responsibility or explore problem-solving perspectives. This is consistent with Cates (2013) and Tomlinson (2012), who argue that ecological representation in many foreign language textbooks tends to be surface-level, focusing on exposure rather than critical engagement or behavioral change.

In speaking activities, ecological topics appeared in six instances, usually accompanying reading passages or visual prompts. Learners were occasionally asked to discuss simple questions such as “Was machst du für die Umwelt?” (“What do you do for the environment?”) or to describe eco-friendly habits. While such activities provide a communicative context for expressing opinions, they remain limited in depth. Learners are not challenged to debate controversial issues, consider ethical dimensions, or connect their ideas to broader global contexts. This limited scope reflects the tendency, as noted by Byram (2008) and Gómez-Rodríguez (2010), for foreign language materials to avoid critical or political engagement in favor of neutral topics. Consequently,

while students may learn to talk about ecology using simple structures, the textbook provides few opportunities for developing critical environmental literacy.

The writing tasks included only three instances related to ecology, such as describing a clean environment, writing short notes about daily eco-friendly actions, or composing sentences using new environmental vocabulary. These tasks reinforce grammatical accuracy and vocabulary recall but provide minimal space for argumentation or personal reflection. Writing, as emphasized by Freire (2000), can be a transformative tool for articulating values and social change; however, in this textbook, it serves mainly as a language practice activity, not as a medium for ecological expression. This gap illustrates what Stibbe (2014) calls the "silencing" of deeper ecological discourse in educational texts—where language practices normalize environmental care as a minor topic instead of framing it as an urgent social responsibility.

Similarly, listening exercises contained three ecological references, mainly in the form of short dialogues or audio clips about daily habits or classroom recycling activities. These serve as authentic language input, but the ecological message is often secondary to linguistic goals. While listening to real-life ecological situations can strengthen comprehension and cultural awareness, the limited number of instances suggests that auditory modes are underutilized for developing ecological sensitivity. According to Dörnyei and Ushioda (2013), engagement and emotional resonance are key factors in language motivation, implying that more interactive or affective listening materials—such as interviews, news, or stories about environmental heroes—could enhance both listening competence and ecological empathy.

Interestingly, the vocabulary recognition activities contained ten ecological items, equaling the number found in reading tasks. Words related to die Umwelt (environment), der Müll (trash), die Natur (nature), and das Wasser (water) were introduced through matching tasks, labeling exercises, and picture-based quizzes. This indicates that the textbook designers recognize the importance of introducing environmental terminology as part of basic communicative competence. Nevertheless, vocabulary tasks often remain decontextualized and isolated from real discourse, which can limit learners' ability to use the words meaningfully. As Tomlinson (2012) and Ekasiwi & Bram (2023) note, ecological vocabulary gains true pedagogical value only when embedded in authentic communicative contexts that allow learners to negotiate meaning and reflect on its relevance.

Overall, the findings show that Deutsch echt einfach A1.1 integrates ecological content moderately and asymmetrically, emphasizing recognition and comprehension over production and reflection. The ecological materials in the textbook provide a useful entry point for environmental awareness but do not fully realize the transformative potential of ecopedagogy—that is, learning that cultivates critical thinking and moral responsibility toward nature (Freire, 2000; Cates, 2013). The textbook thus aligns with what Stibbe (2014) terms weak sustainability discourse: it encourages care and conservation in a general sense but avoids questioning the deeper socio-economic structures behind environmental degradation.

In the Indonesian educational context, where curriculum goals increasingly emphasize environmental literacy and global citizenship (Seli et al., 2025; Made Adi Andayani et al., 2025), such findings highlight the need for textbook developers to go beyond vocabulary and factual knowledge. Integrating ecological themes in a balanced way across all four language skills could enable learners to internalize sustainability values not only cognitively but also affectively and behaviorally. This approach would align with Basya and Maulidia (2024), who advocate for action-oriented ecological education—a framework that positions students as active agents of environmental change through communicative tasks, reflection, and collaboration.

In summary, while Deutsch echt einfach A1.1 contributes to environmental awareness at a foundational level, its pedagogical design still treats ecology as a complementary rather than central aspect of language learning. To fully support the vision of education for sustainability, future textbook revisions and classroom implementations should adopt more critical and interactive ecopedagogical strategies—linking linguistic competence with ecological consciousness, intercultural understanding, and global responsibility.

CONCLUSION

This study set out to explore how ecological themes are represented in the German language textbook Deutsch echt einfach A1.1, which is widely used in Indonesian senior high schools. Through qualitative content analysis, the study identified the presence of ecological topics across different language skill areas—reading (10 instances), speaking (6), writing (3), listening (3), and vocabulary recognition (10). The findings demonstrate that while the textbook incorporates environmental content, its integration remains imbalanced and primarily descriptive, with a stronger emphasis on reading comprehension and vocabulary recognition than on productive or critical engagement.

The dominance of ecological representation in receptive skills indicates that learners are mostly positioned as consumers of environmental information rather than as active participants in sustainability discourse. Activities related to speaking and writing seldom extend beyond surface-level discussions or sentence construction, offering limited opportunities for learners to reflect critically on environmental challenges or to connect language learning with ecological citizenship. This finding aligns with previous research on

environmental discourse in language textbooks (Cates, 2013; Tomlinson, 2012; Stibbe, 2014; Ekasiwi & Bram, 2023), which suggests that ecological content is often presented as a peripheral rather than central pedagogical focus.

Despite these limitations, Deutsch echt einfach A1.1 still provides a useful entry point for fostering environmental awareness in foreign language education. The presence of eco-related vocabulary, texts, and dialogues introduces students to key environmental concepts within authentic communicative contexts. However, the ecological narratives embedded in the textbook largely reflect weak sustainability discourse—that is, they promote awareness and care without challenging learners to critically question the socio-cultural and economic systems contributing to environmental degradation (Stibbe, 2014).

In light of Indonesia's urgent environmental challenges—deforestation, pollution, and biodiversity loss—the role of education in shaping ecological consciousness becomes indispensable (Made Adi Andayani et al., 2025; Seli et al., 2025). Therefore, foreign language textbooks such as Deutsch echt einfach A1.1 hold great potential as vehicles for ecopedagogy, capable of linking language learning with global citizenship and sustainability values. To realize this potential, textbook designers, curriculum developers, and educators should move beyond factual representation and integrate action-oriented, reflective, and participatory ecological content.

Future textbook development should ensure that environmental issues are addressed through balanced tasks across all four language skills, encouraging learners not only to understand but also to discuss, write about, and act upon ecological concerns. Integrating project-based learning, problem-solving tasks, and intercultural comparisons related to sustainability could deepen learners' ecological literacy while enhancing communicative competence. In doing so, foreign language education would not only teach language for communication but also language for transformation—empowering students as global citizens who can think critically, act responsibly, and contribute meaningfully to the sustainability of life on Earth.

REFERENCES

1. Basya, D., & Maulidia, B. A. (2024). How does Indonesian Secondary-ELT Textbook Shape Environmental Consciousness? An Ecocritical Discourse Analysis. Proceedings of English Linguistics and Literature, 4 (Reconnecting with Nature through Literature, Language, & Culture). Retrieved from proceeding.unnes.ac.id
2. Basya, D., & Maulidia, R. (2024). Environmental awareness through ELT materials: A pathway to sustainability education. Journal of Language Teaching and Learning Studies, 7(2), 122–136.
3. Belgrave, L. L. (1993). Content analysis of textual materials in educational research. Educational Research Review, 18(3), 215–228.
4. Bowen, G. A. (2009). Document analysis as a qualitative research method. Qualitative Research Journal, 9(2), 27–40.
5. Byram, M. (2008). From foreign language education to education for intercultural citizenship. Multilingual Matters.
6. Cates, K. A. (2013). Teaching for a better world: Global issues and language education. Humanizing Language Teaching, 15(3), 1–9.
7. Creswell, J. W., & Poth, C. N. (2018). Qualitative inquiry and research design: Choosing among five approaches (4th ed.). Sage Publications.
8. Dörnyei, Z., & Ushioda, E. (2013). Teaching and researching motivation (2nd ed.). Routledge.
9. Ekasiwi, A. N., & Bram, B. (2023). Ecolinguistic Topics in Indonesian English Textbooks. Interference: Journal of Language, Literature, and Linguistics, 4(1). Retrieved from ojs.unm.ac.id
10. Ekasiwi, F. R., & Bram, B. (2023). Ecolinguistic content in Indonesian ELT textbooks: A critical discourse perspective. Indonesian Journal of Applied Linguistics, 13(1), 85–97.
11. Farahiba, A. S., Laksono, K., & Nurhadi, D. (2025). Analisis Ekolinguistik dalam Buku Teks Bahasa Indonesia Siswa Kelas VII SMP/MTS Edisi Revisi. Jurnal Bastra (Bahasa dan Sastra), 10(1), 242–250.
12. Freire, P. (2000). Pedagogy of the oppressed (30th Anniversary ed.). Continuum.
13. Gómez-Rodríguez, L. F. (2010). The cultural content in EFL textbooks and what teachers need to do about it. Profile: Issues in Teachers' Professional Development, 12(2), 33–46.
14. Grave, H., & Rein, M. (1990). Textbook analysis in foreign language education. Cornelsen.
15. Lincoln, Y. S., & Guba, E. G. (1985). Naturalistic inquiry. Sage Publications.
16. Made Adi Andayani, T., Laelani Marda, I., & Fitriani, I. (2025). The representation of environmental awareness in the Indonesian ELT textbook for senior high school students. IDEAS: Journal on English Language Teaching and Learning, Linguistics and Literature, 13(1). Retrieved from ejournal.iainpalopo.ac.id
17. Made Adi Andayani, L., Marda, L., & Fitriani, N. (2025). Framing ecological values in Indonesian ELT textbooks. EduLingua Journal, 9(1), 55–70.

18. Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). Qualitative data analysis: A methods sourcebook (3rd ed.). Sage Publications.
19. Schreier, M. (2012). Qualitative content analysis in practice. Sage Publications.
20. Seli, F. Y., Manar, M., Hardono, A. A., & 'Aini, S. (2025). A critical eco-perspective in English textbook for Indonesian 12th graders: A case on nationally issued textbook. ETERNAL (English Teaching Journal), 16(1), 169–186. Retrieved from journal2.upgris.ac.id
21. Seli, M., Pradana, A., & Nuraini, R. (2025). Challenges in integrating environmental awareness into EFL classrooms in Indonesia. Journal of Education for Sustainability, 5(2), 88–101.
22. Stibbe, A. (2014). Ecolinguistics: Language, ecology and the stories we live by. Routledge.
23. Suwandi, S., Zainnuri, H., & Yunus, A. (2019). Ecological literacy values in Indonesian language textbook for senior high school students published by Ministry of Education and Culture. Journal of Physics: Conference Series. Retrieved from OUCI.
24. Tomlinson, B. (2012). Materials development for language learning and teaching. Language Teaching, 45(2), 143–179.
25. Triyono, S., Sahayu, W., Margana, M., & Fath, S. N. (2023). Ecological discourse and environmental education in English textbooks: A multimodal eco-critical discourse analysis. 3L: Language, Linguistics, Literature® – The Southeast Asian Journal of English Language Studies. Retrieved from ejournals.ukm.my

A Comparative Study of I Wayan Mudita Adnyana's Prasi Works and Traditional Balinese Prasi

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Abstract. This study aims to understand and describe in depth the similarities and differences between the Prasi artwork of I Wayan Mudita Adnyana and Traditional Balinese Prasi. Additionally, it seeks to explore and introduce traditional Balinese local values with the hope of contributing to the development of Prasi in Indonesia. The analytical focus of this research emphasizes aspects related to the visual language of modern Prasi and traditional Prasi, including forms of wayang (shadow puppets), clothing, jewelry, attributes, animals, buildings, composition, space, and writing. The method used is descriptive qualitative research. Descriptive research utilizes data sources from the Prasi artwork of I Wayan Mudita Adnyana and traditional Indonesian wayang stories, supported by opinions from respondents consisting of Prasi artists and art critics knowledgeable about the issues addressed. The sampling is adjusted according to the sources used, such as library sources, proportionally selected informants, and "purposive sampling," along with historical data records and direct field notes. To obtain objective data, this research uses data collection techniques, including observation supported by photographic documentation, documentation techniques, and interviews. To analyze the artwork, a comparative study is used to compare the visual language of modern Prasi with traditional Prasi, identifying the similarities and differences between modern Prasi and traditional Prasi that depict classic Indonesian wayang stories. The data analysis model in this process involves three main elements: data reduction, data presentation, and conclusion drawing/verification, as interconnected steps before, during, and after data collection.

Keywords: Comparative Study of Modern Prasi Artwork by I Wayan Mudita Adnyana, Traditional Prasi.first, second, and third level headings (first level heading)

BACKGROUND

Bali is an island known for its natural beauty, with a society that is agrarian, religious, and advanced in culture and tourism. Hindu culture came to Bali, influencing and blending with the indigenous culture, resulting in a unique Balinese culture (with its own distinct characteristics). Religious factors and its geographical conditions greatly support the development of this culture. Bali is home to a variety of arts, such as visual arts, music (karawitan), dance, sculpture, and many others, all of which are still preserved and developing to this day. Prasi art is one of the visual arts that is still preserved and continuously produced in Bali. Prasi art uses lontar leaves as the medium, and a special tool called "Pengutik" or "Pengrupak" (a knife made of steel) is used to write or draw on the lontar leaves.

From the 10th to the 15th centuries, Balinese literature was influenced by Javanese Hindu literature. During this time, the royal family of Warmadewa introduced lontars from Java, such as the Sanghyang Kemahyanikam lontar, which was written during the reign of King Sindok in East Java, and introduced works like Purwadigama, Cimasesana, Astasaparwa, Candrakirana, and others. Later, during the Gelgel kingdom era, Prasi art, alongside other forms of art, reached high-quality standards. According to the book "Monografi Daerah Bali," the Gelgel period (1380-1690) was considered Bali's golden age, during which high-quality artistic works were created.

With the arrival of the Western nations, Western culture influenced Balinese art, making it even richer and more developed, in line with the development of the times, including Prasi art. After 1930, many well-known Prasi artists emerged, including I Ketut Badung, I Wayan Mudita Adnyana, I Gusti Bagus Sudiasta, and many others. In this study, the author is interested in researching the Prasi works of I Wayan Mudita Adnyana and comparing them with traditional Balinese Prasi. The study focuses on changes in the Prasi work of I Wayan Mudita Adnyana, including changes in lines, forms/positions of human heads, bodies, animals, trees/plants, stones, mountains, clouds, and the perspective in his work titled Gugurnya Salya.

Definition of Traditional Prasi

Prasi is a form of traditional visual art from Bali, known for its unique characteristic of being created on lontar leaves. Suwidja (no date) states that "prasi is an illustration made on lontar leaves" (p. 4). This shows that prasi is not just a drawing, but also a cultural expression using a natural medium long known in the Nusantara tradition. In the introduction of Gedong Kirtya Singaraja, it is explained that prasi is "lontar with illustrations (drawings) etched with a pengrupak" (Gedong Kirtya Singaraja, 1975, p. 4). The pengrupak is a small knife made of steel used to etch the lontar leaves, producing distinctive lines and illustrations. This technique highlights a special skill that has been passed down through generations in Balinese art tradition.

Poerwadarminta (1976) in the Kamus Umum Bahasa Indonesia explains that lontar refers to a palm tree (Borassus), the leaves of which are used for writing, as well as the ancient manuscripts written on lontar leaves (p. 377). Thus, lontar not only serves as a writing medium but also as a cultural documentation tool with high historical value. Suwidja (no date) further adds that the term lontar is a metathesis of the word "rontal," which comes from Old Javanese. The word rontal consists of "ron" meaning leaf and "tal" meaning the rontal tree. This term has been known since the early 10th century, even before the reign of King Balitung. This explanation emphasizes that prasi art has deep historical roots and is closely tied to the development of ancient literacy in Indonesia. Studies on prasi not only focus on its technical and historical aspects but also include aesthetic and social functions. Prasi often serves as a medium for visual narratives that contain moral teachings, epic stories, or legends that live within Balinese society. Thus, prasi plays a dual role as a work of visual art as well as a cultural communication medium. Over time, prasi has undergone visual changes, especially with the emergence of modern Balinese artists like I Wayan Mudita Adnyana, who explored new styles. However, despite the variations in form, the fundamental principles of line usage, proportions, composition, and etching techniques remain the main features that distinguish prasi from other forms of visual art. This shows that prasi has been able to adapt to the dynamics of the times without losing its traditional identity.

As traditional Balinese illustration art, prasi cannot be separated from the basic concept of illustration itself. According to the Kamus Latin–Indonesia, the word illustration means appearance, grandeur, light, or the brilliance of a vivid depiction. As a verb, the term "ilustrasi" means "to illuminate, brighten, make real, perform, decorate, or radiate" (Kamus Latin–Indonesia, no date). From this definition, illustration can be understood broadly, encompassing various forms of art that aim to clarify, beautify, or animate, including music, drama, film, and books.

Poerwadarminta (1976) in the Kamus Umum Bahasa Indonesia explains that illustration specifically means decoration with images, paintings, diagrams, or graphics that help explain the content of a book (p. 377). Thus, illustration is applied visual art that serves to complement texts, providing additional explanation and clarifying meaning.

A similar opinion was expressed by Robert Roos in his book Illustration Today, where he states, "Illustration, as used in the title of this book, means drawings or other pictorial representation intended for elucidation or adornment—representation with individuality, color, and excitement that stimulate and motivate to action" (Roos, no date, p. xx). This means that illustration is a visual representation intended to explain or adorn a text, with unique characteristics, full of color, and capable of evoking emotions and encouraging specific actions.

Wallace S. Baldinger (in the study of modern illustration) also mentions that "illustration itself [is a] picture made for a specific text and designed to help a reader visualize the characters and action of the story" (Baldinger, no date, p. xx). This statement clarifies that illustration directly helps bring narratives to life and assists readers in visualizing characters and storylines.

Meanwhile, Soedarso Sp. (1990) in his book Tinjauan Seni emphasizes that illustration art falls into the category of applied art, meaning art dedicated to other purposes. He gives the example of illustrations in short stories in magazines or diagrams of tree cross-sections in biology books. According to him, "often, the illustrations will explain more than the words accompanying them" (Soedarso, 1990, p. xx).

From these definitions, it can be concluded that illustration is an image or painting that accompanies a text or manuscript with the aim of clarifying, illuminating, or decorating. In the context of prasi art, illustration takes the form of two-dimensional images on lontar leaves, functioning just like illustrations in books, that is, to illuminate, clarify, animate, or adorn the text or stories they accompany.

To clarify the understanding of the term traditional, the Kamus Besar Bahasa Indonesia (KBBI) defines "traditional" as something that is passed down through generations, based on customs and traditions, and inherited from one generation to the next (KBBI V, 2016). This definition aligns with Poerwadarminta's (1976) explanation that the term "traditional" comes from the English word "tradition," meaning customs, so "traditional" means in accordance with time-honored customs.

Fowler (in the study of cultural anthropology) adds that tradition can be defined as customs inherited from one generation to another, including customary laws, mythological stories, artistic principles, and literary

traditions based on the collective experiences of society. Thus, tradition includes both material and non-material aspects passed down consistently from one generation to the next.

Based on these explanations, prasi can be understood as traditional Balinese illustration art passed down through generations. Ancient Balinese prasi is not just a drawing on lontar leaves but also part of a cultural heritage containing artistic principles, visual techniques, and literary values that have been preserved from generation to generation.

Historical Background of Prasi

Discussing Balinese prasi art cannot be separated from the cultural context in which it developed. According to G. M. Sudarta, the history of Balinese art began with the history of Bali itself. During the Majapahit period, when the kingdom expanded its influence to Bali, Javanese Hindu art spread its influence to the island, encouraging a shift away from primitive culture and megalithic art. Sudarta affirms that "the Balinese took over Javanese Hindu art, aligning it with their own tastes. From here, art began to develop with its own unique characteristics, namely Balinese art" (Sudarta, no date, p. xx).

Stutterheim, in his study of Balinese art history, divides its development into three periods. The first is the Hindu Bali period (8th–10th century), marked by the development of Indian or Javanese-style sculptures. The second is the Old Bali period (10th–13th century), during which Indian influence was adapted into a more simplified Balinese style. The third is the Medieval Bali period (13th–14th century), which marks the transition to modern Balinese art (Stutterheim, no date, p. xx).

Claire Holt adds that traditional Balinese art began to take shape in the Medieval Bali period in the 13th century. One of the forms that emerged was prasi art, which is the art of drawing on lontar leaves, a tradition that continues to this day (Holt, 1967). Ketut Ginarsa, in his book The Lontar (Palmyra) Palm, explains that "in the past, because paper had not yet existed in the archipelago, lontar leaves were used to write babads, kekawins, prasi illustrations, and other things" (Ginarsa, no date, p. xx). This shows that prasi is not only a visual artwork but also a written medium and a form of visual literature.

P. M. D. Purnata emphasizes that the reign of Dalem Baturenggong in Gelgel in the 16th century marked the peak of Balinese literature and art, including prasi. According to him, "the Gelgel era was Bali's golden age, during which high-quality artworks were created" (Purnata, no date, p. xx). However, foreign influences, especially after the arrival of the Dutch in the early 20th century, led to an aesthetic shift and directed Balinese visual art towards commercial art for tourism (Wardhana et al., no date, p. xx).

Prasi types, based on the content of the lontar, can be classified into seven major groups, including Weda, Agama, Wariga, Itihasa, Babad, Tantri, and Lalampahan. Among these, prasi based on literary works from Kakawin, Kidung, Parwa, and Tantri stories is the most popular. I Ketut Suwidja confirms that "the prasi we encounter today, based on its story content, can be divided into four major genres from literature: Kakawin, Kidung, Parwa, and Tantri" (Suwidja, no date, p. xx).

The visual style of prasi often features characters from wayang (shadow puppetry). According to I Ketut Suwidja, "the images on lontar leaves are taken from wayang characters or figures from wayang" (Suwidja, no date, p. xx). Classical prasi paintings are known for the distinctive Kamasan style. I Made Kanta explains that wayang Kamasan, or the Kamasan style of painting in Bali, uses only two-dimensional shapes but still conveys high expression and beauty (Kanta, no date, p. xx).

Thus, prasi art can be understood as the result of the long history of Balinese culture, influenced by Javanese Hinduism, lontar traditions, and wayang aesthetics. It is a visual art as well as a form of pictorial literature passed down through generations and remains alive in both traditional and modern contexts.

RESEARCH METHOD

In this study, the applied method is qualitative with a hermeneutic approach enriched by the views of Paul Ricoeur. The emphasis on language as the primary place of meaning reflects the essence that thought manifests in language as the primary container of meaning. Hermeneutics, as a method of interpretation, is applied to understand complex Visual texts, particularly in interpreting the symbols in the Prasi artwork of I Wayan Mudita Adnyana. This approach requires a deep understanding of the meaning of these symbols, particularly in the context of prasi, representing a careful and meaning-rich interpretive approach (Hadi, 2014).

Location and Time

This research was conducted in Tenganan Pagringsingan, Karangasem, Bali, focusing on the Prasi artwork of I Wayan Mudita Adnyana and comparing it with traditional Balinese prasi. The study examines the changes in the prasi works of I Wayan Mudita Adnyana, including changes in lines, shapes/positions of the human head, body, animal forms, trees/plants, stones, mountains, clouds, and perspective in his work titled Gugurnya Salya.

Sampling Technique

The sampling technique used is purposive sampling, where the sample is selected in the field based on its relevance to the research design. The researcher directly determines the sample based on the essential characteristics of the population, which are already known in advance, thus considered sufficiently representative. The essential characteristics, and the strata to be represented, depend on the judgment or assessment of the researcher (Nasution, 2000: 98). This sampling technique is used to select data with a specific purpose in mind. In this way, the selected data can be trusted according to the needs of the research.

Research Design

The implementation of this research is designed to begin with observation as an introduction by visiting the prasi visual artists to gather initial information. Afterward, the type of prasi visual art to be analyzed is determined, along with the methods and techniques of data collection, data collection instruments, data reduction, data analysis techniques, inferences, and the research schedule. The target output of this research is an international journal. Additional outputs include a national seminar and publication in national media.

RESULTS AND DISCUSSION

In this research report, the author outlines the stages of the research and the data obtained. The study was conducted in three stages: preparation, implementation, and data presentation. The preparation stage involved creating a list of questions and a checklist of factors to be researched, preparing documentation tools such as tape recorders and cameras, as well as planning the research schedule and budget. The research object focused on the Prasi artwork of I Wayan Mudita Adnyana, compared with traditional Balinese prasi.

The implementation stage involved direct observation, photographic documentation, and interviews. The research began on May 22, 2025, at I Wayan Mudita Adnyana's house in Tenganan Pagringsingan, Karangasem. Subsequently, documentation of traditional prasi was conducted at the Art Center in Denpasar on May 28, 2025. Interviews were conducted with several sources, including I Gusti Bagus Sudiasta, I Nyoman Sukadana, Ida Bagus Sugata, I Ketut Suwidja, I Wayan Turun, and I Gusti Bagus Nyoman Panji, who are also well-known Balinese art critics.

The data presentation stage was carried out in a descriptive and tabular manner, highlighting the factors of change in I Wayan Mudita Adnyana's prasi works when compared to traditional prasi. To clarify the background, a biography of the artist is also presented, including the natural, social, religious, and artistic environment that influenced his work.

I Wayan Mudita Adnyana was born in 1928 in Tenganan Pagringsingan, Karangasem, into a family of musicians who made the *genggong* musical instruments and weaved fabrics. From a young age, he showed a talent for drawing and later pursued prasi art, often imitating traditional works and studying the Kamasan style. His works often feature themes from epic stories such as the Mahabharata, Ramayana, and Sutasoma. The technique used is etching with a knife (pengrupak) on lontar leaves, followed by the application of black ink made from a mixture of candlenut charcoal and oil. His distinctive prasi style includes the use of perspective, light-dark contrasts, and dimensional effects that differ from traditional prasi. His works have been awarded by the Regent of Karangasem (1973), the Governor of Bali, Ida Bagus Mantra (1984), and the Dharma Kusuma Madia Award (1987).

One of the stories analyzed in this study is *Salya Gugur*. This story tells of Salya, the king of Madradesa, who initially planned to join the Pandavas but was persuaded by Duryodhana to side with the Kauravas. In the Bharatayudha war, Salya became the commander of the Kaurava army after Karna's death. Eventually, he was killed by Yudistira after a fierce battle. The tragedy continued when his wife, Dewi Setyowati, committed suicide upon discovering her husband's body. This story not only highlights political conflict and a great war but also depicts the moral values of loyalty and sacrifice in the Mahabharata epic.

Salya, the king of Madradesa (Madaraka) and the brother of Dewi Madri—the mother of Nakula and Sahadewa—heard that the Pandavas were camping at Upaplavya (Kuru Setra), preparing for a great war. Salya immediately mobilized his large army to join the Pandavas. It was mentioned that his entourage was so large it required a resting area of over 20 km².

The news of Salya's departure reached Duryodhana. He ordered his officers to greet Salya and his army with special services: providing all necessities, luxuries, and entertainment without shortage. This reception made all of Salya's soldiers feel satisfied and happy, for which Salya was very grateful. Believing that all this kindness came from the Pandavas, Salya intended to repay the favor by supporting them. However, this reception was actually a scheme by Duryodhana.

When Duryodhana met Salya—who was actually his father-in-law, since Salya's daughter, Banowati, was his wife—he expressed his gratitude and honor for Salya's reception. With sweet words, Duryodhana requested Salya and his army to side with the Kauravas. Initially shocked, Salya eventually could not refuse because he felt he had received so much kindness during his stay. Thus, he agreed to assist the Kauravas in the Bharatayudha war.

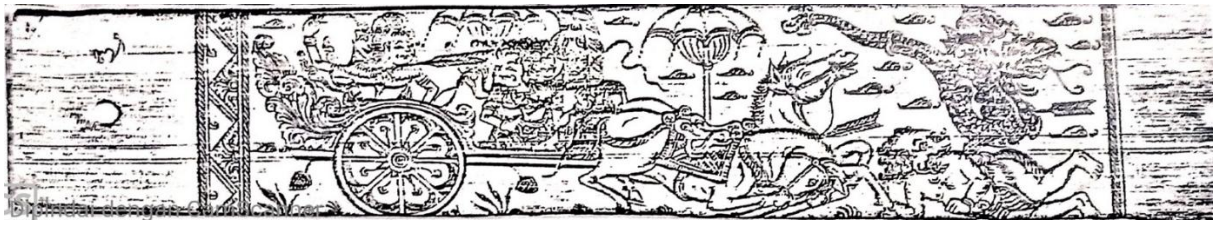
After Karna fell on the seventeenth day of the war, Salya was appointed as the supreme commander of the Kauravas. This made the Pandavas uneasy, as their own uncle was now leading the opposing side. At Krishna's suggestion, Nakula—Salya's favorite nephew—was sent to meet his uncle that night. Nakula offered to be killed to allow Salya to atone for his sins. However, Salya refused, stating that the Pandavas would surely win because they were on the righteous side. He also added that he could only be defeated by a virtuous person. Nakula then returned and relayed the message to Krishna and his brothers.

The next day, Salya went to war. His wife, Dewi Setyowati, filled with anxiety, tied her cloth to Salya's cloth to stay connected, but Salya secretly cut the tie so his wife would not wake up.

On the eighteenth day of the war, Yudistira (Dharmawangsa) directly faced his uncle in battle. Their fierce combat ensued. Yudistira showered Salya with arrows, severely wounding him, then threw a divine spear that pierced Salya's body. Finally, Salya fell at the hands of Yudistira.

Meanwhile, on the other side of the battlefield, Bhimasena fulfilled his vow to destroy all the sons of Dhritarashtra. He killed them one by one until only Duryodhana remained.

After the war ended, Dewi Setyowati searched for her husband's body among the pile of casualties. When she found him, she could not contain her grief and stabbed herself with a kris, ending her life and following Salya.



In the story of Karna's death, it is told that he died on the seventeenth day of the Bharatayudha war after being struck by an arrow from Arjuna in his neck. Afterward, the position of the commander was taken over by Salya.

In the traditional Balinese prasi (Figure 1):

Karna is depicted with the arrow still lodged in his neck, while Salya is looking towards him. The faces of both figures are shown in a three-quarter view from the front, while their bodies face straight ahead. Karna's chariot appears intact, the wheels remain sturdy, and his horses are detailed: one horse bows its head with a wide saddle, and the other horse groans with an arrow lodged in its neck. In front of the horse is a dragon, also struck by an arrow in its neck, with a giant figure beneath the dragon depicted crouching to avoid the arrow. The giant is shown with a three-quarter view of the face, but its body faces forward. At the bottom, plants are visible but no rocks, and at the top, there are two umbrellas and cloud-like decorations (aun-aun) filling the empty space.

CONCLUSION

This study shows that prasi, as one of Bali's traditional visual arts, has undergone a dynamic development from traditional forms to modernity, as illustrated in the comparison between traditional prasi works and those of I Wayan Mudita Adnyana.

Both traditional prasi and I Wayan Mudita Adnyana's prasi are rooted in the same media, technique, and themes, i.e., drawing on lontar leaves with a pengrupak tool, and both draw from the Mahabharata or Ramayana epics. Visual elements such as wayang figures, animals, trees, and ornaments remain key features, thus the modern works maintain continuity with the tradition.

Traditional Balinese prasi emphasizes iconic iconography: characters are depicted frontally, faces shown in a three-quarter view, the space is filled with decorative ornaments (horror vacui), and the narrative is collective and sacred. Its function focuses more on cosmic symbolism and the continuity of tradition. In contrast, I Wayan Mudita Adnyana's prasi introduces innovation through the use of perspective, realism, volume, light-dark contrasts, and empty space. The characters are depicted from various angles, trees and backgrounds appear more plastically, and the atmosphere of war is visualized more dramatically. This highlights the shift in aesthetics towards a more empirical and individual visual experience.

In traditional prasi, war is depicted as a cosmic drama, part of a collective myth, where realistic details are not the primary focus. However, in Mudita Adnyana's works, war is not only a mythical symbol but also a human experience: there is room for the reality of conflict, suffering, and even philosophical reflection, such as in the conversation between Krishna and Arjuna.

Traditional prasi represents the horizon of collective culture, emphasizing order, symbolism, and continuity of customs. Mudita Adnyana's works open a new horizon: prasi is no longer just a medium for sacred stories but

also a modern art expression that allows for interpretative freedom, presenting experiences of space, depth, and realism.

The shift from tradition to modernity in prasi demonstrates that Balinese culture is dynamic and adaptive, capable of assimilating external influences without losing its core identity. Modern prasi art serves as evidence that tradition can continue to thrive by transforming, becoming a relevant creative medium in contemporary visual arts while still rooted in local values.

REFERENCES

1. Baldinger, W. S. (1974). *Illustration and Visual Communication*. New York: Dover Publications.
2. Duija, I. N. (2019). Prasi: Karya Kreatif Estetik Unggulan Bali (Sebuah Studi Teo-Antropologi). *Mudra Jurnal Seni Budaya*, 34(1), 19–29.
3. Firmansyah, I. (2021). Representasi Visual Prasi untuk Mempertahankan Kearifan Lokal Masyarakat Bali pada Era Disruptif 4.0. *JADECS (Journal of Art, Design, Art Education & Cultural Studies)*, 6(1).
4. Fowler, H. W. (1974). *The Dictionary of Modern English Usage*. London: Oxford University Press.
5. Poerwadarminta, W. J. S. (1976). *Kamus Umum Bahasa Indonesia*. Jakarta: Balai Pustaka.
6. Hadi, S. (2014). *Hermeneutika: Interpretasi dalam seni dan kebudayaan*. Jakarta: Penerbit Prenada Media.
7. Nasution, S. (2000). *Metode penelitian naturalistik-kualitatif*. Bandung: Tarsito.
8. Ricoeur, P. (1976). *Interpretation theory: Discourse and the surplus of meaning*. Fort Worth: Texas Christian University Press.
9. Roos, R. (1976). *Illustration Today*. London: Thames & Hudson.
10. Soedarso, S. P. (1990). *Tinjauan Seni*. Yogyakarta: Gadjah Mada University Press.
11. Suardana, I. W. (2014). Aspek-Aspek Ikonografi Penggambaran Tokoh Ramayana Seni Prasi di Desa Sidemen Karangasem Bali. *Patrawidya: Seri Penerbitan Penelitian Sejarah dan Budaya*, 15(1), 11–28.
12. Sutrisno, M. (2020). Teori Estetika dalam Kesenian Tradisional Nusantara. *Jurnal Seni dan Budaya Nusantara*, 12(2), 45–56.
13. Suwidja, I. K. (1990). *Mengenal Prasi*. Denpasar: Pustaka Bali.

EXPERIMENTAL STUDY OF SOFTWARE DEFINED RADIO (SDR) USING UNIVERSAL SOFTWARE RADIO PERIPHERAL (USRP) B210 FOR THE DEVELOPMENT OF WIRELESS AND MOBILE DIGITAL COMMUNICATION IN 5G AND 6G

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Abstract. The rapid evolution of fifth-generation (5G) wireless communication technologies and the emerging prospects of sixth-generation (6G) systems necessitate research platforms that are highly flexible, adaptive, and reconfigurable. One promising approach is Software Defined Radio (SDR), which decouples traditional hardware functions and implements them through software-based signal processing. This study aims to evaluate the performance of wireless communication systems utilizing LoRa technology and Software Defined Radio (SDR). Frequent transitions in communication standards often require hardware replacement, resulting in substantial costs for users and service providers, particularly within communities of limited economic resources. SDR offers a practical solution by allowing modifications to communication standards through software without the need for hardware replacement. This research presents an experimental investigation of SDR implementation using the Universal Software Radio Peripheral (USRP) B210 for the development of mobile wireless digital communication systems. The experimental methodology involves configuring the USRP B210 hardware, designing communication system models via GNU Radio Companion, and evaluating the performance of digital signal transmission and reception. Experimental results demonstrate that the USRP B210 effectively supports various frequency and modulation schemes relevant to 5G and 6G implementations, providing flexibility in channel parameter configuration and efficiency in rapid prototyping. These findings confirm that SDR with USRP B210 represents an effective and scalable research testbed for the development of next-generation wireless communication systems, facilitating the transition toward intelligent, adaptive, and service-oriented 6G networks. Keywords: Software Defined Radio (SDR); Universal Software Radio Peripheral (USRP) B210; 5G; 6G; GNU Radio Companion; Wireless Communication Systems

INTRODUCTION

Wireless telecommunication systems have evolved rapidly and brought significant impacts to users. Each technological advancement introduces a new communication standard, and since most of these advancements are implemented in hardware, users are often forced to replace their existing devices. For instance, when cellular subscribers using first-generation (1G) networks transition to second-generation (2G) services, they must purchase new 2G-compatible devices, rendering the previous equipment obsolete. Similarly, such changes in communication standards compel network operators to incur high costs to upgrade their infrastructure and improve service delivery.

In response to these challenges, the concept of a flexible radio system controlled by software running on hardware emerged. In this approach, changes in radio communication standards require only software updates rather than new hardware acquisition. This system is known as Software Defined Radio (SDR), first introduced by Joseph Mitola in 1991.

In 2001, Matt Ettus launched an FPGA-based SDR platform designed for high-frequency digital signal processing, known as the Universal Software Radio Peripheral (USRP) version 1.0. Later, in 2008, Ettus introduced USRP version 2.0. More recent models, including the USRP B200, B210, and N210 series, feature more compact designs and broader operating frequency ranges (50 MHz to 6 GHz) with high-speed Analog-to-Digital Converters (ADC) operating at 100 Ms/sec and 400 Ms/sec.

The integration of SDR platforms using USRP and computers demonstrates the core characteristics of flexibility, reconfigurability, and reprogrammability of hardware components in building SDR-based communication systems (Mitola, 2000; Reed, 2002).

The issue of hardware dependency due to evolving communication standards also arises in the development of Internet of Things (IoT) systems. The diversity of hardware types and specifications often complicates the design of wireless IoT systems. Variations in communication standards—such as differences in radio frequencies, modulation types, data bit rates, and communication protocols—pose significant challenges to implementing robust and interoperable wireless IoT networks.

A previous study (2024) successfully installed and operated an Ettus-compatible USRP B210, demonstrating its capability to run demo programs for 5G communication. However, limitations in supporting hardware components, such as antennas and computer specifications, continued to present challenges. Incompatibility between the antenna and the 5G operating frequencies (2.5 GHz and 3.6 GHz) required the transmitter and receiver to be positioned extremely close (within 0.5 to 1 cm), which is unrealistic for wireless communication scenarios. Moreover, computer hardware components—such as RAM capacity, number of processor cores, CPU speed, and storage performance—were insufficient to efficiently run 5G mobile communication applications.

This study addresses two key research questions:

(a) What types of hardware components (antennas and computer specifications) are suitable to enable optimal operation of USRP for 5G communication?

(b) How can demo program parameters—such as frequency, modulation type, and data rate—be modified to allow USRP B210 to communicate with other devices operating under different standards?

The outcomes of this research are expected to contribute significantly to the further development and optimization of USRP B210 for implementing next-generation wireless, cellular, and mobile communication technologies from 5G toward 6G.

LITERATURE REVIEW

Development of Radio Communication Technology

Wireless telecommunication systems have evolved rapidly and brought significant impacts to their users. Each new technological advancement leads to the emergence of a new communication standard. Unfortunately, every technological change has traditionally been implemented in hardware form, forcing users to continually replace their existing devices.

For example, when mobile subscribers using first-generation (1G) communication standards migrated to second-generation (2G) services, they were required to purchase new 2G-compatible devices, rendering the previous equipment obsolete. Likewise, network operators also faced substantial hardware costs when transitioning to newer generations due to differences in communication standards.

In response to these challenges, the idea emerged to create a flexible radio system that could be controlled and reconfigured through software running on a hardware platform. In this concept, changes to radio communication standards would only require software modifications rather than new hardware acquisition.

Mitola (1991) proposed a flexible radio system consisting of hardware and software platforms capable of executing radio functions. This system supports the dynamic modification of communication standards through software updates alone. The concept was later known as Software Defined Radio (SDR) (Mitola, 2000; Reed, 2002).

SDR is a type of radio that utilizes software to perform functions such as modulation techniques, wideband or narrowband operations, communication security (e.g., frequency hopping), and waveform requirements for current and future standards across broadband frequency ranges. In short, SDR is a technology in which software runs on a hardware platform equipped with a Digital Signal Processor (DSP) or Field Programmable Gate Array (FPGA) to implement radio functions such as modulation in the transmitter and demodulation in the receiver entirely through software.

This concept began to materialize when Matt Ettus introduced an FPGA-based SDR platform named Universal Software Radio Peripheral (USRP) version 1.0 in 2001 and version 2.0 in 2008 (Popescu, 2017). Both USRP v1.0 and v2.0 were modular systems consisting of a main board and daughter boards with different frequency ranges. In later developments, newer versions such as USRP B200, B210, and N210 were designed as compact, non-modular units capable of operating across a wide frequency range—from DC up to 6 GHz—and featuring Analog-to-Digital Converters (ADC) and Digital-to-Analog Converters (DAC) operating at speeds of 100 Ms/sec and 400 Ms/sec, respectively.

Parallel to the advancement of SDR technology through the USRP series, in 2016, a new SDR variant known as RTL-SDR began to enter the market. The RTL-SDR functions as a radio and television receiver equipped with a USB interface for computer connectivity. Both USRP and RTL-SDR platforms demonstrate the core characteristics of SDR technology: flexibility, reconfigurability, and reprogrammability, allowing hardware platforms to be dynamically adapted for various wireless communication systems (Mitola, 2000; Reed, 2002).

SDR technology can be implemented in both military and commercial radio applications. Furthermore, its use has expanded to a wide range of wireless communication standards, including Bluetooth, WLAN, GPS, Radar, WCDMA, GPRS, CDMA, and GSM. These applications illustrate the versatility and transformative

potential of SDR in supporting multi-standard, software-driven communication environments suitable for next-generation systems such as 5G and 6G.

Software Defined Radio (SDR)

Figure 1 illustrates the general architecture of a Software Defined Radio (SDR) system (Riyanto et al., 2007). The SDR architecture consists of an antenna, a wideband RF signal amplifier, analog-to-digital (ADC) and digital-to-analog converters (DAC) for high-frequency RF signals, and a Field Programmable Gate Array (FPGA) processor.

In the SDR receiver configuration, the analog RF signal captured by the antenna is first amplified by the wideband RF amplifier. The analog RF signal is then converted into a digital RF signal by the ADC. Subsequently, this digital RF signal is processed by a high-speed digital signal processor (DSP) or FPGA, which performs radio receiver functions through software algorithms. The processor output is a digital information signal identical to the information transmitted by the sender.

Conversely, the SDR transmitter operates in the opposite manner. The digital information signal is processed by the DSP to perform digital modulation and other signal processing functions, resulting in a digital RF signal. This digital signal is then converted into an analog RF signal by the DAC and amplified using a wideband RF amplifier before being transmitted via the antenna.

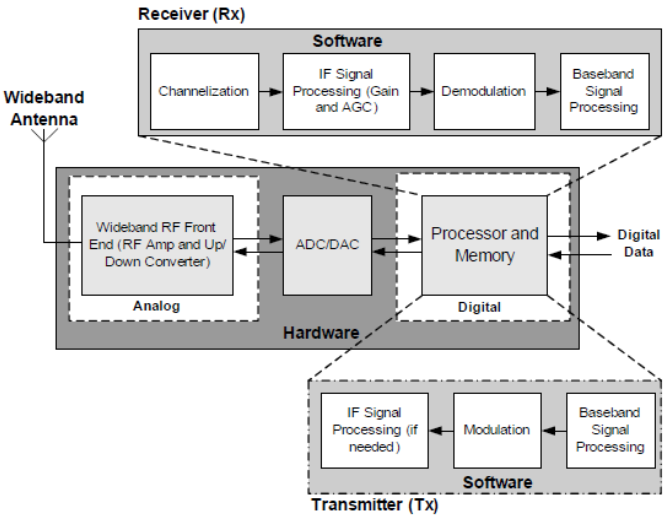

FIGURE 1. General SDR Architecture.

Based on this description, it is evident that the SDR platform can execute multiple radio functions depending on the software implemented by the processor. This demonstrates that SDR possesses flexibility, reprogrammability, and reconfigurability (Mitola, 2000).

In practical implementation, SDR provides several advantages when used as a data communication gateway in Internet of Things (IoT) systems, including:

1. Flexibility – radio functionality can be modified or reconfigured through software without changing hardware components.
2. Multiservice capability – a single radio device can support multiple communication services.
3. Multistandard operation – SDR can operate across various communication standards such as GSM, AMPS, GPRS, DECT, GPS, WCDMA, CDMA, and WiMAX.
4. Multiband support – the system can operate over a wide range of frequencies, extending up to the gigahertz (GHz) range.
5. Reconfigurability – the system configuration can be modified dynamically to adapt to different communication standards.
6. Reprogrammability – software updates can be downloaded and installed without requiring new hardware.

SDR systems can adapt to different wireless communication standards—multiband and multistandard—without requiring new physical hardware. As commercial wireless networks evolve from 2G to 2.5G/3G, 4G, 5G, and eventually 6G, each generation introduces unique link-layer protocols. These variations often create compatibility challenges for consumers, network operators, and equipment vendors. SDR technology mitigates these challenges by requiring only software updates on the DSP or FPGA processors, rather than costly hardware replacements. Consequently, users are no longer compelled to purchase new handsets for each new

generation, and network operators can reduce infrastructure costs during standard migration, as the same hardware can support multiple generations through software-defined configuration.

Furthermore, SDR systems provide operational simplicity. Selecting or switching radio systems merely requires activating the desired software module. Similarly, developing new radio systems or services can be achieved efficiently through software design and testing. SDR technology also supports the advancement of radio communication by bridging different air interfaces and link-layer protocols used across regions—for instance, GSM/TDMA networks prevalent in Europe versus IS95/CDMA networks dominant in the United States. Such compatibility allows global interoperability for mobile users traveling internationally.

In addition, SDR technology supports over-the-air (OTA) software updates for user devices, enabling network operators to function similarly to handset vendors. Operators can perform mass customization of handsets by remotely uploading updated software versions, thereby accelerating the deployment of new services. Manufacturers can also enhance system performance and address deficiencies by distributing improved software versions directly to end-user devices.

Despite its many advantages, SDR also presents certain challenges. It requires RF front-end and antenna systems capable of supporting multiple frequency bands and transmission power levels associated with various radio systems. The ADC used in SDR must meet specific criteria to handle diverse radio environments, including:

1. A high sampling rate (above 100 mega samples per second, MSPS) to accurately capture RF signals.
2. A wide dynamic range, adaptable to different communication systems (e.g., approximately 91 dB for GSM).
3. A high bit resolution, ideally 12 bits or more.
4. Minimal error sources, such as low jitter, reduced thermal noise, and minimal quantization errors.

In summary, SDR represents a transformative technology in wireless communication systems, offering flexibility and adaptability that align with the continuous evolution of network standards from 4G toward 5G and 6G networks.

Universal Software Radio Peripheral (USRP)

Mitola's vision began to materialize when Matt Ettus introduced the FPGA-based Software Defined Radio (SDR) known as the Universal Software Radio Peripheral (USRP), version 1.0 in 2001 and version 2.0 in 2008 (Popescu, 2017). The USRP v1.0 and v2.0 were designed as modular systems, consisting of a main board and interchangeable daughter boards, each supporting different frequency ranges.

In subsequent developments, newer versions of the USRP became more compact and non-modular, such as the B200, B210, and N210 series. These models offer frequency coverage from DC up to 6 GHz, with Analog-to-Digital Converters (ADC) and Digital-to-Analog Converters (DAC) operating at sampling rates of 100 Ms/s and 400 Ms/s, respectively.

As SDR technology evolved through the USRP platform, a more affordable alternative appeared in 2016 with the introduction of RTL-SDR, a low-cost SDR receiver for radio and television signals featuring a USB interface for computer connectivity. Both USRP and RTL-SDR platforms exemplify the core SDR characteristics of flexibility, reconfigurability, and reprogrammability, enabling a single hardware device to perform diverse communication functions simply by modifying its software (Mitola, 2000; Reed, 2002).

SDR technology implemented through the USRP platform has found broad application across both military and commercial domains. Beyond traditional radio communication, SDR-based systems are now widely utilized in Bluetooth, WLAN, GPS, Radar, WCDMA, GPRS, CDMA, and GSM technologies.

Figure 2 illustrates the USRP B210 AD9361, a fully compatible model within the Ettus USRP B210 series, demonstrating high-performance capabilities for broadband digital communication systems.

(a) (b)

FIGURE 2. USRP B210 AD9361 Compatible with USRP B210 Ettus:

(a) Rear view; (b) Front view.

LoRa dan Arduino-Uno

In addition to using USRP for observing Software Defined Radio (SDR), this study employs the Arduino UNO® R3 board as the data communication control platform and the LoRa RFM98W 433 MHz module as the radio communication device. A vertical antenna is used in this setup. The vertical antenna was chosen because it provides an omnidirectional radiation pattern, delivering equal signal strength in all directions. In contrast, horizontal antennas, such as half-wave dipoles, exhibit maximum radiation primarily in the front and back of the antenna (Kraus, 2003; Marpanaji, 2019; Marpanaji, 2023). This ensures greater flexibility in the positioning between the Gateway and Node, as the radio waves are received consistently regardless of orientation.

The LoRa RFM98W 433 MHz module and Arduino UNO® R3 are assembled into both Gateway and Node units. LoRa is a low-power wireless technology operating over the radio spectrum. One key advantage of LoRa is its long communication range despite low transmission power, which can exceed 1 km under optimal environmental conditions. Its characteristics, including low power consumption, resistance to noise during data transmission, and long-range capability between Gateway and Node, make LoRa particularly suitable for Wireless Sensor Networks (WSN) and IoT applications.

There are several types of LoRa modules (Low Power Range Transceiver Modules). For example, HopeRF Microelectronics produces modules such as RFM95W, RFM96W, and RFM98W, while Semtech manufactures modules like SX1276 and SX1278. LoRa modules are available in different operating frequencies, including 433 MHz, 868 MHz, and 915 MHz, to comply with frequency regulations in different countries. In Asia, the standard operating frequency for LoRa is 433 MHz (LoRa Alliance, 2024). Figure 3 illustrates the LoRa and Arduino UNO® R3 units used in this study, showing the configuration for both the Gateway and Node units.

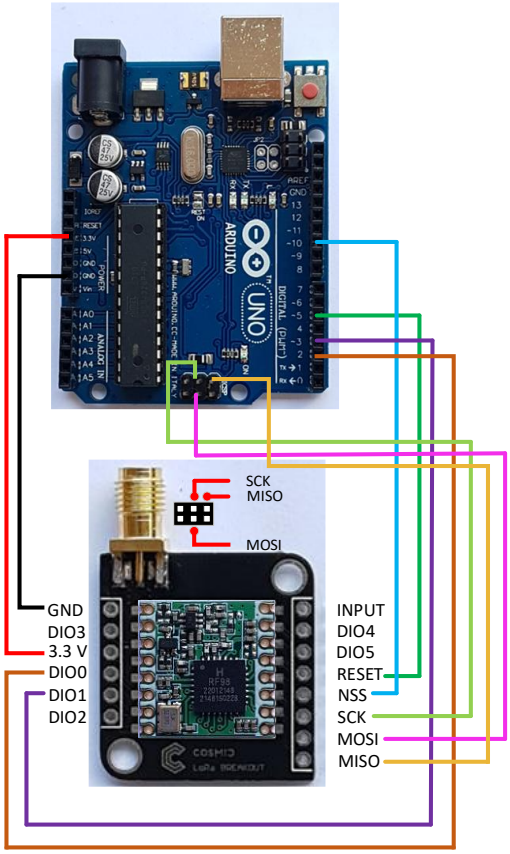

FIGURE 3. Wiring diagram of Arduino with the LoRa RFM98W Module Breakout Board pins

Wireless Communication System Performance (Radio Communication System)

In wireless communication (radio communication), the performance of a communication system is significantly influenced by key parameters such as the Path Loss Exponent (PLE) and Received Signal Strength Indicator (RSSI). These parameters play a crucial role in determining the strength, quality, and coverage range of the received signal.

1. Path Loss Exponent (PLE) is a measure of the signal power attenuation as it propagates through the air from the transmitter to the receiver. The PLE provides insight into how a signal weakens depending on distance and environmental conditions, such as free space, urban areas, or indoor environments. PLE

values vary according to the type of environment and are often used in planning and estimating the coverage range of communication systems, including LoRa-based systems used in the Internet of Things (IoT).

2. Received Signal Strength Indicator (RSSI) measures the power of the signal received by a wireless device's antenna. RSSI values indicate how effectively the receiver can detect the transmitter's signal and can be used to assess communication quality. High RSSI values indicate strong signals, whereas low values indicate weak or poor signals. RSSI is also influenced by various factors, including the distance between transmitter and receiver, physical obstructions, and signal attenuation.

By understanding PLE and RSSI values, communication planners can optimize wireless systems to operate effectively in various environmental conditions and ensure strong and reliable signals for data communication between wireless devices. The following sections provide a detailed explanation of PLE and RSSI.

Path Loss Exponent (PLE)

Radio communication planning typically considers the transmitter's power requirements to ensure that the transmitted signal reaches the receiver while satisfying the receiver's sensitivity criteria. This calculation is often referred to as the link budget, which accounts for channel losses and other components between transmitter and receiver that reduce transmitted power. The reduction or loss of transmitted power as it propagates through the air is referred to as path loss.

The free-space path loss can generally be calculated using the following equation (Khondoker Ziaul Islam et al., 2019):

$$L_{FS} = P_{Tx} + G_{Tx} - L_{Tx} - L_M + G_{Rx} - L_{Rx} - P_{Rx} \quad (1)$$

where:
L_FS= Free space loss (dB)
P_Tx= Transmit power (dB)
G_Tx=Transmit gain (dB)
L_Tx= Transmit loss (dB)
L_M= Media propagation loss (dB)
G_Rx= Receive gain (dB)
L_Rx= Receive loss (dB)
P_Rx= Received power (dB)

Using this equation, the coverage range of a LoRa Gateway can be estimated with the free-space path loss formula as follows (Debus, 2006; Dharmawan, 2016):

$$L_{FS} = 32.45 + 20\log(d) + 20\log(f) \quad (2)$$

where:
L_FS= Free Space Loss (dB)
d= Coverage distance (km)
f= Frequency of LoRa (MHz)

For the purpose of predicting RSSI values based on the known distance between the Gateway and Node, equation (2) [11] can be applied. **Table 2.1** presents the transmission constant values included in the Path Loss Exponent (PLE) for various environments (Rappaport, 2002).

TABLE 1. Path Loss Exponent for Different Environments.

Environment	Path Loss Exponen, n
Free space	2
Urban area cellular radio	2.7 to 3.5
Shadowed urban cellular radio	3 to 5
In building line-of-sight	1.6 to 1.8
Obstucted in building	4 to 6
Obstucted in factory	2 to 3

Received Signal Strength Indicator (RSSI)

Received Signal Strength Indicator (RSSI) is a measure of the power received by the antenna from a wireless communication device. RSSI values indicate the strength and quality of the received wireless signal. In other words, RSSI measures how effectively a wireless communication receiver can "hear" the signal transmitted from the sender. This value can serve as a reference to determine whether the received signal is sufficient for communication.

In addition to RSSI, power measurements in telecommunication systems are often expressed in dB (decibels) or dBm (decibel-milliwatts). The key difference is that RSSI is a relative index, while dBm represents an absolute value of power in milliwatts (mW). RSSI is used to assess the relative quality of the signal received by the user device but does not provide an absolute power level. RSSI values are influenced not only by transmitter power but also by other factors such as path loss, antenna gain, and cable/connector losses [12]. Environmental conditions, including distance and physical obstructions, also heavily affect RSSI: the farther the distance and the more obstructions present, the lower the RSSI. This can impact the performance of LoRa systems (Tri Wahyudi et al., 2022; Lilik Triyono et al., 2022).

RSSI values are expressed as negative numbers in decibel-milliwatts (-dBm). The RSSI can be calculated using the following equation (L'houssaine Aarif et al., 2022; Sella et al., 2022; Rifqi Nafis Mubaroq & Nina Siti Aminah, 2021; Helmy Fitriawan et al., 2020):

$$RSSI = A + 10n\log_{10}(d) \tag{3}$$

where:
A = reference RSSI value measured at 1 m distance (- dBm)
n = path loss exponent (free space = 2; Urban area cellular radio = 2.7 – 3.5)
d = distance (m)

Based on the obtained RSSI values, the distance between the transmitter and receiver can be estimated using the general formula (LoRa Alliance, 2024).

$$d_i = d_0 * 10^{\left(\frac{RSSI_0 - RSSI_i}{10 * n_i}\right)} \tag{4}$$

where:
d_i = distance between transmitter and receiver (m)
d_0 = reference distance (usually 1 m)
$RSSI_0$ = reference RSSI at d_0
$RSSI_i$ = measured RSSI at distance d_i

This is equivalent to rewriting equation (4) as:

$$d = 10^{\frac{RSSI - A}{10n}} \tag{5}$$

Table 2 presents RSSI levels corresponding to the quality of radio communication signals received by the receiver, based on the signals transmitted. Signal quality is categorized into five levels: Very Strong, Very Good, Good, Bad, and Very Bad, with Very Strong representing the highest signal quality and Very Bad the lowest. These levels can serve as a guideline for assessing connectivity during data communication between Gateway and Node.

TABLE 2. RSSI Signal Level (Asaad & Maghdid, 2022).

RSSI (dBm)	Information
$-30 \sim -60$	Very strong. The transmitter and receiver distance is very close.
$-60 \sim -90$	Very good. Close coverage.
$-90 \sim -105$	Good. Some data are not accepted.
$-105 \sim -115$	Bad. Can accept but often drop-out.
$-115 \sim -120$	Very bad. Weak signal data is often lost.

RESEARCH METHOD

This study employed a development research method conducted in the laboratory, with field trials in open areas once the system prototype was available. Experimental studies were also carried out to determine the appropriate hardware requirements. The experimental scenarios followed the standard schematic of a radio

transmitter and receiver (superheterodyne radio system), which served as the basis for experimenting with an SDR-based IoT gateway system to communicate with LoRa-based IoT nodes. The block diagrams of the transmitter and receiver and the system workflow are shown in **Figure 4**.

Data transmission via radio waves requires several processes. The transmitter block performs multiple steps to send data, starting with modulating the data with a high-frequency carrier, followed by transmitting the modulated signal through the assigned frequency channel. The receiver block performs demodulation to recover the original data.

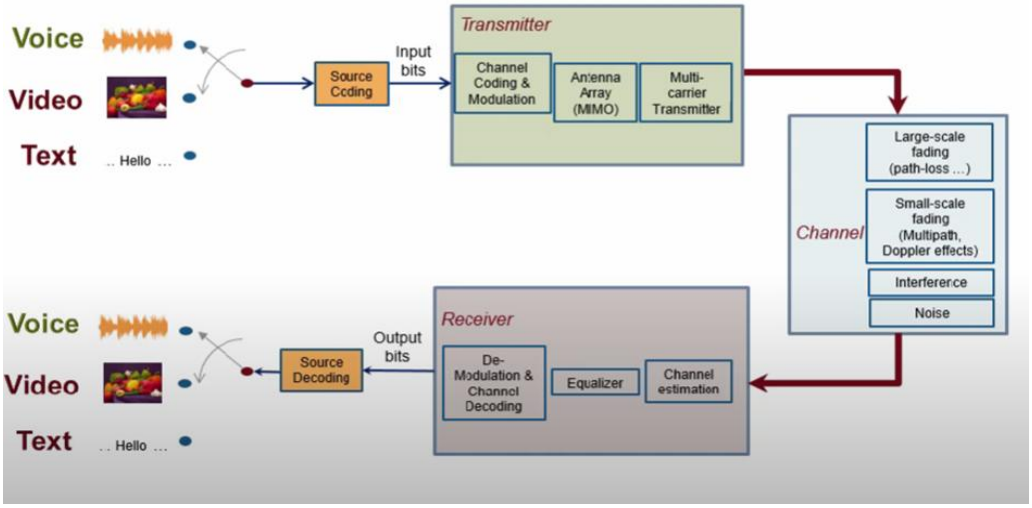

FIGURE 4. Data Transmission Flow via Radio Waves.

The complete processes of the transmitter and receiver systems are illustrated in **Figure 4**, with detailed explanations as follows.

Transmitter System

The transmitter system consists of source coding, channel coding & modulation, antenna array, and a multicarrier transmitter. The main process in the transmitter is to provide digital data with the desired coding in the source coding section. The resulting bitstream is then modulated at a specific RF frequency in the channel coding & modulation section, generating a digital RF signal. Modulation is the process of sending data by varying the amplitude, frequency, or phase of a signal, allowing the information to be effectively transmitted and received. Next, the digital RF signal is fed into the antenna section as an analog RF signal to be transmitted through the air. All of these processes are executed using software running on the SDR platform. An FPGA processor is used for digital RF signal computation to implement radio functions such as modulation, ensuring rapid processing without communication delays.

Receiver System

The receiver system consists of an antenna, channel estimation, equalizer, demodulation & channel decoding, and source decoding. The main process at the receiver involves capturing the analog RF signal via the antenna. The signal is then processed in the channel estimation section, which selects the appropriate frequency and digitizes the analog RF signal into a digital RF signal. The digital RF signal is subsequently processed in the demodulation & channel decoding section, where demodulation converts it back into a digital bitstream of the information signal. Finally, the source decoding section reconstructs the original information from the bitstream. Similar to the SDR transmitter, all processes in the receiver are performed using software running on the SDR platform. The FPGA processor ensures that digital RF signal processing and demodulation occur without delays.

Figure 5 illustrates the research roadmap over two years. The first stage involves preparation for the second stage, including installing SDR software and setting up the USRP B210. The USRP B210 provides a fully integrated Universal Software Radio Peripheral (USRP™) Single Board platform, supporting a continuous frequency range of 70 MHz – 6 GHz. This frequency range allows connectivity with GPS, WiFi, and cellular networks, enabling transmission and reception of text, video, and image data.

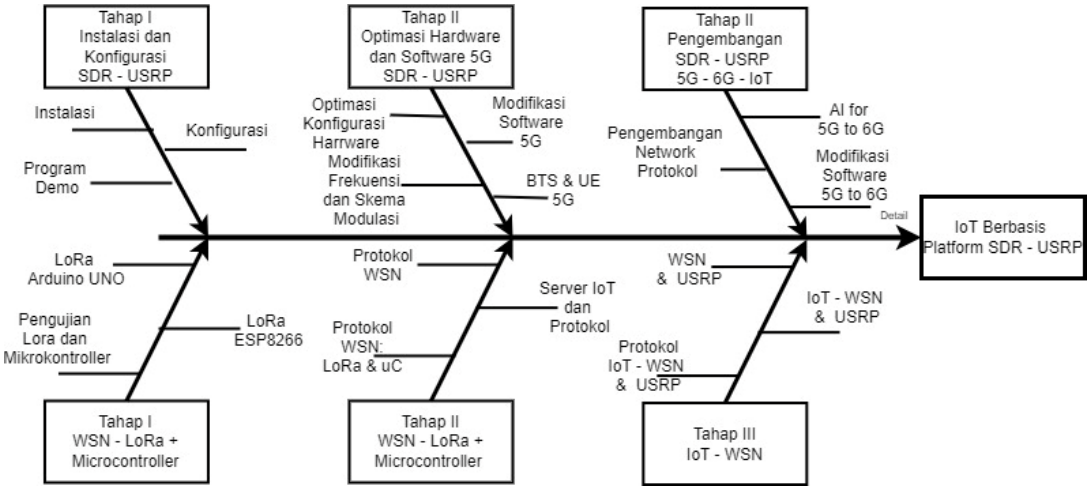

FIGURE 5. Research Roadmap.

The research workflow across the first, second, and third stages is outlined in the SDR-USRP and IoT-WSN roadmap. The first stage involves SDR experimentation using USRP, while on the other side, WSN experiments use LoRa and various microcontrollers. This stage was completed in the previous year.

The second stage focuses on developing an SDR-USRP prototype at the laboratory scale for 5G communication trials. Simultaneously, IoT-WSN development continues with WSN protocol development and connection to the IoT server. This stage is the primary focus of the current study.

The third stage integrates the outcomes of the first and second stages to advance SDR-USRP systems from 5G toward 6G, while simultaneously configuring IoT-WSN to communicate with SDR-USRP. This results in the integration of SDR-USRP with IoT – LoRa + microcontrollers.

System Architecture

LoRa and Arduino UNO®R3

The first activity in this study was to develop a communication system using an Arduino Uno board as the data communication processing base, paired with a LoRa RFM98W module operating at a frequency of 433 MHz. The antenna used was a vertical antenna with specifications shown in Table 3. This vertical antenna was chosen because it has an omnidirectional radiation pattern, unlike horizontal antennas that radiate most strongly in limited directions—for example, a half-wave open dipole antenna radiates primarily in the front and back of its span (Kraus, 2003; Marpanaji et al., 2019; Marpanaji et al., 2023).

Using a vertical antenna allows greater flexibility in positioning the Gateway and Node, as it receives radio wave radiation equally in all directions. **Figure 6** shows the physical appearance of the Gateway or Node unit using Arduino UNO® R3 and LoRa RFM98W.

TABLE 3. Antenna Specification

Parameter	Spesification
Frequency	433 MHz ±5 MHz
Gain	3 dBi
Input Impedance	50 Ω
Polarization	Vertical
Interface	SMA connector

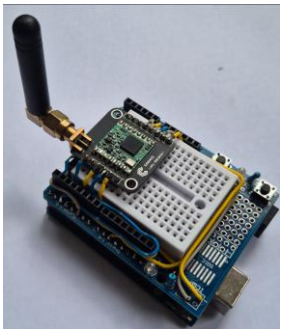

FIGURE 5. LoRa and Arduino UNO® R3 Setup for Gateway and Node

The use of the LoRa RFM98W 433 MHz module for WSN or IoT development has become increasingly common. Research on using LoRa modules with Arduino UNO® R3, NodeMCU ESP8266 (Arlingga Utama & Agung Setia Budi, 2024), and even Raspberry Pi [8] is still ongoing, primarily in the experimental development stage to achieve better results.

USRP and Computer Installation and Configuration

The USRP installation was carried out for 2 USRP units and 2 PC units. The operating system used was the open-source Ubuntu 24.04.1 LTS, which can be downloaded from https://ubuntu.com/download/desktop. The installation steps, along with the required software to run the USRP B210 compatible with Ettus on a PC, refer to the documentation provided by the GNU Radio community for USRP B210 AD9361 compatible with USRP B210 Ettus. Once the installation and configuration were completed, the next step was to test the installation by running demo applications previously developed by GNU Radio researchers. **Figure 6** shows the system architecture for the installation and configuration of USRP B210 AD9361 compatible with USRP B210 Ettus and the PC used in the experiments.

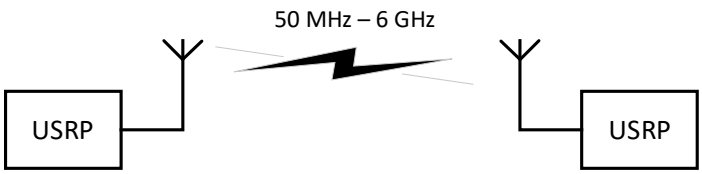

FIGURE 6. USRP B210 AD9361 and PC System Architecture

The subsequent stage involved testing based on the results of the USRP B210 AD9361 and PC installation and configuration, as will be described in the Results and Discussion section.

RESULTS AND DISCUSSION

LoRa – Arduino Testing

The architecture for observing RSSI values relative to the distance between the Gateway and Node using LoRa and Arduino® UNO is shown in **Figure 7**. The Gateway unit is connected to a notebook to monitor the RSSI values received, while the Node unit uses a battery so it can be moved during the observation process.

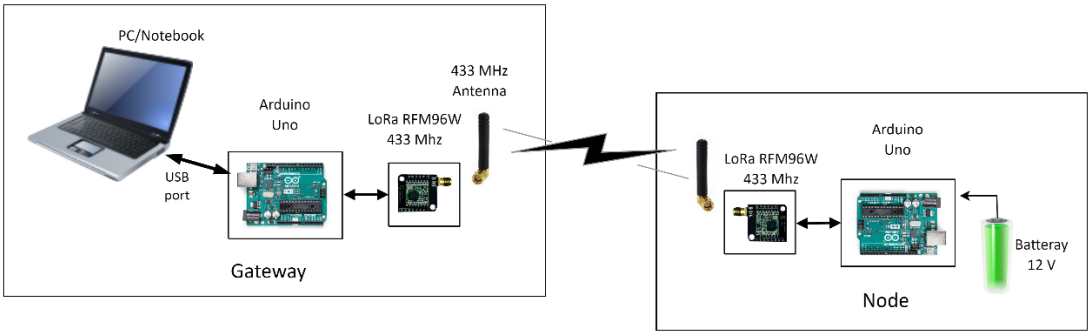

FIGURE 7. RSSI Observation Architecture between Gateway and Node using LoRa and Arduino® UNO

RSSI measurements were conducted in a village/rural area with a maximum distance of 160 m between point A (Gateway unit location) and point B (Node unit location). The GPS coordinates for point A, where the LoRa Gateway unit was placed, are -7.832904, 110.254841. The observation site is in Polaman Hamlet, Argorejo, Sedayu, Bantul, Yogyakarta, Indonesia. The communication frequency of the LoRa module was set to 460 MHz. The farthest Node position from the Gateway was at GPS coordinates -7.834498, 110.254301. RSSI measurements were conducted at distances from 1 m to 160 m. **Figure 8** shows a map of the measurement location as seen on Google Maps in satellite view.

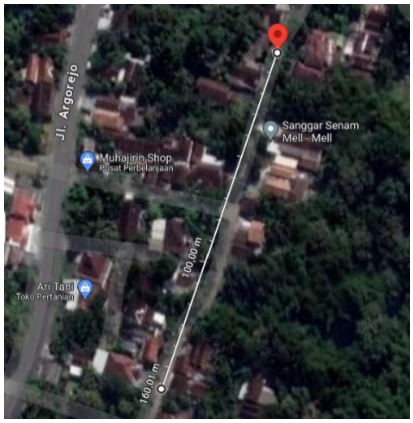

FIGURE 8. Layout of Gateway-Node Test using LoRa and Arduino® UNO

Table 4 presents the RSSI measurement results between the Gateway and Node over distances ranging from 1 m to 160 m, including predicted RSSI values, RSSI errors (difference between measured and predicted RSSI), predicted distance, and distance errors (difference between measured and predicted distances). The RSSI measured at a 1 m distance was -35 dBm, while at 160 m it was -102 dBm. At a distance of 3 m, the measured RSSI was -43 dBm, consistent with previous data.

Distance Measurement (m) and RSSI Value Measurement (dBm) represent values obtained during the observation. RSSI Value Calculation (dBm) was computed using Equation (3) based on measured distances. Distance Calculation (m) was derived from Equation (5) using RSSI values from measurements. The n (PLE) in this observation was taken as 2.7 for rural areas, and A is the RSSI when the Gateway and Node are 1 m apart, which is -35 dBm. Subsequently, RSSI Error is calculated as the difference between RSSI Value Measurement and RSSI Value Calculation, and the difference between Distance Measurement and Distance Calculation was also computed.

TABLE 4. Distance (m) and RSSI (dBm) Data for Gateway-to-Node Communication

n = 2,7
A = -35 (dBm)

Distance Measurement (m)	RSSI Value Measurement (dBm)	RSSI Value Calculation (dBm)	Error RSSI (dBm)	Distance Calculation (m)	Error Distance (m)
1	-35	-35	0,00	1,00	0,00
3	-43	-48	5,00	1,98	1,02
5	-56	-54	-2,00	5,99	-0,99
7	-65	-58	-7,00	12,92	-5,92
10	-69	-62	-7,00	18,17	-8,17
20	-73	-71	-2,00	25,55	-5,55
30	-77	-75	-2,00	35,94	-5,94
40	-76	-79	3,00	33,00	7,00
50	-78	-81	3,00	39,14	10,86
60	-79	-84	5,00	42,62	17,38
70	-79	-85	6,00	42,62	27,38
80	-83	-87	4,00	59,95	20,05
90	-82	-88	6,00	55,05	34,95
100	-89	-89	0,00	100,00	0,00
105	-91	-90	-1,00	118,60	-13,60
120	-92	-92	0,00	129,15	-9,15
130	-94	-93	-1,00	153,17	-23,17
140	-98	-93	-5,00	215,44	-75,44
150	-100	-94	-6,00	255,51	-105,51
160	-102	-95	-7,00	303,03	-143,03

Figure 9 illustrates the relationship between distance and RSSI values received by the Gateway when communicating with the Node. Signal strength, expressed as RSSI, decreases exponentially with increasing distance between the Gateway and Node, from 1 m to 160 m. This graph reflects the path loss characteristics of a rural area with many houses and trees in residential yards. Using nonlinear regression, the distance (m) versus RSSI (-dBm) relationship can be approximated by the equation: $y = -21{,}68\ \ln(x) - 32{,}148$ with value $R^2 = 0.9701$.

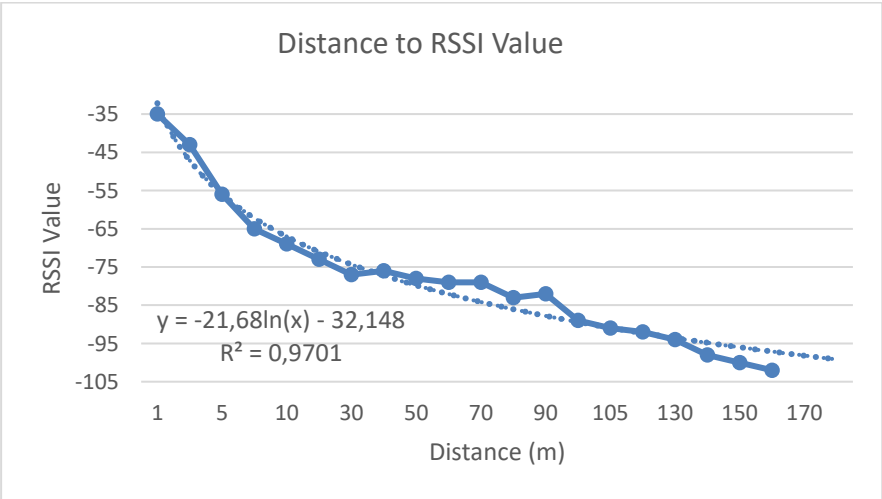

FIGURE 9. Relationship between Distance and RSSI between Gateway and Node

Communication Testing Using USRP B210 AD9361

The next activity involved installing and configuring USRP B210 AD9361 compatible with Ettus B210 using PC computers. Software installation for each PC began with the installation of the Linux Ubuntu 24.04.1 LTS operating system, followed by supporting software for running the USRP B210 AD9361 compatible with B210 Ettus, including Python, since some applications use Python for their user interface. Several software libraries for USRP were also installed. **Figure 10** shows the system architecture used in the experiment.

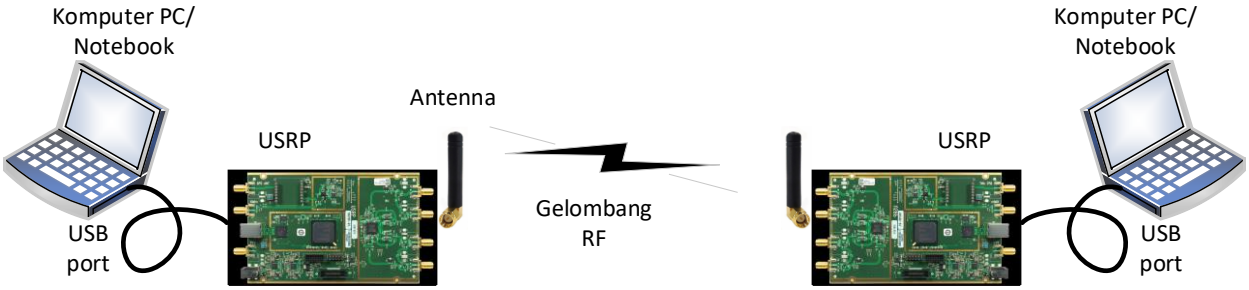

FIGURE 10. USRP-to-USRP Communication Architecture

Table 5 below shows the specifications of the personal computer (PC) used in the USRP B210 AD9361 experiment.

TABLE 5. Hardware specifications of the computer used.

Hardware	Specification
CPU	Intel i5-10400 (12) @ 4.300GHz
GPU:	Intel CometLake-S GT2 [UHD Graphics 630]
Memory	8 GB
SSD	256 GB

Figure 11 below shows the hardware and software specifications of the operating system after the installation process is complete.

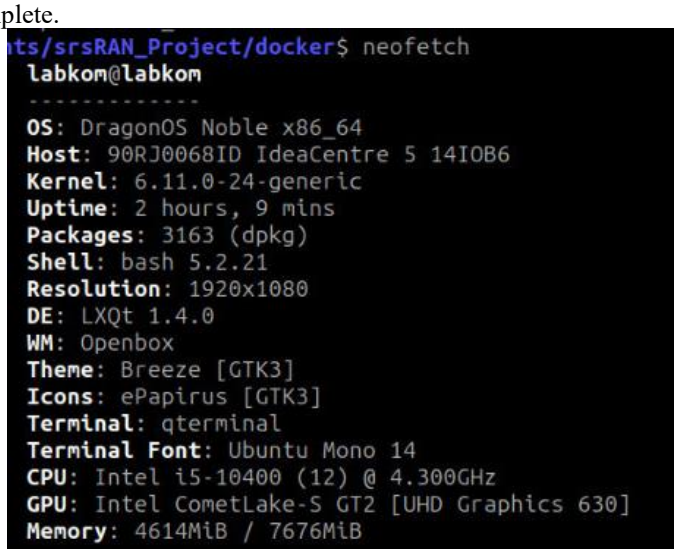

FIGURE 11. Computer operating system hardware and software specifications.

After all software installations were complete, radio communication programs using USRP B210 were tested. The antennas used were vertical antennas, similar to those used in the LoRa and Arduino UNO® R3 experiments, but with a frequency specification of 915 MHz. USRP-to-USRP communication experiments were conducted at frequencies range 2 – 3.6 GHz. The results showed poor communication performance; the USRPs could only communicate at a distance of approximately 1–2 cm.

Several antenna types were then tested, including commonly used WiFi antennas at 2.4 GHz, but the results were still unsatisfactory, with communication distances less than 5 cm. A more promising result was obtained using 3G/4G/5G antennas with 12 dBi gain, which have a wide operating frequency range from 600 – 6000 MHz. Specifications of this antenna are shown in **Table 6**.

TABLE 6. Specifications of 3G/4G/5G Antenna, Gain 12 dBi, Frequency 600 – 6000 MHz

Specification	Details
Connector:	SMA Male connector
Frequency range:	600-6000MHz
Gain:	12 dBi
SWR:	less than 1.5
Impedance	50 ohm
Antenna length:	19.6 cm
Polarization mode:	vertical polarization
Application:	GSM/GPRS/5G/4G/3G/NB-IoT/DTU Network devices

Using the 3G/4G/5G antenna, the communication range between USRPs increased to 2–10 meters. **Table 7** summarizes the experimental results regarding successful USRP communication distances based on the antenna used.

TABLE 7. Distance Between USRPs (meters) Based on Antenna Used

Antena type	Distance between USRP
Antena 915 MHz	0,01 – 0,02 m
Antena WiFi	0,03 – 0,1 m
Antena 3G/4G/5G	Up to 10 m

Figure 12 shows a photo of the experiment using the 3G/4G/5G antenna (600–6000 MHz, 12 dBi gain). Communication between USRPs was successful at longer distances (1 to 10 meters).

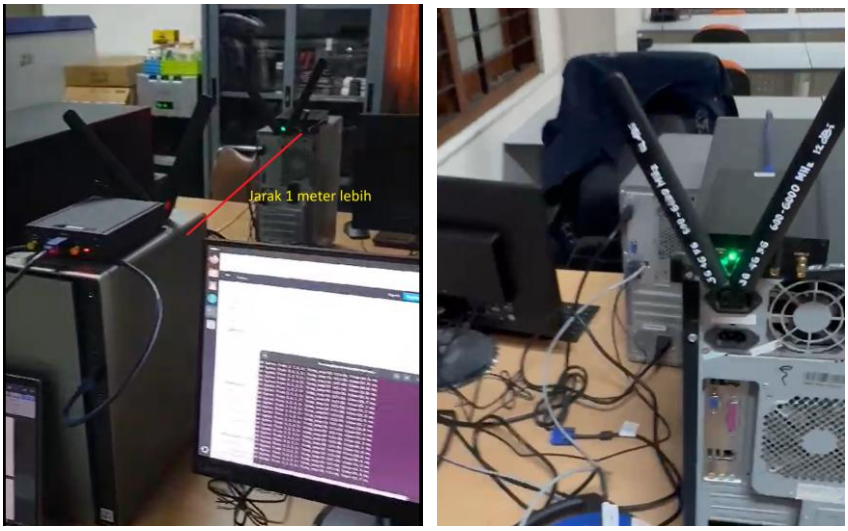

FIGURE 12. Experiment Photo Using 3G/4G/5G Antenna, 600–6000 MHz, 12 dBi

USRP Antenna Testing

Following successful experiments with the 3G/4G/5G antenna, antenna specifications were tested using a Vector Network Analyzer (VNA), Nano VNA v2. **Figure 13** shows the measurement of the 3G/4G/5G antenna characteristics using three frequency markers: 1.24 GHz, 3.07 GHz, and 3.64 GHz.

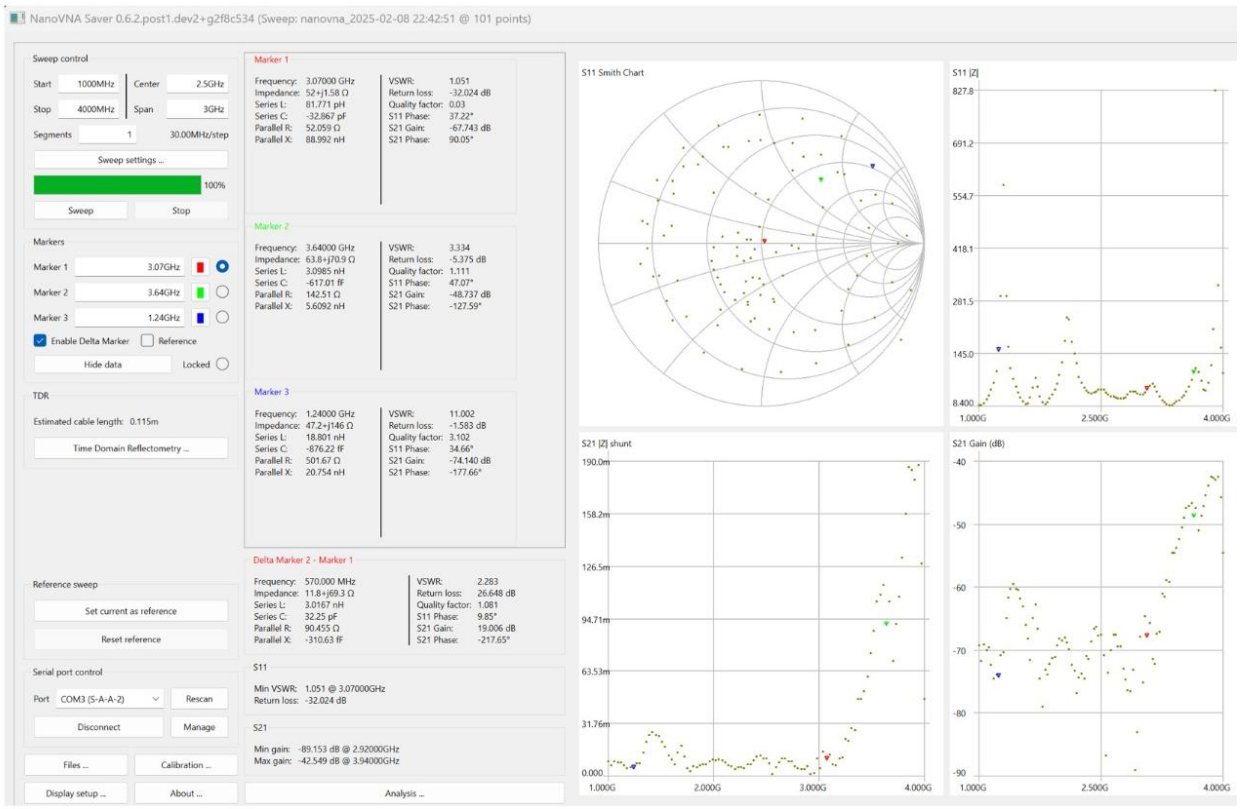

FIGURE 13. Measurement Results of 3G/4G/5G Antenna Characteristics (600–6000 MHz, 12 dBi) Using NanoVNA v2

Table 8 summarizes the antenna measurements at three different frequencies. Key parameters include Impedance, L-series (H), C-series (F), R-parallel (Ohm), X-parallel (H), VSWR, Return Loss (dB), Quality Factor, S11 Phase (degrees), S21 Gain (dB), and S21 Phase (degrees).

TABLE 8. Summary of 3G/4G/5G Antenna Measurements at 1.24 GHz, 3.07 GHz, and 3.64 GHz

Parameter	Freq. 1.24 GHz	Freq. 3.07 GHz	Freq. 3.64 GHz
Impedance	47.2 + j146 Ohm	52+j1.58 Ohm	63.8+j70.9 Ohm
Series L	18.801 pH	81.771 pH	3.0985 nH
Series C	-876.22 fF	-32.867 pF	-617.01 fF
Parallel R	501.67 Ohm	52.059 Ohm	142.51 Ohm
Parallel X	20.704 nH	88.992 nH	5.6092 nH
VSWR	11.02	1.051	3.334
Return Loss	-1.583 dB	-32.024 dB	-5.375 dB
Quality factor	3.102	0.03	1.111
S11 Phase	34.66º	37.22º	47.07º
S21 Gain (dB)	-74.140 dB	-67.743 dB	-48.737 dB
S21 Phase (º)	-177.66º	90.05º	-127.59º

Based on the testing results, using standard communication frequencies for 3G/4G/5G technology is relatively safe for USRP, especially at 3.60 GHz with VSWR = 3.334. The safest condition for USRP experiments is at 3.07 GHz with VSWR = 1.051.

USRP Experiment for OpenBTS

This study also conducted OpenBTS experiments using USRP B210 AD9361 compatible with B210 Ettus. System functionality can be observed using mobile phones. OpenBTS operates if surrounding phones recognize the OpenBTS and list it in their detectable network. Experiments were conducted using standard 2G and 3G OpenBTS frequencies: 900 MHz and 1.3 GHz. **Figure 14** shows the general architecture, while **Figure 15** depicts the OpenBTS system architecture using USRP B210 AD9361 compatible with B210 Ettus.

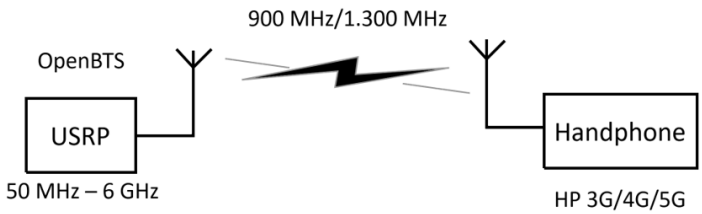

FIGURE 14. USRP B210 AD9361 Experiment Architecture for OpenBTS

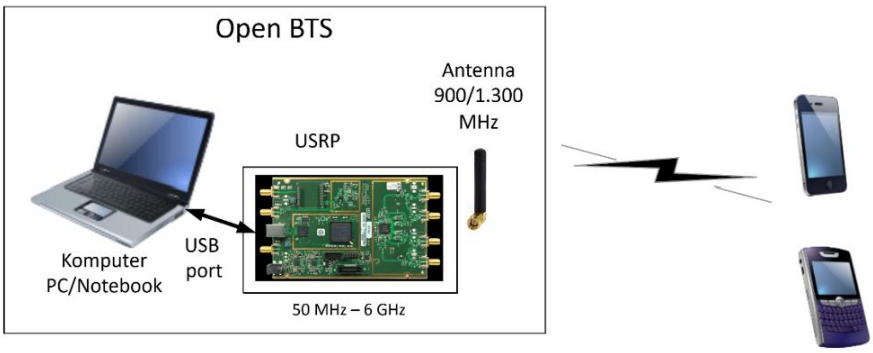

FIGURE 15. OpenBTS System Architecture Using USRP B210 AD9361

The experimental results are shown in **Figure 16**, where one USRP runs OpenBTS, another USRP runs a User Equipment application (as a mobile phone simulator), and a mobile phone is used to observe OpenBTS functionality.

The OpenBTS experiment was conducted with USRP as an IMSI Catcher, a shadow BTS that detects active phones near OpenBTS. IMSI Catcher systems are typically used to track the location of target subscribers.

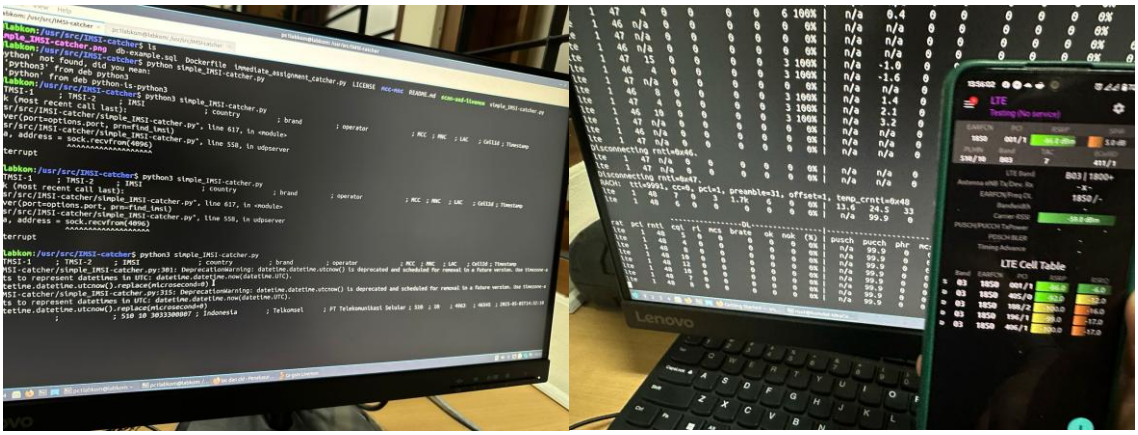

FIGURE 16. OpenBTS Experiment Photo Using IMSI Catcher to Track Nearby Mobile Phones

CONCLUSION

Based on the results of trials and experiments conducted in this study, the conclusions can be stated as follows:

1. Computer hardware that can be used for experiments with the Ettus-compatible USRP B210 AD9361 is as follows:
   - The computer hardware can utilize components that are easily available on the market, with specifications commonly used today.
   - The antenna used should support an operating frequency range of 600–6000 MHz, while for USRP experiments involving 3G/4G/5G technologies, antennas supporting those technologies and available commercially can be used.

- The communication range between USRPs is highly dependent on the type of antenna used; if necessary, a receiver amplifier module can be added to improve reception sensitivity.

2. The USRP B210 AD9361 can perform radio functions with a very wide frequency variation according to its specifications (70 MHz–6 GHz) and supports various modulation types depending on the software executed by the USRP. This characteristic demonstrates that the USRP can be utilized to meet the demands for flexibility and reconfigurability of future radio communication devices.

Future Works

The follow-up of this research includes developing radio communication-based applications with operating frequencies ranging from 70 MHz to 6 GHz, intended for radio communication-based IoT systems as well as 5G and 6G technologies.

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REFERENCES

17. J. Mitola III, 2000. Software Radio Architecture. Object-Oriented Approaches to Wireless Systems Engineering. Canada: John Eiley & Sons, Inc, 2000.
18. Reed, J. H., 2002. "Software Radio: A Modern Approach to Radio Engineering", New Jersey, Prentice Hall, 2002.
19. Riyanto, B., Langi, A.Z.R., Marpanaji, E. 2007. Software Architecture of Software-Defined Radio (SDR). Processing International Seminar R-ICT ITB.
20. Popescu, O., Tawab, S., Abraham, S., 2017. A Mobile Platform Using Software Defined Radios for Wireless Communication Systems Experimentation. ASEE 2017, [On-line] available at https:// www.researchgate.net/publication/319174918
21. Khondoker Ziaul Islam, et al, "LoRa localisation using singlemobile gateway," Computer Communications, Volume 219, 1 April 2024, Pages 182-193, https://doi.org/10.1016/j.comcom.2024.03.012.
22. W. Debus, "RF Path Loss & Transmission Distance Calculations," Axonn, LLC, pp. 1–5, 2006.
23. Willy Dharmawan, et al, "Peningkatan Akurasi Estimasi Jarak RSSI dengan Model Log Normal Menggunakan Metode Kalman Filter Pada Bluetoooth Low Energy," Prosiding SEMNASTEK 2016, p-ISSN : 2407 – 1846, e-ISSN : 2460 – 8416, https://jurnal.umj.ac.id/index.php/semnastek/article/view/701/632.
24. Rappaport, T. E., 2002. Chapter 3 – Wireless Communications. Principles and Practice. 2nd Edition. New Jersey: Prentice Hall.
25. Tri Wahyudi, et al, "Pengujian Performansi Modul Radio *Transceiver* RfM95W Menggunakan Sistem Komunikasi Bergerak dengan Beberapa Pola Secara *Real-Time* pada Area Perairan/Sungai Di Kota Pontianak," Journal of Electrical Engineering, Energy, and Information Technology (J3EIT), Vol 10, No 1 Januari 2022, DOI: http://dx.doi.org/10.26418/j3eit.v10i1.52519.
26. Lilik Triyono, et al, Optimasi PemanfaatanRSSI-WifiSebagai Asisten Navigasi Lokasi Gedung Politeknik Negeri Semarang Berbasis Android," IJAI, Vol. 6, No. 2, 2022, pISSN: 2548-3846, eISSN: 2598-5981.
27. L'houssaine Aarif, et al, "Experimental test and performance of RSSI-based indoor localization in LoRa Networks," The 4th International Workshop on the Future of Internet of Everything (FIoE) August 09-11, 2022, Ontario, Canada, ScienceDirect Available online at www.sciencedirect.com Procedia Computer Science 203 (2022) 420–425.
28. Sella Sella, et al, "Receive Signal Strength Indicator (RSSI) pada Swarm Robot untuk Menentukan Jarak Antara Robot Leader dan Robot Follower," Prosiding SNITT, 2022, eISSN : 3024-9538.
29. Rifqi Nafis Mubaroq & Nina Siti Aminah, "A Monitoring System for Wifi-RSSI Conversion to Distance Between Device and Router Using Node-Red in Development of Narrow-Navigation System," Proceedings Series on Physical & Formal Sciences, Volume 1, 2021, DOI: 10.30595/pspfs.v1i.130, https://conferenceproceedings.ump.ac.id/index.php/pspfs/article/view/130.

30. Helmy Fitriawan, et al, "Pengukuran RSSI Jaringan Sensor Nirkabel Berbasis ZigBee pada Berbagai Topologi," Jurnal Rekayasa Elektrika Vol. 16, No. 2, Agustus 2020, hal. 120-126, DOI: 10.17529/jre.v16i2.15750, https://jurnal.usk.ac.id/JRE/article/view/15750.
31. LoRa Alliance, "What is LoRaWAN® Specification," 2021. https://lora-alliance.org/about-lorawan (accessed Aug. 15, 2024).
32. Safar M. Asaad, Halgurd S Maghdid, "A Comprehensive Review of Indoor/Outdoor Localization Solutions in IoT era: Research Challenges and Future Perspectives," Computer Networks Volume 212, 20 July 2022, 109041, https://doi.org/10.1016/j.comnet.2022.109041.
33. Kraus, John D., Marhefka, Ronald J., 2003. Antennas. For All Applications. 3rd Edition. Singapore: McGraw – Hill Education.
34. Marpanaji, et. al. 2019. Experimental Study of Measuring Radiation Patterns for VHF and UHF Antennas. Journal of Physics Conference Series 1413 (2019) 012013, IOP Publishing.
35. Marpanaji, et. al. 2023. Arduino-Based High-Frequency Signal Data Acquisition for Learning Media on Antenna and Wave Propagation Practices. ELINVO (Electronics, Informatics, and Vocational Education), Vol. 8, No. No. 1: 8-18.
36. LoRa Alliance Technical Committee Regional Parameters Workgroup, RP002-1.0.3 LoRaWAN® Regional 41 Parameters, 2021. https://lora-alliance.org/wp-content/uploads/2021/05/RP002-1.0.3-FINAL-1.pdf (accesseg Aug. 15, 2024).

Analysis of Internal and External Factors of School Principals' Resilience in Facing Professional Challenges

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Abstract. School principals play a crucial role in the education ecosystem, where they are faced with a variety of complex challenges. Resilience, or the ability to persevere and bounce back from adversity, is a key attribute for effective leadership. This study aims to identify and analyze the internal and external factors that most affect the resilience of school principals. Using a mixed-methods approach through questionnaires distributed to 25 school principals at various levels, this study combines qualitative thematic analysis of essay answers with quantitative descriptive analysis of Likert scale data. The results of the study showed that the most dominant internal factors were spiritual beliefs and positive mindsets, which provided calm and strength to endure. Meanwhile, the most significant external factor is the support of fellow teachers/staff and family, which serves as an emotional support system and a source of practical solutions. These findings imply the importance of developing leadership training programs that focus not only on managerial competence but also on strengthening personal resilience capacity and building supportive communities in the school environment.

Keywords: resilience, educational leadership, principal, internal factors, external factors, professional challenges

INTRODUCTION

Leadership in the world of education is one of the main pillars that determine the quality and direction of a school institution. The principal, as the supreme leader, holds a great responsibility not only in the managerial and administrative aspects, but also as a driving force for innovation, motivator for teachers, and guarantor of the quality of learning for students [1]. In carrying out their roles, principals are often faced with pressures coming from various directions, such as the ever-increasing demands of educational standards, the implementation of complex new policies, high expectations from parents, internal dynamics of staff, and limited resources [2].

In the midst of the complexity of these challenges, resilience is an essential psychological capacity. Historically, the study of leadership resilience has only received significant attention from academics since 2005 and continues to grow rapidly to date [3]. Resilience is defined as the ability of individuals to adapt positively in the face of difficulties, trauma, or significant sources of stress [4]. For an education leader, resilience is not just the ability to "survive", but the ability to learn from failures, bounce back stronger, and turn challenges into opportunities for growth, both for themselves and for the institution they lead [5].

Furthermore, principal resilience has been conceptualized as a multidimensional construct that includes physical, emotional, psychological, cognitive, and social resilience [6]. The demands of leadership in the modern era, which are colored by uncertainty and crises such as pandemics or spillover impacts of public policies [7], make these dimensions very important. Compassionate leadership is also increasingly recognized as a crucial factor that allows school principals to navigate crises while maintaining the well-being of teachers [8]. Based on preliminary survey data, a principal defined resilience as "the ability to stay strong, bounce back, and find solutions when faced with tough problems." Research in the Southeast Asian region also confirms that primary school teachers in Malaysia must have resilient leadership in the face of challenging circumstances (Hamid et

al., 2023). Therefore, this study aims to delve deeper into the specific factors, both internal and environmental, that support the resilience of school principals in Indonesia.

LITERATURE REVIEW

Construct of Resilience

The landscape of modern education, characterized by rapid technological advancement, continuous policy changes, and emergent crises (e.g., pandemics, social pressures), necessitates a robust form of leadership known as Principal Resilience (Chen, 2025). Resilience, often termed "ketahanan" in Indonesian contexts, has evolved from a deficit-based, trauma-focused concept (Rutter, 1985; Werner & Smith, 1982) to a positive psychology construct focusing on adaptive capacity and thriving (Seligman & Csikszentmihalyi, 2000; Richardson, 2002).

In the domain of educational management, resilience is defined as the capacity of school leaders to effectively lead, adapt, and grow in the face of persistent adversity, challenges, and transformational pressures (Chen, 2024; Hamid et al., 2023). This capacity is crucial not only for the individual well-being of the principal but also for ensuring institutional stability and achieving quality educational outcomes.

2. Theoretical Foundations of Principal Resilience

2.1. Defining Resilience in a Leadership Context

The most influential conceptualization of resilience, providing a robust measurement tool, is the Connor-Davidson Resilience Scale (CD-RISC). Connor and Davidson (2003) define resilience as a measure of stress coping ability, emphasizing qualities such as personal competence, tolerance of negative affect, sense of humor, and spiritual influences [10].

In the school setting, this translates into Adaptive Coping, the ability to return to a state of equilibrium following a major disruptive event (Hamid et al., 2023). Proactive Growth: The capacity to leverage challenges as opportunities for professional and organizational development [3].

2.2. The Multidimensional Nature of Resilience

Contemporary research asserts that principal resilience is not a unitary trait but a complex, multidimensional construct. Chen (2023) developed the Principal Resilience Inventory (PRI), identifying five core interconnected dimensions that capture the most salient resilience experiences of school principals:

Dimension	Description	Supporting Literature
Physical Resilience	The ability to maintain energy and health necessary to manage heavy workload demands and stress.	Chen (2023); Whitson et al. (2016)
Emotional Resilience	The capacity to manage and regulate emotions, maintain calmness under pressure, and bounce back from emotional setbacks.	Chen (2023); Hamid et al. (2023)
Psychological Resilience	Maintaining a positive self-view, self-efficacy, a clear sense of purpose, and an optimistic outlook despite adversity.	Chen (2023); Watt & Martin (1994)
Cognitive Resilience	The flexibility to think clearly, adapt problem-solving strategies, and maintain focus during crisis or uncertainty.	Chen (2023); Hamid et al. (2023)
Social Resilience	The ability to build and effectively utilize supportive professional and personal relationships and networks.	Chen (2023, 2024); Hamid et al. (2023)

Chen (2024), utilizing network analysis, further illustrates that these dimensions are dynamically linked, confirming that resilience functions as an interconnected system rather than a set of discrete attributes.

3. Drivers of Principal Resilience: Internal and External Factors

Resilience is fostered by the interplay of internal psychological resources and external protective environmental factors.

3.1. Internal Psychological Resources

Internal drivers act as mediators between job demands and principal well-being [11]. Self-Efficacy and Purpose: High self-efficacy—the belief in one's capacity to execute tasks successfully—is fundamental to psychological resilience [12]. This is often buttressed by strong spiritual convictions and personal values, which provide a sense of stability and acceptance during unfavorable conditions [6].

Coping Mechanisms and Emotional Regulation: The use of specific coping strategies is key. [13] found a significant positive correlation between a principal's use of humor in leadership and their level of resilience, suggesting humor serves as an effective mechanism for diffusing stress and maintaining a positive work

atmosphere. Similarly, [14] advocate for mindfulness practices as a means for principals to achieve well-being and shift from a reactive to a reflective response pattern.

3.2. External Support Systems

External factors provide the safety net that buffers principals against the risk of burnout. Social Support Network: The quality and breadth of social support are consistently identified as critical (Hamid et al., 2023). This includes collegial support from teachers and staff, personal support from family, and the professional sharing platforms provided by fellow principals.

Organizational Climate and Culture: The organizational structure can either deplete or replenish a principal's resilience. The concept of Empowering Leadership suggests that a principal's behaviors can positively influence the psychological resilience of their teachers (Çevik & Doğan, 2025). This reciprocal relationship suggests that resilient teachers contribute back to the principal's own well-being and capacity to lead.

Compassionate Leadership**:** [8] position Compassionate Leadership as a crucial framework, especially during crises. A principal who leads with compassion helps maintain teacher morale, which in turn solidifies the organizational structure that supports the principal's own resilience.

4. Resilience in Organizational and Policy Contexts

The study of principal resilience also extends to the resilience of the educational institution itself. Organizational Resilience: The development of strategic human resources, such as through cadre development in institutions like *pesantren*, is a systematic roadmap towards achieving long-term Organizational Resilience (Prasetyo et al., 2025). This macro-level resilience ensures the sustainability of the institution against future shocks.

Transboundary Impacts: Global reports, such as those by [7], emphasize that the implementation of macro-level policies, including the 2030 Agenda and SDGs, generates spillover and transboundary impacts. In this environment, principal resilience is paramount as leaders must navigate external pressures and uncertainties that extend beyond the school gates, such as managing societal expectations and community critiques that might be voiced through the media.

The literature affirms principal resilience as a core competency for modern school leadership, characterized by five dimensions (physical, emotional, psychological, cognitive, and social) and driven by both internal mechanisms (efficacy, humor, spirituality) and external supports (social networks, compassionate leadership). However, while the existing research has successfully clarified the construct and its drivers, further empirical work is required to explore: (1) the specific moderating role of cultural context (such as the Indonesian context) on the network structure of these five resilience dimensions; and (2) the causal link between specific resilience-building interventions (e.g., mindfulness training) and measurable school improvement outcomes.

METHOD

This study uses a mixed-methods approach, especially a sequential explanatory design, which combines qualitative and quantitative data to provide a comprehensive understanding. The use of this approach aims to obtain the narrative depth of the subject's experience (qualitative) while validating the patterns that emerge descriptively (quantitatively). Data collection was carried out through the distribution of online questionnaires to 25 school principals who served at various levels (kindergarten, elementary, junior high, high school/vocational school) and types of school (public and private). This sample count is exploratory and aims to capture the richness of experience, especially in a qualitative context.

The research instrument consists of three parts: (1) respondent demographic data, (2) open-ended questions to explore qualitative experiences and perceptions about the meaning of resilience, the toughest challenges, and survival strategies, and (3) a series of statements using a Likert scale of 1-4 (1=Strongly Disagree, 4=Strongly Agree) to measure the level of agreement on various aspects of resilience. Although not using a standard instrument, the dimensions asked in the questionnaire were designed based on an established theoretical framework of resilience, including elements contained in common resilience scales such as CD-RISC [10] and dimensions developed in the Principal Resilience Inventory [6], such as the ability to manage emotions and social support.

Qualitative data analysis is carried out using thematic analysis techniques, where the answers to open-ended questions are inductively coded to identify patterns and themes that repeat until they reach thematic saturation. Meanwhile, quantitative data from the Likert scale were analyzed using descriptive statistics (frequency and percentage) with the help of basic statistical software to see the central tendency and level of agreement with the resilience variables. The combination of these two types of data (quantitative validates breadth, qualitative provides depth) allows researchers to produce stronger findings.

RESULT

Respondent Profile shows a total of 25 school principals participated in this study. The majority of respondents were women (68%), with an average total experience as a principal of 9.8 years. Respondents were spread across elementary (44%), junior high (28%), high school/vocational school (20%), and kindergarten (8%), with a balanced proportion between public (52%) and private (48%) schools.

Qualitative Analysis showed Key Themes of Resilience. From the analysis of open-ended answers, four main themes emerged:

Theme 1: The Meaning of Resilience as the Ability to Rise and Adapt. Most respondents defined resilience as *"the ability to bounce back from adversity, not solve problems, and be able to adapt to any situation to find the best solution."*

Theme 2: The Toughest Challenge. The most often cited challenges are external pressure such as excessive student parents and supervision from NGOs, as well as internal conflicts with teachers or staff who are difficult to work with. One respondent recounted, *"The pressure from a parent who feels the most right and always blames school policy is the toughest test."*

Theme 3: Internal Resilience Factor. The most dominant factors from within are spirituality and personal beliefs. Many respondents stated that *"drawing close to God, praying, and surrendering"* provided great calm. In addition, a positive mindset and the ability to manage emotions are also considered crucial.

Theme 4: External Resilience Factors. Support from fellow teachers and staff at the school is the number one external factor. The form is in the form of *"discussions to find common solutions and provide motivation."* Furthermore, family support is referred to as *a "place to vent and a source of encouragement,"* followed by support from fellow principals in the community as a place to share experiences.

Quantitative analysis of Likert scale data shows a very high level of agreement on the importance of resilience factors. Some of the key findings include:

96% of respondents agreed or strongly agreed that "Having a clear purpose at work helped me get through a difficult time."

100% of respondents agree or strongly agree that "The ability to manage emotions is essential to staying calm under pressure."

92% of respondents agreed or strongly agreed that "Support from colleagues (teachers/staff) is very important when facing problems."

100% of respondents agree or strongly agree that "Spiritual values or personal beliefs give me strength."

DISCUSSION

The findings of this study confirm that a principal's resilience is a multifaceted construct built by the synergy between internal strength and external support. The high emphasis on aspects of spirituality and personal beliefs is in line with research by [15,16], who found that personal beliefs and values become strong anchors for educational leaders amid uncertainty. When faced with uncontrollable external pressures, such as unrealistic parental demands, principals tend to draw strength from within through spiritual reflection and the maintenance of a positive mindset. This spiritual power can be categorized as part of psychological resilience, which is one of the crucial dimensions of principal resilience [6]

Other relevant internal factors are positive mindsets and the ability to manage emotions. This response reflects the dimensions of cognitive resilience (the ability to think clearly in times of crisis) and emotional resilience (the ability to maintain calm) as identified by Chen (2023). In addition, the use of *humour* in leadership, which also includes internal mechanisms, has been shown to be positively correlated with the level of resilience of principals, especially in the context of problem-solving [13]. Thus, the resilience of a school principal is not just a passive ability, but a network structure of various interconnected components, where internal strength serves as the core of stability [3].

Furthermore, the importance of social support from the work and family environment strengthens the theory of *Social Support* [17]. Support from teachers is not only emotional but also instrumental, where discussion and collaboration can lead to innovative solutions. This shows that a resilient principal is one who is able to build and maintain good relationships around them, creating a supportive ecosystem. The presence of strong support from staff also allows principals to lead with composure, which is indispensable to reducing stress and improving teacher performance, especially after going through a challenging period (Marcel & Kamalanabhan, 2024).

The challenges faced by school principals, especially those involving NGO oversight or parental complaints expressed on social media, can be categorized as *spillover* or *transboundary* impacts from public issues to the school environment [7]. Therefore, structured external support—both from the community of fellow principals and families—is vital to deal with pressures beyond the confines of school authority. These findings are also relevant to the study by [18] that identified gender differences in resilience structures, where women tend to rely

more on interpersonal components, which may explain why the majority of women (68%) in this study strongly emphasized the importance of social support.

CONCLUSION

This study concludes that principals' resilience is significantly underpinned by two main pillars: internal strength rooted in spirituality and a positive mindset (reflecting psychological, cognitive, and emotional resilience), as well as external support coming from the school community (teachers/staff), family, and peers. The biggest challenges they face tend to be relational and arise from complex external and internal dynamics.

The implication of these findings is the need for education quality assurance institutions and related agencies to design sustainable professional development programs that explicitly include a component of resilience training. The training focuses not only on managerial skills but also on stress management strategies, emotional intelligence, and solid and supportive school community-building techniques that enable leaders to lead with compassion and humor. The limitation of this study is the relatively small number of samples, so generalizations need to be made carefully. Further research is recommended to involve a larger sample and explore differences in resilience based on geographic contexts, specific school cultures, and the role of gender moderation on resilience factors.

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REFERENCES

1 P. Hallinger, and R.H. Heck, “Leadership for learning: Does collaborative leadership make a difference in school improvement?,” Educational Management Administration and Leadership 38(6), (2010).

2 C. Day ACP, and K.A. Leithwood, Successful Principal Leadership in Time of Change : An International Perspective (2007).

3 J. Chen, “Principal resilience research from its birth in 2005 to 2024: A narrative review and a conceptual framework,” Educational Management Administration and Leadership, (2025).

4 F. Luthans, “The need for and meaning of positive organizational behavior,” J Organ Behav 23(6), (2002).

5 D.E.R. Jerry L. Patterson, George A. Goens, “Resilient Leadership for Turbulent Times: A Guide to Thriving in the Face of Adversity,” Resilient Leadership for Turbulent Times: A Guide to Thriving in the Face of Adversity, (2009).

6 J. Chen, “Conceptualising principal resilience: Development and validation of the Principal Resilience Inventory,” Educational Management Administration and Leadership, (2023).

7 OECD, Understanding the Spillovers and Transboundary Impacts of Public Policies (2021).

8 Richard Marcel I, and T.J. Kamalanabhan, “Leading with Compassion: An Inquiry into Compassionate Leadership of School Principals that Impact Teacher Attitudes and Job Performance,” Management and Labour Studies, (2024).

9 H. Che Abdul Hamid, P.L. Ghazali, S.N. Mohamad Fauzi, J. Arifin, R. Abdul Razak, N.S.A. Mohd Rozi, and E.N. Mohamad Zain, “A Review of Resilience Leadership in Challenging Circumstances: A Case Study of Malaysia Primary School Head Teachers,” International Journal of Academic Research in Business and Social Sciences 13(4), 494–502 (2023).

10 K.M. Connor, and J.R.T. Davidson, “Development of a new Resilience scale: The Connor-Davidson Resilience scale (CD-RISC),” Depress Anxiety 18(2), (2003).

11 D. Xanthopoulou, A.B. Bakker, E. Demerouti, and W.B. Schaufeli, “The role of personal resources in the job demands-resources model,” Int J Stress Manag 14(2), (2007).

12 S.E. Watt, and P.R. Martin, “Effect of General Self-Efficacy Expectancies on Performance Attributions,” Psychol Rep 75(2), (1994).

13 M.S. Alazmi, and S.S. Alhajeri, “Leading with humour and its effect on resilience in the workplace: The perspectives of principals in Kuwaiti secondary schools,” Management in Education 39(3), (2025).

14 Caryn M Wells, and Barbara A Klocko, “Principal Well-Being and Resilience: Mindfulness as a Means to That End,” NASSP Bulletin 102(2), 161–173 (2018).

15 Y.F.H. Al-Mahdy, M. Emam, and T. Hassan, "Workplace spirituality and organizational citizenship behavior among teachers in bahrain: commitment as a mediator," Journal of Beliefs and Values 43(3), (2022).
16 Y.R. Effendi, and P. Sahertian, "Principals' academic supervision based on humanistic spiritual values to increase student achievement motivation," International Journal of Innovation and Learning 34(1), (2023).
17 S. Cohen, and T.A. Wills, "Stress, Social Support, and the Buffering Hypothesis," Psychol Bull 98(2), (1985).
18 J. Chen, M. Toprak, M. Karakus, and M. Kouhsari, "The Network Structure of School Principal Resilience: Gender Differences," Eur J Educ 60(1), (2025).

NAVIGATING ETHICAL BOUNDARIES: HOW CHATGPT CHALLENGES ACADEMIC INTEGRITY IN HIGHER EDUCATION

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Abstract. This study addresses the growing issue of academic dishonesty intensified by technological advances and internet accessibility. Artificial intelligence (AI) tools such as ChatGPT, based on natural language processing, pose new challenges to academic integrity by enabling students to generate essays automatically without genuine cognitive engagement. Using a survey design, this research examines how AI use affects academic integrity among university students. Data were collected through an online questionnaire consisting of 30 items, completed by 1,168 active students from 13 universities across Indonesia. Descriptive and inferential statistics, including Spearman correlation, Mann–Whitney U, and Kruskal–Wallis tests, were applied for analysis. Findings reveal that 55.1% of students view ChatGPT as a legitimate writing aid, while 55.6% strongly oppose its use for completing academic papers. A significant positive correlation ($\rho = 0.363$; $p < 0.01$) was found between attitudes toward academic dishonesty and perceptions of ChatGPT use. Semester level and age significantly influenced ChatGPT usage intensity. These results suggest that students can distinguish between ethical and unethical applications of AI tools, reflecting a critical awareness of technological and moral boundaries. The study highlights the need to develop AI literacy frameworks that balance innovation with ethical responsibility to sustain academic integrity in higher education.

Keywords: Academic Integrity; ChatGPT; Higher Education; Ethical Perception.

INTRODUCTION

The rapid advancement of digital technology over the past decade has brought significant changes to the higher education ecosystem. Developments in artificial intelligence (AI)—particularly in Natural Language Processing (NLP)—have led to systems capable of mimicking human reasoning and language with increasing sophistication [1], [2], [3]. One of the most prominent examples of this development is ChatGPT, a language model developed by OpenAI that can automatically generate text based on user prompts. The emergence of this technology not only enriches students' learning and writing experiences but also introduces new ethical dilemmas in the domain of academic integrity [4], [5], [6], [7].

As a form of Generative AI, ChatGPT is a Large Language Model (LLM) designed to understand and produce natural text based on user inputs [8], [9], [10], [11]. Within higher education, ChatGPT holds revolutionary potential as a learning tool. Studies have shown that students use ChatGPT for various legitimate purposes, such as clarifying difficult concepts, generating writing ideas, and improving sentence structure.

However, concerns have arisen regarding its potential misuse. Susnjak [12] highlights that ChatGPT may serve as a form of academic outsourcing, where students delegate cognitive and writing responsibilities to the machine. This trend threatens the originality of academic work and may reshape how students perceive the learning process. On the other hand, when used ethically, ChatGPT can enhance academic literacy and metacognitive awareness [13], [14], [15]. Thus, the central issue is not the prohibition of AI, but rather the cultivation of balanced AI literacy that integrates innovation with ethical responsibility.

Academic integrity has long been regarded as the moral foundation of higher education. Principles such as honesty, trust, fairness, respect, and responsibility uphold the credibility of scholarly work and the reputation of

academic institutions [7], [16], [17]. However, technological advancement has been accompanied by new forms of academic misconduct, ranging from digital plagiarism and data manipulation to contract cheating outsourcing assignments to third parties [18]. ChatGPT presents a more complex challenge due to its ability to produce original text that can evade conventional plagiarism detection.

Globally, breaches of academic integrity have increased significantly with the rise of digital technology. Practices such as online plagiarism, purchasing assignments, and manipulating research data are increasingly common [18], [19]. In Indonesia, a national survey revealed that more than 40% of students admitted to using digital sources without proper citation [19]. This finding underscores the urgent need to foster academic integrity awareness in the increasingly complex digital era.

Digital transformation has reshaped how students access, process, and produce knowledge. While technology facilitates learning and research, it also opens subtle and harder-to-detect pathways for academic dishonesty [19], [20]. The copy-paste culture and dependency on search engines have been linked to declining critical thinking and intellectual independence [21], [22], [23]. Moreover, digital tools such as grammar checkers, paraphrasing software, and automatic translators blur the boundary between legitimate assistance and misconduct [24], [25], [26]. This boundary becomes even more ambiguous with generative AI systems like ChatGPT, which can compose essays, generate code, and answer academic questions autonomously. The ethical challenge lies not within the technology itself, but in human agency whether it is used to support thinking or to replace it entirely.

Early studies reveal that students exhibit ambivalent attitudes toward AI use in academic contexts. While many perceive ChatGPT as an efficient learning assistant for generating ideas or clarifying concepts [27], [28], [29], educators and institutions often classify unacknowledged use as academic misconduct [30]. This ambiguity indicates a need for deeper exploration into how students perceive and utilize such technology in their academic practices.

Student perceptions of AI use in academia remain diverse. Some view ChatGPT as a productive learning partner, while others consider it contradictory to the principles of academic honesty [31]. Zhang & Hyland [32] found that students with higher levels of digital ethics literacy tend to distinguish between supportive use (to enhance learning) and substitutive use (to replace cognitive effort).

In Indonesia, such perceptions are further shaped by sociocultural and regulatory factors. The absence of explicit institutional guidelines regarding ethical AI usage leaves students to rely on personal judgment [33], [34]. This creates a moral ambiguity in which actions perceived as "assistance" by students may be deemed "misconduct" by institutions. Thus, mapping students' perceptions of ChatGPT use is a critical step in formulating adaptive educational policies and learning strategies that align with AI advancements.

This issue is particularly relevant in Indonesia's higher education landscape, where AI integration has accelerated due to the Merdeka Belajar Kampus Merdeka (MBKM) policy and post-pandemic digital transformation. Although students' technological proficiency is rising, their ethical digital literacy and awareness of academic integrity have not developed proportionally [4]. This imbalance creates a gap between technological competence and academic responsibility, potentially undermining the culture of scholarly honesty.

Based on this review, the present study adopts a conceptual framework linking students' perceptions of ChatGPT use, attitudes toward academic integrity, and demographic factors. The use of AI—particularly ChatGPT—may shape students' understanding of ethical boundaries in academic writing, which in turn influences their integrity-related behaviors. These relationships are moderated by variables such as age, study level, and technological experience. Accordingly, this research aims to identify students' perceptions, attitudes, and behaviors regarding ChatGPT use in academic contexts and to examine the correlations between AI perception and academic integrity. The findings are expected to contribute to the development of academic ethics policies and AI literacy education in Indonesian higher education, providing a conceptual foundation for the responsible integration of AI in 21st-century learning.

RESEARCH METHOD

This study employed a quantitative approach with a descriptive–inferential survey design [33], [34], [35]. This design was chosen because it enables the researcher to identify and map students' perceptions, attitudes, and behaviors toward the use of ChatGPT within the context of academic integrity. The survey method was used to systematically collect data from a large number of respondents, aiming to describe the actual phenomena in the field and examine the relationships among relevant variables. Inferential statistical analyses—including Spearman's rank correlation, Mann–Whitney, and Kruskal–Wallis tests—were applied to analyze the relationships between perceptions of ChatGPT, attitudes toward academic dishonesty, and demographic factors such as age and semester level.

Research Subjects

The participants of this study were undergraduate students (Bachelor's level) from 13 universities across Indonesia, representing various regions (Java, Sumatra, Kalimantan, Sulawesi, and Bali). The universities were selected purposively to represent the diversity of public and private higher education institutions. A total of 1,168 active students participated, consisting of 586 students from the odd semester (even intake) and 582 students from the even semester (odd intake). Inclusion criteria were: (1) Active students enrolled in at least their second semester; (2) Having used or currently using ChatGPT or similar AI applications; and (3) Providing voluntary participation through informed consent at the beginning of the online questionnaire.

Data Collection Instrument

Data were collected through a self-developed online questionnaire (Google Form) based on a literature review on academic integrity and AI use in higher education [36], [37], [38]. The instrument consisted of 30 closed-ended statements using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree), covering three main dimensions: (1) Perceptions of ChatGPT use in academic contexts (10 items); (2) Attitudes toward academic dishonesty and integrity (12 items); and (3) Ethics and digital responsibility in AI use (8 items). Content validity was evaluated by three experts in higher education and academic ethics, while internal reliability testing yielded a Cronbach's Alpha coefficient of 0.87, indicating a high level of internal consistency.

Data Collection Procedures

The data collection process was conducted online over two weeks using the Google Form platform, distributed via official academic channels, student social media groups, and campus communities. The procedure consisted of: (1) Preparation; (2) Instrument development; (3) Limited pilot testing, and (4) Revision based on expert feedback. The survey link was then distributed to potential respondents, accompanied by an explanation of the study's objectives and a confidentiality statement. Respondents completed the questionnaire independently, without researcher interference. Collected data were subsequently verified and cleaned to ensure completeness and remove duplicate responses.

Data Analysis Techniques

Data were analyzed using both descriptive and inferential statistical methods. Descriptive statistics were employed to describe the characteristics of the sample—particularly students' attitudes toward academic dishonesty and their perceptions of ChatGPT in academic contexts. Mean (M), standard deviation (SD), item range, frequency, and percentage were computed.

Before inferential testing, normality and homogeneity tests were conducted. Since the data were found to be non-normal and non-homogeneous, non-parametric tests were used. These included Spearman's rank correlation, Mann–Whitney, and Kruskal–Wallis tests to examine group differences across gender, educational level, semester level, and age.

Spearman's rank correlation was used to assess the relationship between students' attitudes toward academic dishonesty and their perceptions of ChatGPT use at a 5% significance level. The alternative hypothesis was accepted when the significance value was below 0.05. Correlation coefficients were used to describe the strength of relationships, while determination coefficients indicated the magnitude of contribution.

Further analysis using Mann–Whitney and Kruskal–Wallis tests explored the differences in attitudes and perceptions based on demographic characteristics. Expert judgment was conducted to ensure the validity and clarity of the questionnaire items prior to the main analysis. Given the non-normal distribution of the data, non-parametric tests were deemed the most appropriate analytical approach.

RESULTS AND DISCUSSION

Distribution of Respondent Data

The total number of respondents collected was 1,168 undergraduate students from 13 universities across various regions of Indonesia.

The distribution of respondents based on region and university is presented in Table 1 below.

Table 1. Distribution of Respondent Data

No	Region	Province	University Name
1	Sumatra	North Sumatra	Universitas Negeri Medan (Unimed)
		Lampung	UIN Raden Intan Lampung (UIN RIL)
		Bengkulu	Universitas Bengkulu
		Bangka Belitung Islands	Universitas Muhammadiyah Bangka Belitung
2	Java	Central Java	UIN Walisongo Semarang
		East Java	Universitas Negeri Surabaya (Unesa)

		Special Region of Yogyakarta	Universitas Tribhuwana Tunggadewi (Unitri) UIN Kiai Haji Achmad Siddiq (UIN Jember) IKIP PGRI Wates Universitas Negeri Yogyakarta
3	Sulawesi	Southeast Sulawesi Gorontalo	Universitas Muhammadiyah Buton Universitas Negeri Gorontalo (UNG)

Respondent Distribution

A total of 1,168 respondents were successfully collected from 13 universities located across three main regions of Indonesia: Sumatra, Java, and Sulawesi. The Java region contributed the largest number of universities, totaling six institutions across three provinces—Central Java, East Java, and the Special Region of Yogyakarta. The high representation from Java was influenced by the researchers' institutional network, ease of communication, and the availability of students willing to participate.

The Sumatra region was represented by four institutions from North Sumatra, Lampung, Bengkulu, and the Bangka Belitung Islands, indicating a balanced representation from western Indonesia. Meanwhile, Sulawesi contributed two institutions—one from Southeast Sulawesi and one from Gorontalo. Although fewer in number compared to Java and Sumatra, the inclusion of Sulawesi strengthened the geographical diversity of this research.

The overall distribution of universities demonstrates that the dataset encompasses a wide geographical range. This diversity provides valuable opportunities to capture variations in students' perceptions and behaviors influenced by distinct social and cultural contexts. Such a broad representation adds value to the study by offering a more comprehensive understanding of AI utilization and academic integrity at the national level.

Respondent Demographics

Descriptive data were presented to illustrate the respondents' profiles, serving as the foundation for further analysis. The study examined students' attitudes toward academic dishonesty and their perceptions of ChatGPT usage based on several demographic characteristics, including gender, age, academic level, semester, and Grade Point Average (GPA). This information is essential for identifying potential differences in attitudes and perceptions across groups, as well as for understanding emerging patterns associated with various background characteristics.

Table 2. General Profile of Respondents

No	Characteristic	Category	Frequency	Percentage
1	Gender	Male	175	15%
		Female	993	85%
2	Level of Education	Bachelor's Degree	1141	97.7%
		Master's Degree	27	2.3%
3	Semester	Graduated	6	0.5%
		2nd Semester	269	23%
		3rd Semester	11	0.9%
		4th Semester	548	46.9%
		5th Semester	4	0.3%
		6th Semester	316	27.1%
		7th Semester	-	-
		8th Semester	13	1.1%
		9th Semester	-	-
		10th Semester	1	0.1%

Distribution of Respondents

Based on the collected data, out of a total of 1,168 respondents, 993 respondents (85.0%) were female, while 175 respondents (15.0%) were male. This distribution indicates that the sample was predominantly composed of female students, showing a notable gender disparity.

The majority of respondents were undergraduate (Bachelor's) students, totaling 1,141 individuals (97.7%), whereas only 27 respondents (2.3%) were graduate (Master's) students. This pattern demonstrates that the study on academic integrity in the ChatGPT era primarily reflects the perspectives of undergraduate students.

The distribution by semester reveals a concentration in the mid-study phase. Most respondents were in the fourth semester (548 students or 46.9%), followed by those in the sixth semester (316 students or 27.1%) and second semester (269 students or 23.0%). The number of respondents from other semesters was relatively small, with 13 students (1.1%) in the eighth semester, 11 students (0.9%) in the third semester, 6 students (0.5%) who had graduated, 4 students (0.3%) in the fifth semester, and 1 student (0.1%) in the tenth semester.

This pattern suggests that most respondents were in the middle stage of their academic journey, particularly in the fourth semester, which accounted for nearly half of the total participants. At this stage, students generally possess sufficient academic experience to provide reflective judgments regarding issues of academic integrity.

Overall, the demographic profile of respondents in this study is dominated by female students (85.0%), primarily undergraduate students (97.7%), and mostly in the fourth semester (46.9%). This composition implies that the findings predominantly represent the perspectives of pre-service primary education teachers who are actively engaged in their academic development and are therefore in a relevant position to evaluate ethical issues surrounding the use of AI technologies in higher education.

Overview of Research Variables

Descriptive statistics for the main research variables include attitudes toward academic dishonesty and perceptions of ChatGPT use in academic contexts, which are presented in two dimensions: opinion and intensity. The descriptive results are shown in Table 3 below.

Table 3. Overview of Research Variables

	N	Minimum	Maximum	Mean	Std. Deviation
SIKAP	1168	18	54	45.40	6.339
PERSEPSI_P	1168	23	60	40.38	7.847
PERSEPSI_I	1168	22	48	39.40	5.161
Valid N (listwise)	1168				

Descriptive Statistics of Research Variables

Based on the results of the descriptive statistical analysis presented in Table 3, the variable attitude toward academic dishonesty shows a mean value of 45.40 with a standard deviation of 6.339. The score range varies between 18 and 54, indicating a considerable variation in respondents' attitudes toward academic misconduct.

For the variable perception of ChatGPT use in academic contexts, the opinion category (PERSEPSI_P) obtained a mean score of 40.38 with a standard deviation of 7.847. The lowest score was 23 and the highest 60, reflecting diverse viewpoints among respondents regarding the use of ChatGPT in academic activities.

Meanwhile, the intensity category (PERSEPSI_I) recorded a mean score of 39.40 with a standard deviation of 5.161. The score range for this category varied from 22 to 48, showing a relatively lower variation compared to the opinion category, as reflected in the smaller standard deviation value.

Overall, the data suggest that all three variables exhibit moderate variability with an adequate number of respondents (N = 1,168), thus fulfilling the requirements for further statistical analyses.

Percentage Description of Attitudes Toward Academic Dishonesty

This section presents the percentage distribution of respondents' attitudes toward 18 statement items that describe various forms of academic behavior potentially violating academic integrity. Respondents' attitudes were categorized into three groups based on their perception level: (1) Not considered cheating; (2) Unethical but not cheating, and (3) Cheating. The distribution of percentages for each statement item is presented in Table 4 and the following diagram.

Table 4. Percentage Description of Attitudes Toward Academic Dishonesty

Statement	Attitudes Toward Academic Dishonesty (%)		
	Not Cheating	Unethical but Not Cheating	Cheating
Copying from another student during an exam or quiz	3,68	4,62	91,70
Allowing another student to see your answers during a quiz or exam	3,85	26,97	69,18
Asking another student about questions on an exam you have not yet taken	20,53	34,25	55,22
Postponing an exam or submitting a paper later with a false excuse	7,71	38,70	53,60
Copying from unauthorized reference sheets during a closed-book exam or quiz	3,34	7,53	89,13
Claiming to have submitted an assignment or exam when you have not	5,39	19,86	74,74
Taking an exam for another student	5,57	18,58	75,86
Working in a group on an assignment when no group work policy exists	17,55	43,07	39,38
Adding false references to a term paper to expand the bibliography	8,39	44,01	47,60
Copying a term paper or lab report from a previous year	8,73	30,14	61,13
Studying with other students for an exam	45,29	23,89	30,82
Copying homework from students of a previous semester	7,71	27,14	65,15
Witnessing cheating in class but not reporting it to the instructor	15,41	54,62	29,97
Changing answers on an exam/homework after grading and claiming a	5,82	7,53	86,64

marking error			
Paying someone to take an exam or write a paper for you	5,31	15,75	78,94
Working in a group on an online quiz	16,27	25,94	57,79
Working in a group on a take-home exam	13,53	23,63	62,84
Cheating is an essential part of exams	19,61	6,68	73,72

Based on the analysis, significant findings were obtained in three categories of attitudes representing the spectrum of perceptions toward academic integrity. The highest percentage in the non-dishonest category was found in the statement "Studying with other students for an exam" at 45.29%. This finding indicates that nearly half of the respondents consider collaborative learning a legitimate academic practice that does not violate academic integrity. It reflects an understanding that academic discussions, idea exchange, and cooperative learning are integral to a healthy intellectual development process within an academic environment.

The highest percentage in the unethical but not dishonest category was for the statement "Witnessing cheating in class and not reporting it to the instructor" at 54.62%. The majority of respondents classified this behavior as unethical because it violates the collective moral responsibility to maintain academic integrity and ensure a fair learning environment. However, they did not categorize it as direct cheating since it is passive and does not involve active participation in dishonest acts.

The highest percentage in the dishonest category was for the statement "Copying from another student during an exam or quiz" at 91.70%. This remarkably high figure indicates a universal understanding among respondents that direct plagiarism during exams or quizzes is an intolerable violation of academic integrity. It shows a solid grasp of the fundamental principles of integrity in formal evaluation situations.

These data reveal that respondents possess a fairly good ability to distinguish between constructive academic collaboration, unethical but non-explicitly dishonest behavior, and clear cheating actions. The variation in perceptions underscores the complexity of evaluating academic behavior and highlights the need for continuous education accompanied by consistent reinforcement of academic integrity standards within higher education institutions.

Description of Respondents' Perception Percentages Toward ChatGPT Use in Academic Contexts

This data presents the distribution of respondents' perception percentages toward 12 statements describing various forms of academic perception. Respondent perceptions were categorized into two groups. Category 1 consists of five scales: Strongly Disagree (STS), Disagree (TS), Somewhat Agree (KS), Agree (S), and Strongly Agree (SS). Category 2 includes four scales: Never (TP), Rarely (J), Sometimes (K), and Often (S). The percentage distribution for each statement is presented in the table and diagram below.

Table 5. Percentage Distribution of Perceptions Toward ChatGPT Use in Academic Contexts

No.	Scenario	Opinion					Intensity			
		STS	TS	KS	S	SS	TP	J	K	S
1	A student uses the university library website to find references for a paper. They find an article containing all the main points they want to include. They copy and paste several parts of the article into ChatGPT, which automatically paraphrases the text into its own format.	8,3	17,3	48,7	24,6	1,1	14,3	42	38,8	5
2	A student uses ChatGPT to complete most of a group assignment because other members are not interested in contributing. The student does not disclose the use of AI tools to the group members and submits the assignment with all their names included.	21,1	28,9	40,1	9,2	0,7	53,6	32,1	11,9	2,4
3	A student believes that the lecturer will reuse last year's exam questions. The student obtains a copy of the previous test and uses ChatGPT to generate the answers, which they then memorize.	21	31,2	35,2	12,2	0,4	72,1	18,9	8	0,8
4	The university selection process for a competitive national program requires a two-page personal statement. The applicant uses ChatGPT to refine or enhance some details of their experiences.	13,4	18,7	32,2	33,8	1,9	59,8	19,7	17,5	3
5	A student writes a paper for a course	4,5	9,2	25,2	55,1	6,1	12,2	28,8	40,4	18,6

	assignment but lacks confidence in their writing skills. The student uses ChatGPT to correct errors and make the paper more coherent.									
6	A student must write a reflective paper but feels their personal experience is insufficient. Therefore, they use ChatGPT to create a story.	13,6	24,7	42,3	18,8	0,7	47,2	33,2	17	2,6
7	A student realizes that the final paper for a course this semester is very similar to a paper they submitted in another course last year. The student uses ChatGPT to automatically edit the old paper and submits it for the current class.	17	33,5	37	12,2	0,4	69,5	21	8,5	1
8	During an online multiple-choice test, a student uses ChatGPT to check which answers are correct.	17,1	29	37,8	15,5	0,5	34,8	39,7	21,7	3,7
9	A student asks a friend to send an email containing a completed assignment, claiming they want to compare answers. After receiving it, the student uses ChatGPT to paraphrase the text and submits it under their own name.	50,9	33,5	13,6	1,9	0.1	86,2	9,8	3,6	0,3
10	A student uses ChatGPT to write their entire paper from scratch and submits it as is.	55,6	28,8	13,6	1,6	0,4	83,1	13,2	3,3	0,4
11	A student uses their phone to access ChatGPT and obtain answers during an exam.	33,4	38,8	24,1	3,6	0,1	53,9	36,4	8,7	0,9
12	A student is required to participate in an online discussion forum for a course. The student uses ChatGPT to generate responses in the chatroom.	13,3	22,6	40,2	23,1	0,9	38,9	35,4	22,4	3,3

Based on the analysis, significant findings were obtained in various forms of academic perceptions. The perceptions were categorized into two types: the first related to opinions, and the second related to intensity.

In the opinion category, the highest percentage in the strongly disagree category was found in the statement "A student uses ChatGPT to write the entire paper from scratch and submits it as is," with 55.6%. This finding reflects that respondents have a high level of awareness regarding academic ethics. They reject the full use of ChatGPT to write papers without personal contribution. This indicates that acceptance of ChatGPT use is selective and still grounded in academic norms.

The highest percentage in the disagree category was found in the statement "A student uses their phone to access ChatGPT and obtain answers during an exam," with 38.8%. This finding shows that most respondents disapprove of using ChatGPT during examinations. It demonstrates their awareness that such practices violate exam regulations and academic integrity. Respondents perceive the use of ChatGPT in exam contexts as a form of cheating that is unacceptable.

The highest percentage in the somewhat disagree category was found in the statement "A student uses the library website to search for references needed for a paper. They find an article containing all the main points they want to include. They copy and paste parts of the article into ChatGPT, which automatically paraphrases the text into its own format," with 48.7%. This finding indicates that some respondents are hesitant about using ChatGPT to paraphrase text from reference sources. It reflects ethical doubt—although the information originates from legitimate sources, the use of ChatGPT for paraphrasing is viewed as potentially diminishing originality and independent thinking.

The highest percentage in the agree category was found in the statement "A student writes a paper for a course assignment but, lacking confidence in their writing skills, uses ChatGPT to correct errors and make the content more understandable," with 55.1%. This finding shows that most respondents agree that ChatGPT can be used as a tool for improving written work. They believe that using AI to correct errors and enhance readability is acceptable as long as the main ideas and content originate from the student.

The highest percentage in the strongly agree category was found in the same statement, "A student writes a paper for a course assignment but, lacking confidence in their writing skills, uses ChatGPT to correct errors and make the content more understandable," with 6.1%. This indicates that some respondents strongly agree with

using ChatGPT for improving writing quality. They view AI assistance in enhancing readability and correcting errors as a positive form of support, as long as the substance of the paper remains the student's own work.

In the intensity category, the highest percentage for never was found in the statement "A student asks a friend to send an email containing a completed assignment, claiming to compare answers. After receiving it, the student uses ChatGPT to paraphrase the text and submits it under their own name," with 86.2%. This finding reflects that the majority of respondents stated they have never engaged in such behavior. It indicates a high level of awareness regarding the importance of maintaining originality and avoiding practices that could lead to plagiarism.

The highest percentage for rarely was found in the statement "During an online multiple-choice test, a student uses ChatGPT to check which answers are correct," with 39.7%. This finding indicates that some respondents rarely use ChatGPT to check answers during online tests. It shows that although this practice exists, its frequency is relatively low and students tend to limit its use during exams.

The highest percentage for sometimes was found in the statement "A student writes a paper for a course assignment but, lacking confidence in their writing skills, uses ChatGPT to correct errors and make the content more understandable," with 40.4%. This shows that some respondents sometimes use ChatGPT to correct errors and improve readability. It indicates that AI is utilized as a writing aid, particularly when students feel less confident in their writing ability.

The highest percentage for often was also found in the same statement, with 18.6%. This suggests that a portion of respondents frequently use ChatGPT to improve their writing. It demonstrates a relatively high dependence on AI as a writing support tool, especially when students lack confidence in their own skills.

From the overall opinion category, the findings suggest that students tend to be selective—they accept the use of AI for writing support but reject practices that violate academic integrity. In the intensity category, although ChatGPT is quite often used as a writing aid, its use in ethically questionable contexts remains relatively rare.

Overall, these results indicate that students' perceptions of ChatGPT use in academic settings are generally positive when it functions as a writing companion. However, clear ethical boundaries are maintained to uphold academic integrity.

Normality Test

The normality test was conducted using Kolmogorov–Smirnov and Shapiro–Wilk on the scores of the three research variables: attitudes toward academic dishonesty (ATTITUDE), perceptions of ChatGPT use—opinion category (PERCEPTION_P), and perceptions of ChatGPT use—intensity category (PERCEPTION_I).

The decision criterion was: $p > 0.05 \rightarrow$ data are normally distributed,$p \leq 0.05 \rightarrow$ data are not normally distributed. The results of the normality test for the three variables are presented in Table 6. Normality Test Results.

Table 6. Normality Test Results

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
SIKAP	.099	1168	.000	.909	1168	.000
PERSEPEKTIF_P	.057	1168	.000	.985	1168	.000
PERSEPEKTIF_I	.099	1168	.000	.964	1168	.000

a. Lilliefors Significance Correction

Based on the results presented in Table 5, all variables showed a p-value of 0.000 ($p < 0.05$) in both tests, indicating that the three variables are not normally distributed. This condition may be attributed to the use of the Likert scale, which produces ordinal data that tend to have uneven response distributions across categories. Since the assumption of normality was not met, non-parametric methods were employed for further inferential analysis, namely: the Kruskal–Wallis test to examine differences in medians among more than two groups, and the Spearman correlation test to assess relationships between variables.

Homogeneity Test

A homogeneity of variance test was conducted using Levene's test to determine whether variances across data groups were equal. The decision criteria were as follows: $p > 0.05$ indicates equal variances (homogeneous), $p \leq 0.05$ indicates unequal variances (non-homogeneous). The results of the homogeneity test are presented in Table 7. Homogeneity Test Results.

Table 7. Homogeneity Test Results.

Levene Statistic	df1	df2	Sig.
85.012	2	3501	.000

Based on the results presented in Table 6, the significance value of Levene's test was 0.000 ($p < 0.05$), indicating that the variances among data groups were not homogeneous. Given the results of the normality and homogeneity assumption tests, the subsequent analyses were carried out using non-parametric tests, namely: the Spearman correlation test to examine relationships between variables, the Mann–Whitney U test to compare two groups, and the Kruskal–Wallis test to compare more than two groups.

Spearman's Rank Correlation Test

The Spearman's Rank Correlation analysis was conducted to explore the relationship between students' attitudes toward academic dishonesty and their perceptions of ChatGPT use in academic contexts. The choice of the Spearman test was based on the nature of the data, which were ordinal (Likert scale) and non-normally distributed.

The interpretation of correlation results followed these criteria: A significance value (p) < 0.05 indicates a significant correlation. The correlation coefficient represents the strength of the relationship, categorized as:

0.00–0.25 = weak,
0.26–0.50 = moderate,
0.51–0.75 = strong, and
0.76–1.00 = very strong.

The results of the descriptive statistical analysis are presented in Table 8. Spearman Correlation Test Results.

Table 8. Spearman Correlation Test Results.

			Attitudes toward Academic Dishonesty	**Perception of ChatGPT Use in Academic Contexts**	**Intensity of ChatGPT Use in Academic Contexts**
Spearman's rho	**Attitudes toward Academic Dishonesty**	Correlation Coefficient	1.000	.363**	.260**
		Sig. (2-tailed)	.	.000	.000
		N	1168	1168	1168
	Perception of ChatGPT Use in Academic Contexts	Correlation Coefficient	.363**	1.000	.532**
		Sig. (2-tailed)	.000	.	.000
		N	1168	1168	1168
	Intensity of ChatGPT Use in Academic Contexts	Correlation Coefficient	.260**	.532**	1.000
		Sig. (2-tailed)	.000	.000	.
		N	1168	1168	1168

**. Correlation is significant at the 0.01 level (2-tailed).

Based on the results of the Spearman correlation test presented in Table 7, the analysis of the relationships among variables can be summarized as follows.

Correlation between Attitude and Perception (Opinion Dimension). The analysis shows a correlation coefficient ($\rho = 0.363$; $p < 0.01$), indicating a positive relationship of moderate strength between attitudes toward academic dishonesty and perceptions (opinion) regarding the use of ChatGPT in academic contexts. This relationship suggests that the more permissive students' attitudes are toward academic dishonesty, the more positive their perceptions tend to be toward using ChatGPT in academic settings. Conversely, students who uphold strict academic integrity standards tend to have a more critical perspective on ChatGPT's implementation in learning activities.

Correlation between Attitude and Usage Intensity. The relationship between attitudes toward academic dishonesty and intensity of ChatGPT use shows a correlation coefficient ($\rho = 0.260$; $p < 0.01$), indicating a positive correlation of moderate strength. This finding implies that students with more tolerant attitudes toward academic dishonesty tend to use ChatGPT more frequently. In contrast, students who highly value academic integrity exhibit a more limited tendency to use ChatGPT.

Correlation between ChatGPT Perception Dimensions. The correlation between perception (opinion) and usage intensity of ChatGPT yielded the highest value ($\rho = 0.532$; $p < 0.01$), indicating a positive relationship of moderate-to-strong strength. The positive coefficient of 0.532 demonstrates consistency between cognitive attitudes and actual behavior. Students who hold favorable views of ChatGPT are more likely to use it frequently, while those with negative perceptions tend to use ChatGPT less often.

Results Based on Group Categorization.

The Mann–Whitney and Kruskal–Wallis tests were conducted to determine whether there were mean differences among respondent groups regarding the research variables based on specific characteristics. A significance value of $p < 0.05$ indicates statistically significant differences, whereas $p \geq 0.05$ suggests insufficient evidence to conclude that significant differences exist.

Differences Based on Gender.

The Mann–Whitney test was performed to examine differences in attitudes toward academic dishonesty and perceptions of ChatGPT use between male and female students. The test results are presented in the following table:

Table 9. Mann–Whitney Test Results Based on Gender

	Attitude	Perception_Opinion	Perception_Intensity
Mann-Whitney U	86003.500	78474.500	83343.500
Wilcoxon W	578531.500	571002.500	575871.500
Z	-.314	-2.141	-.960
Asymp. Sig. (2-tailed)	.754	.032	.337

a. Grouping Variable: Gender

The analysis results indicate that for the variable attitude toward academic dishonesty, the significance value of 0.754 ($p > 0.05$) suggests no significant difference between male and female students. This finding reflects that perceptions of academic integrity are relatively homogeneous across genders, implying that the internalization of academic values has occurred evenly without notable gender bias.

For the variable perception (opinion dimension) of ChatGPT use, the significance value of 0.032 ($p < 0.05$) indicates a significant difference between male and female students, which may reflect variations in technology acceptance and attitudes toward technological innovation between the two groups.

Meanwhile, for the variable perception (usage intensity dimension) of ChatGPT use, the significance value of 0.337 ($p > 0.05$) indicates no significant difference across genders. Thus, although differences were found in the opinion dimension, the actual use practices of ChatGPT are relatively consistent between male and female students.

Differences Based on Educational Level (Undergraduate and Graduate)

The Mann–Whitney U test was conducted to examine differences in attitudes toward academic dishonesty and perceptions of ChatGPT use based on educational level (undergraduate and graduate). The results are presented in the following table.

Table 10. Mann–Whitney U Test Results Based on Educational Level

	Attitude	Perception_Opinion	Perception_Intensity
Mann-Whitney U	12913.500	15104.000	12589.000
Wilcoxon W	13291.500	15482.000	664100.000
Z	-1.440	-.173	-1.628
Asymp. Sig. (2-tailed)	.150	.863	.104

a. Grouping Variable: Pendidikan

The analysis results show that for the variable attitude toward academic dishonesty, the significance value of 0.150 ($p > 0.05$) indicates no significant difference between undergraduate (S1) and graduate (S2) students. This suggests that educational level does not significantly influence perceptions of academic integrity, reflecting the consistent internalization of ethical academic values across higher education levels.

For the variable perception (opinion dimension) of ChatGPT use, the significance value of 0.863 ($p > 0.05$) shows that undergraduate and graduate students have relatively similar perceptions of ChatGPT's role, indicating no disparity in views regarding the role of AI in learning.

For the variable perception (usage intensity dimension) of ChatGPT use, the significance value of 0.104 ($p > 0.05$) indicates no significant difference between educational levels, reflecting that the frequency of AI use is relatively consistent—likely due to similar accessibility and technological needs among S1 and S2 students.

Differences Based on Semester Level

The Kruskal–Wallis test was conducted to examine differences in attitudes toward academic dishonesty and perceptions of ChatGPT use based on semester level. The results are presented in the following table.

Table 11. Kruskal–Wallis Test Results Based on Semester Level

	Attitude	Perception_Opinion	Perception_Intensity
Chi-Square	6.564	11.714	39.335
df	7	7	7
Asymp. Sig.	.476	.110	.000

Based on Table 10, it can be interpreted that the attitude toward academic dishonesty variable shows a significance value of 0.476 ($p > 0.05$), indicating no significant difference across semester levels. This finding suggests consistent academic integrity among students at all semester levels.

The significance value of 0.110 ($p > 0.05$) for the perception (opinion dimension) of ChatGPT use also indicates no significant difference between semester levels. This implies stability in students' views toward AI technology across semesters.

However, for the perception (usage intensity dimension) of ChatGPT, a significance value of 0.000 ($p < 0.05$) indicates a significant difference between semester levels. This difference suggests that the frequency of ChatGPT use varies across semesters.

Differences Based on Respondents' Age

The Kruskal–Wallis test was conducted to examine differences in attitudes toward academic dishonesty and perceptions of ChatGPT use based on respondents' age. The results are presented in the following table.

Table 12. Kruskal–Wallis Test Results Based on Respondents' Age

	Attitude	Perception _P	Perception _I
Chi-Square	15.519	15.228	44.475
df	16	16	16
Asymp. Sig.	.487	.508	.000

Based on the results of the Kruskal–Wallis test conducted to identify differences in the research variables by age category, the significance value for the attitude toward academic dishonesty variable was 0.487, and for the perception (opinion) variable on the use of ChatGPT was 0.508. Both values exceed the 0.05 significance threshold, indicating that there are no significant differences across age groups in either attitudes toward academic dishonesty or perceptions (opinions) regarding the use of ChatGPT. Meanwhile, the perception (intensity) variable for ChatGPT use shows a significance value of 0.000, which is below the 0.05 threshold. This indicates a significant difference in the intensity of ChatGPT use among age groups, whereas attitudes toward academic dishonesty and perceptions (opinions) about its use remain relatively similar across all age categories.

Discussion

The findings of this study provide a comprehensive overview of students' perceptions and behaviors regarding academic integrity in the ChatGPT era. Involving 1,168 respondents from 13 universities across Indonesia, the research successfully captures a diverse range of views reflecting the complex relationship between AI technology and academic ethics in Indonesian higher education.

The main findings reveal that students generally possess a good understanding of the boundaries of academic integrity, as evidenced by the high percentage (91.70%) of respondents who classified copying answers from peers during exams as cheating. This indicates that fundamental awareness of plagiarism and explicit forms of dishonesty remains well established among students. However, the situation becomes more complex when it

comes to the use of AI technologies such as ChatGPT, where ethical boundaries are less clear and require deeper interpretation.

Correlation analysis using the Spearman test showed a significant positive relationship between attitudes toward academic dishonesty and perceptions of ChatGPT use. The moderate correlation between attitudes toward academic dishonesty and perceptions of ChatGPT use suggests that students with higher tolerance for unethical behaviors tend to hold more permissive views toward AI use in academic contexts. This finding aligns with cognitive consistency theory, which posits that individuals tend to maintain coherent attitudes across different domains of ethical behavior [39].

Interestingly, the correlation between opinion perception and the intensity of ChatGPT use showed the strongest value, reflecting consistency between cognitive attitudes and actual behavior. This suggests that students who hold positive evaluations of ChatGPT not only perceive it favorably but also actively apply it in their academic practices. This finding is important because it indicates that interventions to enhance academic integrity should focus not only on cognitive (understanding) aspects but also on behavioral (practice) dimensions.

Gender-based analysis revealed no significant differences in attitudes toward academic dishonesty between male and female students. This contrasts with previous studies suggesting gender-based differences in ethical academic behavior [40]. One possible explanation is the unbalanced distribution of respondents, with female participants dominating (85%), thus creating gender bias and limiting the generalizability of the findings. This distribution reflects the demographic characteristics of elementary education programs, which are predominantly female. Nevertheless, the study found significant gender differences in perceptions regarding ChatGPT use, which may reflect variations in technology acceptance and attitudes toward innovation between genders. Research on the Technology Acceptance Model (TAM) indicates that gender can influence perceptions of usefulness and ease of use of technology [41].

Analyses by educational level revealed no significant differences between undergraduate and graduate students across all research variables. This suggests that higher academic maturity associated with advanced degrees does not automatically lead to different perceptions of academic integrity or AI use.

The most noteworthy finding concerns significant differences in the intensity of ChatGPT use across academic semesters and age groups. This pattern indicates that academic experience and age maturity influence the frequency of AI technology use, even though they do not significantly affect attitudes or perceptions toward it. Students in higher semesters tend to face more complex academic workloads and thus are more likely to utilize tools that enhance efficiency, including ChatGPT [27], [42].

Perceptions of ChatGPT usage scenarios revealed nuanced understandings of academic ethics. The majority of respondents (55.1%) agreed with using ChatGPT to correct errors and improve readability of papers, indicating acceptance of AI as a writing assistant. Conversely, 55.6% strongly disagreed with using ChatGPT to write entire papers, demonstrating relatively sound comprehension of the boundaries of academic originality. This pattern suggests that students can distinguish between using AI as a tool versus as a substitute in the academic process.

Findings regarding relatively high tolerance toward the behavior of "witnessing cheating without reporting" (54.62% considered it unethical but not cheating) reflect the moral complexity of academic dilemmas. This can be explained by the bystander effect and social responsibility diffusion theory, which suggest that individuals are less responsive to situations requiring intervention when operating within group settings [43].

The implications of this study for higher education policy are substantial. First, institutions need to develop specific guidelines for AI use in academic settings—not merely prohibiting but also providing ethical and constructive frameworks for its use. Second, digital literacy and academic ethics programs must be strengthened with particular focus on emerging technologies such as ChatGPT. Third, detection and prevention systems for academic dishonesty need to adapt to the challenges posed by AI-generated content.

From a pedagogical perspective, these findings encourage educators to design authentic assessments that are more resistant to AI-assisted completion. This includes emphasizing process-oriented evaluation, critical thinking assessment, and contextual application that demand deeper understanding and personal reflection [44], [45].

The study's limitations include the predominance of female respondents (85%) and concentration within education-related programs, which restrict the generalizability of the findings to a broader student population. Moreover, reliance on self-report surveys may introduce social desirability bias, as respondents tend to provide answers that appear more acceptable. Future research using mixed method approaches that integrate surveys with behavioral observation or experimental designs would provide a more comprehensive understanding.

This study also opens room for discussion about the evolving concept of academic integrity in the digital age. The traditional notion of academic integrity—centered on individual authorship and original thought—needs to be redefined in the context of collaborative and AI-assisted learning. Such redefinition should not reject technology outright but instead integrate it within a renewed framework of academic ethics.

Overall, this study demonstrates that Indonesian students possess relatively high awareness of academic integrity but still require clearer guidelines to navigate the ethical boundaries of AI use. Selective acceptance of ChatGPT as a writing assistant, combined with rejection of its use as a complete replacement of human effort, illustrates the potential for developing balanced AI literacy that harmonizes innovation adoption with ethical consideration.

CONCLUSION

Based on the results of the survey on students' academic integrity in the ChatGPT era, several key findings can be concluded as follows. First, regarding students' perceptions of ChatGPT use in academic activities, the findings indicate a selective and nuanced attitude. The majority of students (55.1%) accepted the use of ChatGPT as a supporting tool to correct errors and improve the readability of their writing but firmly rejected its total use for completing academic assignments (55.6% strongly disagreed). Students demonstrated an ability to distinguish between the use of ChatGPT as a learning companion and its use that violates academic integrity, as reflected in the high level of rejection toward practices such as copying others' work (86.2%) or using ChatGPT during exams (53.9%). Second, regarding the benefits and drawbacks of ChatGPT use, students perceived its main advantage as assistance in improving the quality of writing—particularly for those lacking confidence in their writing ability (40.4% reported occasional use, while 18.6% used it regularly). ChatGPT was also seen as helpful for understanding complex concepts and enhancing efficiency in task completion. However, students were aware of potential drawbacks, including the degradation of critical thinking skills, reduced academic originality, and the risk of dependency, which could decrease active engagement in the learning process and raise ethical concerns.

The study also found a significant positive relationship between attitudes toward academic dishonesty and perceptions of ChatGPT use, indicating that students with higher tolerance for unethical behavior tended to be more permissive toward the use of AI in academic contexts. Demographic analysis further revealed that academic semester level and age significantly affected the intensity of ChatGPT use, whereas gender and educational level showed no significant differences in terms of academic integrity.

REFERENCES

[1] H. N. Abd Ali, "Advancements in Natural Language Processing: Towards Human-Like Understanding and Generation of Text by AI," *BIOS: Jurnal Informatika dan Sains*, vol. 2, no. 02, pp. 129–139, 2024.

[2] Y. Chen, H. Wang, K. Yu, and R. Zhou, "Artificial intelligence methods in natural language processing: A comprehensive review," *Highlights in Science, Engineering and Technology*, vol. 85, pp. 545–550, 2024.

[3] M. Zhou, N. Duan, S. Liu, and H.-Y. Shum, "Progress in Neural NLP: Modeling, Learning, and Reasoning," *Engineering*, vol. 6, no. 3, pp. 275–290, Mar. 2020, doi: 10.1016/j.eng.2019.12.014.

[4] S. S. Nykyporets, "Digital technologies and academic integrity: exploring challenges and opportunities in the contemporary educational landscape," *Матеріали науково-практичного семінару «Академічна доброчесність: практичний досвід». Вип. 4: 75-90.*, 2023.

[5] A. Adel, A. Ahsan, and C. Davison, "ChatGPT promises and challenges in education: Computational and ethical perspectives," *Educ Sci (Basel)*, vol. 14, no. 8, p. 814, 2024.

[6] P. Sotiriadou, D. Logan, A. Daly, and R. Guest, "The role of authentic assessment to preserve academic integrity and promote skill development and employability," *Studies in Higher Education*, vol. 45, no. 11, pp. 2132–2148, 2020.

[7] R. Mulenga and H. Shilongo, "Academic integrity in higher education: Understanding and addressing plagiarism," *Acta Pedagogia Asiana*, vol. 3, no. 1, pp. 30–43, 2024.

[8] T. F. Tan *et al.*, "Generative artificial intelligence through ChatGPT and other large language models in ophthalmology: clinical applications and challenges," *Ophthalmology Science*, vol. 3, no. 4, p. 100394, 2023.

[9] S. Mohamadi, G. Mujtaba, N. Le, G. Doretto, and D. A. Adjeroh, "ChatGPT in the age of generative AI and large language models: a concise survey," *arXiv preprint arXiv:2307.04251*, 2023.

[10] A. F. Mohammad, B. Clark, and R. Hegde, "Large language model (llm) & gpt, a monolithic study in generative ai," in *2023 Congress in Computer Science, Computer Engineering, & Applied Computing (CSCE)*, IEEE, 2023, pp. 383–388.

[11] R. Khan, N. Gupta, A. Sinhababu, and R. Chakravarty, "Impact of conversational and generative AI systems on libraries: A use case large language model (LLM)," *Sci Technol Libr (New York, NY)*, vol. 43, no. 4, pp. 319–333, 2024.

[12] T. Susnjak and T. R. McIntosh, "ChatGPT: The end of online exam integrity?," *Educ Sci (Basel)*, vol. 14, no. 6, p. 656, 2024.

[13] F. M. Tabib and M. M. Alrabeei, "Can guided ChatGPT use enhance students' cognitive and metacognitive skills?," in *Artificial Intelligence in Education: The Power and Dangers of ChatGPT in the Classroom*, Springer, 2024, pp. 143–154.

[14] S. M. Abdelhalim, "Using ChatGPT to promote research competency: English as a Foreign Language undergraduates' perceptions and practices across varied metacognitive awareness levels," *J Comput Assist Learn*, vol. 40, no. 3, pp. 1261–1275, 2024.

[15] M. F. Teng, "Understanding EFL Student Writers' Metacognitive awareness in utilizing ChatGPT," *System*, p. 103848, 2025.

[16] B. Macfarlane, J. Zhang, and A. Pun, "Academic integrity: A review of the literature," *Studies in higher education*, vol. 39, no. 2, pp. 339–358, 2014.

[17] A. U. Brigue and V. N. Orlu, "Ethical considerations of leaders and integrity in public universities," *International Journal of Institutional Leadership, Policy and Management*, vol. 5, no. 2, pp. 245–261, 2023.

[18] Y. Xu and W. Li, "The causes and prevention of commercial contract cheating in the era of digital education: A systematic & critical review," *J Acad Ethics*, vol. 21, no. 2, pp. 303–321, 2023.

[19] C. L. Jocoy and D. DiBiase, "Plagiarism by adult learners online: A case study in detection and remediation," *International Review of Research in Open and Distributed Learning*, vol. 7, no. 1, pp. 1–18, 2006.

[20] C. Johnson, *Understanding academic integrity and plagiarism in the digital age: can digital forensics techniques help prevent and detect academic misconduct?* University of South Wales (United Kingdom), 2023.

[21] M. Y. I. Helal, I. A. Elgendy, M. A. Albashrawi, Y. K. Dwivedi, M. S. Al-Ahmadi, and I. Jeon, "The impact of generative AI on critical thinking skills: a systematic review, conceptual framework and future research directions," *Inf Discov Deliv*, 2025.

[22] R. Demir and C. Akar, "Transforming Clicks into Critical Thinking: An AI-Based Media Literacy Program for Children," 2025.

[23] D. N. Sari, P. E. Marsella, and A. R. Alfiyan, "Opportunities, challenges and implications of ChatGPT in the self-directed learning process on the critical thinking skills of management students," *International Journal of Integrative Research*, vol. 3, no. 7, pp. 473–488, 2025.

[24] J. Roe, W. A. Renandya, and G. M. Jacobs, "A review of AI-powered writing tools and their implications for academic integrity in the language classroom," *Journal of English and Applied Linguistics*, vol. 2, no. 1, p. 3, 2023.

[25] M. S. Bashir, "Using Text-Matching Software to Deter Plagiarism: The Do's and Don'ts," in *Introduction to Research Ethics and Academic Integrity*, Springer, 2025, pp. 47–60.

[26] A. M. Rogerson, "The use and misuse of online paraphrasing, editing and translation software," in *A research agenda for academic integrity*, Edward Elgar Publishing, 2020, pp. 163–174.

[27] L. P. Patac and A. V. Patac, "Using ChatGPT for academic support: Managing cognitive load and enhancing learning efficiency – A phenomenological approach," *Social Sciences & Humanities Open*, vol. 11, p. 101301, 2025, doi: 10.1016/j.ssaho.2025.101301.

[28] M. Javaid, A. Haleem, R. P. Singh, S. Khan, and I. H. Khan, "Unlocking the opportunities through ChatGPT Tool towards ameliorating the education system," *BenchCouncil Transactions on Benchmarks, Standards and Evaluations*, vol. 3, no. 2, p. 100115, Jun. 2023, doi: 10.1016/j.tbench.2023.100115.

[29] C. K. Boscardin, B. Gin, P. B. Golde, and K. E. Hauer, "ChatGPT and Generative Artificial Intelligence for Medical Education: Potential Impact and Opportunity," *Academic Medicine*, vol. 99, no. 1, pp. 22–27, Jan. 2024, doi: 10.1097/ACM.0000000000005439.

[30] B. Perry, "Exploring academic misconduct: Some insights into student behaviour," *Active Learning in Higher Education*, vol. 11, no. 2, pp. 97–108, Jul. 2010, doi: 10.1177/1469787410365657.

[31] J. A. Oravec, "Artificial Intelligence Implications for Academic Cheating: Expanding the Dimensions of Responsible Human-AI Collaboration with ChatGPT," *Journal of Interactive Learning Research*, vol. 34, no. 2, pp. 213–237, 2023, doi: 10.70725/304731gmmvhw.

[32] Z. (Victor) Zhang and K. Hyland, "The role of digital literacy in student engagement with automated writing evaluation (AWE) feedback on second language writing," *Comput Assist Lang Learn*, vol. 38, no. 5–6, pp. 1060–1085, Jul. 2025, doi: 10.1080/09588221.2023.2256815.

[33] T. Tressyalina, B. M. Ghaluh, E. Wulandari, E. Arief, and E. Noveria, "Enhancing students' critical thinking in criminal case solving: an AI-based pragmatic application for analyzing authentic Indonesian texts and videos," *Interactive Learning Environments*, pp. 1–33, May 2025, doi: 10.1080/10494820.2025.2504062.

[34] H. Haetami, "AI-Driven Educational Transformation in Indonesia: From Learning Personalization to Institutional Management," *AL-ISHLAH: Jurnal Pendidikan*, vol. 17, no. 2, pp. 1819–1832, Apr. 2025, doi: 10.35445/alishlah.v17i2.7448.

[35] D. Hutchison, "Designing your sample efficiently: clustering effects in education surveys," *Educational Research*, vol. 51, no. 1, pp. 109–126, 2009.

[36] J. J. J. , R. V. E. , & T. V. K. Bergström, "Challenges to academic integrity from new tools: A survey of students' perceptions and behaviors of employing ChatGPT. ," in *Proceedings of the 57th Annual Hawaii International Conference on System Sciences*, B. Tung X, Ed., Hawaii: Hawaii International Conference on System Sciences, Jan. 2024.

[37] S. Lord Ferguson, A. Flostrand, J. Lam, and L. Pitt, "Caught in a vicious cycle? Student perceptions of academic dishonesty in the business classroom," *The International Journal of Management Education*, vol. 20, no. 3, p. 100677, Nov. 2022, doi: 10.1016/j.ijme.2022.100677.

[38] D. D. Carpenter, T. S. Harding, C. J. Finelli, S. M. Montgomery, and H. J. Passow, "Engineering Students' Perceptions of and Attitudes Towards Cheating," *Journal of Engineering Education*, vol. 95, no. 3, pp. 181–194, Jul. 2006, doi: 10.1002/j.2168-9830.2006.tb00891.x.

[39] M. Conner, S. Wilding, F. van Harreveld, and J. Dalege, "Cognitive-Affective Inconsistency and Ambivalence: Impact on the Overall Attitude–Behavior Relationship," *Pers Soc Psychol Bull*, vol. 47, no. 4, pp. 673–687, Apr. 2021, doi: 10.1177/0146167220945900.

[40] M. C. Ossai, N. Ethe, D. E. Edougha, and O. D. Okeh, "Academic integrity during examinations, age and gender as predictors of academic performance among high school students," *Int J Educ Dev*, vol. 100, p. 102811, Jul. 2023, doi: 10.1016/j.ijedudev.2023.102811.

[41] M. R. , & A. J. T. Fearnley, "Learning Management System Adoption in Higher Education Using the Extended Technology Acceptance Model," *IAFOR Journal of Education*, vol. 8, no. 2, pp. 89–106, 2020.

[42] M. Civit, M. J. Escalona, F. Cuadrado, and S. Reyes-de-Cozar, "Class integration of <scp>ChatGPT</scp> and learning analytics for higher education," *Expert Syst*, vol. 41, no. 12, Dec. 2024, doi: 10.1111/exsy.13703.

[43] S. M. G. de Campos *et al.*, "Avaliação de programa sobre identificação de emoções por alunos do ensino básico," *Acta Paulista de Enfermagem*, vol. 33, Mar. 2020, doi: 10.37689/acta-ape/2020AO0049.

[44] H. Van Le and S. L. Chong, "The Dynamics of Critical Thinking Skills: A Phenomenographic Exploration from Malaysian and Vietnamese Undergraduates," *Think Skills Creat*, vol. 51, p. 101445, Mar. 2024, doi: 10.1016/j.tsc.2023.101445.

[45] L. Ketonen, M. Körkkö, and S. Pöysä, "Authentic assessment as a support for student teachers' reflection," *European Journal of Teacher Education*, vol. 48, no. 3, pp. 467–488, May 2025, doi: 10.1080/02619768.2023.2229004.

School Community Perceptions of Multiculturalism and Religious Tolerance in the Digital Era

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Abstract. Indonesia is a socio-culturally diverse nation in terms of ethnicity, race, and religion. Maintaining national integration has consistently been a central concern throughout Indonesia's history. In this context, education plays a strategic role in nurturing diversity as a source of social harmony through the implementation of multicultural education. This study aims to analyze school community perceptions of religious tolerance in schools in the digital era. The research employed a qualitative approach using focus group discussions (FGDs) and in-depth interviews involving 15 students and 5 teachers. Data were analyzed descriptively to identify key patterns and themes. The findings reveal several important issues related to interreligious intolerance in the digital era, including teachers' social constructions of intolerance, the practice of multicultural education as a preventive strategy against intolerance, and the selection of practical models of multicultural education implemented in Indonesian schools. These findings highlight the importance of strengthening multicultural education practices to promote religious tolerance amid the challenges posed by digital transformation.

INTRODUCTION

Indonesia is a nation characterized by profound socio-cultural diversity, encompassing differences in ethnicity, race, and religion. While such diversity constitutes a fundamental asset for social cohesion, it simultaneously presents persistent challenges, particularly when primordial identities are mobilized in ways that generate social tension and conflict. Historical evidence indicates that socio-religious conflicts in Indonesia have frequently been triggered by critical moments such as political elections, regime transitions, and structural economic inequalities. These dynamics demonstrate that diversity, although inherent to Indonesian society, is not inherently harmonious but requires continuous social and institutional management.

Diversity continues to shape social relations across multiple spheres of everyday life, including education. Consequently, the question of how to maintain national integration has remained a central concern throughout Indonesia's history. In this context, education occupies a strategic position in cultivating diversity as a source of social harmony through the implementation of multicultural education. Multicultural education is not merely an instructional approach but a normative framework aimed at fostering mutual respect, inclusivity, and social justice within pluralistic societies. However, its implementation faces substantial challenges, stemming not only from persistent structural inequalities but also from evolving social characteristics influenced by rapid advances in science and technology.

Contemporary Indonesian society is increasingly embedded within what is commonly referred to as the digital era, online society, or cyber society. Social interactions are now intensively and extensively mediated by digital networks, particularly social media platforms, which profoundly influence political, economic, and socio-cultural activities. Within this digitally mediated social environment, interreligious relations have become more vulnerable to tension, especially due to the emergence of echo chambers. These algorithm-driven spaces tend to reinforce homogeneous viewpoints while marginalizing alternative perspectives, thereby intensifying religious identity boundaries and reducing opportunities for meaningful interfaith dialogue.

The situation is further exacerbated by the dynamics of the post-truth era, in which emotional resonance often outweighs rational deliberation in the production and consumption of information. In social media interactions, religious identities are increasingly amplified through affective narratives, misinformation, and ideological polarization. This process contributes to the solidification, intensification, and even "freezing" of interreligious relations, where difference is emphasized over shared social values.

These broader socio-digital transformations inevitably extend into educational settings. Schools are not isolated from digital influences; rather, they function as microcosms of wider societal dynamics. Based on systematic data collection, this study identifies three key findings related to interreligious intolerance in

educational contexts in the digital era: teachers' social constructions of digital-era intolerance, the role of multicultural education practices as anticipatory and preventive strategies, and the selection of instructional models applied in multicultural education praxis within schools in the Special Region of Yogyakarta, Indonesia. These findings underscore the urgent need for context-sensitive and digitally responsive multicultural education to sustain religious tolerance in contemporary schooling.

LITERATURE REVIEW

This study is grounded in three key theoretical pillars to construct a holistic solution framework. First, social contact theory (1), which is adapted to digital contexts as digital contact theory (2), posits that structured interactions within virtual environments can reduce prejudice when specific conditions are met: (1) equal status among participants, (2) shared goals, and (3) institutional support. Second, social constructivist theory as articulated by (3) provides a foundational perspective. In its digital adaptation, (4) emphasizes the role of mediated learning through technological scaffolding, wherein multicultural content must be designed within learners' Zone of Proximal Development. Third, the critical digital literacy framework (5) conceptualizes tolerance literacy as a competency enabling learners to deconstruct dominant narratives and algorithmic biases.

Recent findings on information disorder (6) advocate a prebunking approach—countering misinformation before exposure—through gamified learning interventions. Theoretically, this model addresses the challenges of echo chambers (7) and algorithmic bias (8) while aligning with Freire's principles of critical pedagogy in digital contexts. This integrated theoretical framework provides a foundation for transforming tolerance education in alignment with the realities of digital society, while simultaneously anticipating the psychosocial risks associated with online interactions.

Previous research on technology-based tolerance education can be categorized into three generations: Generation 1 (2010–2017), which focused on static digital content such as e-books and videos using one-way communication approaches (9); Generation 2 (2018–2021), which emphasized the development of gamification and basic virtual reality for tolerance simulations (10), (11); and Generation 3 (2022–present), which prioritizes adaptive, participatory, and algorithm-aware digital learning ecosystems.

METHODE

This study employed a qualitative research design using focus group discussions (FGDs) and in-depth interviews. The participants consisted of 15 students and 5 teachers who served as key informants. The primary research instrument was the researcher as a human instrument, responsible for designing the study, collecting and analyzing data, interpreting findings, and reporting results. The researcher determined the research focus, selected participants, conducted observations and interviews, assessed data credibility, and drew conclusions. Data were analyzed using descriptive qualitative analysis.

RESULTS AND DISCUSSION

The dynamics of interreligious social relations in the era of digital transformation are also deeply reflected in educational settings. Following an extensive process of data collection, this study reveals several significant findings related to interreligious relations within educational environments in the digital era. Three major findings emerge concerning interreligious intolerance: 1) teachers' constructions of intolerance in the digital era, 2) multicultural education practices as anticipatory strategies against intolerance, and 3) the selection of praxis models for multicultural education in Indonesia.

1. Teachers' Constructions of Intolerance in the Digital Era

Based on a series of in-depth interviews with key informants, this study finds that religious intolerance, according to teachers' social constructions, has intensified in the digital era. One of the most salient experiences reported by teachers is the increasing prevalence of hate speech, hoaxes, and religiously charged content circulating across various social media platforms. A particularly prominent phenomenon is the growing incidence of interreligious bullying in digital spaces, as expressed by the following informant:

> "…in terms of interreligious intolerance within the school environment, it can be said to be relatively absent. However, on social media, it is clearly present. I often see people attacking one another in the name of religious differences, each claiming their own truth. Then they bully each other and even compare the characters of their respective prophets."

This testimony indicates that overt manifestations of interreligious intolerance are not strongly perceived in offline school environments. However, the same informant acknowledges that hate speech and religious bullying on social media have become increasingly pervasive and deeply concerning. Consequently, while interreligious relations in offline contexts such as schools remain relatively manageable, in virtual spaces or online societies teachers and educational institutions have very limited capacity to exert control.

Nevertheless, although often perceived as sporadic or situational, practices of interreligious intolerance have indeed occurred within educational institutions. One notable example is the case involving a public senior high school in Yogyakarta, SMAN 8 Yogyakarta, which in 2018 required all tenth-grade students to participate in a compulsory scouting camp during a major religious holiday period from March 30 to April 1. This policy went viral on social media for several days because non-Muslim students were required to attend the camp despite the fact that the same period coincided with the observance of the Christian Holy Week and Easter Triduum (12). This case illustrates how educational policies that disregard religious diversity may inadvertently generate intolerance and public controversy.

At the national level, data from Setara Institute further contextualize this issue. In 2023, the institute recorded a total of 217 incidents involving 329 acts of violations of freedom of religion or belief in Indonesia. Among these, Central Java and the Special Region of Yogyakarta ranked within the top five regions, each with 14 recorded incidents of intolerance. The most frequent victims of intolerance were members of the Ahmadiyah community, followers of local or indigenous belief systems, Christians, and Shi'a adherents. Meanwhile, places of worship most frequently targeted included churches, Shi'a and Ahmadiyah mosques, vihara, temples, and synagogues (13,14). These data demonstrate that schools operate within a broader socio-political ecosystem in which intolerance remains structurally embedded.

In response to such conditions, a teacher from SMAN 8 Yogyakarta explained that efforts to strengthen faith within the school environment are continuously pursued. Teachers regularly participate in religious study sessions (pengajian), while students are encouraged to perform dhuha prayers every morning to enhance religious devotion. On certain occasions, the school organizes religious quiz competitions facilitated by the student council, sometimes involving students from junior high schools. However, when asked whether the school had ever conducted religious education sessions attended by students of different faiths in a single class, the informant stated that this had never been done and expressed strong opposition to such an idea:

> "…if religious lessons were conducted in a single session attended by teachers and students of different religions, it would definitely be tense and could lead to conflict."

This response reflects a prevailing assumption among teachers that interreligious encounters within formal religious instruction are inherently risky and conflict-prone. As a result, there is no institutionalized forum for interfaith dialogue or moral education derived from shared ethical teachings across religions. Religion is conceptualized primarily as an individual matter of faith enhancement rooted in one's own religious tradition, which in turn fosters exclusivist orientations.

Based on this informant's account, it becomes evident that students' religious identities are increasingly reinforced in isolation from one another. Instead of facilitating shared ethical reflection, schools prioritize activities that strengthen individual religious identities, such as religious competitions. As a public school, this situation is particularly striking, as civic-oriented activities—such as competitions on Pancasila or national values—are less emphasized. Consequently, incidents of religious intolerance, such as the 2018 case at SMAN 8 Yogyakarta, can be understood as a logical outcome of religious education practices shaped by teachers' exclusivist constructions of religion. In such contexts, religious symbols tend to overshadow national civic symbols, even within state schools.

2. Multicultural Education Practices in the Digital Era

Several informants acknowledged that practices of religious intolerance increasingly occur on social media platforms. Given that learning processes have already integrated e-learning systems, all informants agreed that preventive measures are necessary to anticipate interreligious bullying in digital spaces.

One manifestation of online bullying often stems from comparative and superiority-based perspectives. Social media platforms are saturated with content that emphasizes hierarchical comparisons, particularly highlighting numerical superiority based on the size of religious adherents. This quantitative logic fosters a sense of dominance and majority consciousness, while neglecting the substantive moral teachings that intersect across religions. Such content exploits emotional dimensions, making it more likely to go viral and gain higher engagement.

These dynamics motivated SMA Negeri Playen Gunungkidul to implement multicultural education initiatives, including the dissemination of digital flyers promoting media literacy and religious tolerance. According to informants, multicultural education is integrated into sociology classes, emphasizing inclusive attitudes and religious tolerance. Additionally, the school mandates daily reading activities every Wednesday

and Thursday, including novels and literary works. This initiative aims to cultivate a strong reading culture, which is believed to enhance students' critical filtering skills when engaging with social media content. Students become less susceptible to disinformation, hate speech, hoaxes, and online bullying.

Most informants reported that multicultural education is primarily delivered through civic education (Pendidikan Kewarganegaraan) and sociology as part of the formal curriculum. However, not all schools implement multicultural education through extracurricular activities. Teachers generally argue that civic education includes Pancasila values that promote unity and democracy as foundational elements for tolerance, while sociology covers Indonesia's cultural diversity and encourages mutual appreciation. Notably, none of the senior high schools or vocational schools in this study integrated multicultural education into religious education subjects.

When asked about the possibility of conducting religious education classes attended by students of different faiths, nearly all informants considered it highly unlikely. The primary reason cited was the perceived sensitivity of religious behavior. There is a prevailing assumption that dialogical discussions of religion across faiths pose a high risk of conflict and unproductive debate. This perception indicates that teachers tend to understand religion in normative, formal, and exoteric terms. As one informant stated, "If students of different religions were placed in one religious education class, it would become chaotic."

These accounts suggest that religious education in schools is still largely understood as religiousness rather than religiosity. Religiousness refers to formal, ritualistic, and scriptural practices strictly adhering to canonical doctrines, whereas religiosity emphasizes substantive understanding, contextual interpretation, and ethical processes. Consequently, multicultural education in schools encounters structural constraints. Effective multicultural education, particularly in fostering religious tolerance, requires a foundational shift toward understanding religion as religiosity rather than mere religiousness. It must prioritize substance over form, process over outcomes, and dialogue and encounter as necessities (15).

If religious education remains confined to rigid religiousness, interreligious encounters in schools and broader society become nearly impossible. This presents a significant challenge to the implementation of multicultural education aimed at cultivating religious tolerance. Exclusivist, universalistic, and homogenizing religious interpretations undermine the fundamental premise of multicultural education, which celebrates diversity as a source of social cohesion.

Multicultural education requires open, inclusive perspectives that actively embrace diversity. Schools thus function as arenas for cultivating democratic values, with teachers playing a critical role as agents of change toward democratic thinking. As Levinson and Banks argue, if the core aim of multiculturalism is to celebrate difference, then multicultural education must embody the same spirit. Levinson (16) notes that educational philosophers emphasize preserving minority cultures by fostering autonomy and exposure to diverse ideas, enabling critical thinking and open-mindedness. In contrast, Banks highlights the role of multicultural education in promoting social action, equipping students with the knowledge, values, and skills necessary to challenge injustice and advocate for marginalized groups. Under this model, teachers act as agents of change, promoting democratic values and empowering students to engage in transformative action (17).

Following Banks' perspective, teachers must develop awareness and capacity to integrate multicultural education across all subjects. Students should be actively involved in the production of knowledge that embodies values of diversity and tolerance. Epistemologically, this participatory process reduces racial prejudice, ethnocentrism, and religious intolerance through collaborative learning. Such an environment dismantles stereotypes, fosters cooperative and collaborative dispositions, and cultivates equality and solidarity, ultimately strengthening democratic social structures.

3. Models of Multicultural Education Praxis in Indonesia

Dialogue and encounter constitute the core principles of multicultural education in schools. Without these, the substantial intersections among religious teachings risk becoming rigid and frozen. Teachers play a crucial role in fostering new awareness of dialogue, as canonical religious sources across traditions provide ample foundations for mutual engagement. Opportunities for dialogue expand when religion engages with socio-cultural realities rather than focusing exclusively on ascetic or eschatological concerns.

Drawing on Max Weber's notion of world rejection, religious orientations that prioritize otherworldly salvation over worldly engagement limit the potential for interreligious dialogue. All religions contain principles that balance worldly and otherworldly salvation, and this equilibrium provides a critical foundation for multicultural education. The central thesis advanced here is that the more religion prioritizes eschatological concerns exclusively, the narrower the space for dialogue and encounter. Conversely, balanced orientations open pathways for interreligious collaboration in addressing socio-cultural challenges.

However, conservative perspectives often interpret worldly engagement as secularization that threatens religious purity. This dichotomous and binary mode of thinking poses a significant obstacle to multicultural

education. Teachers' exoteric, eschatological, and scripturalist understandings of religion require transformation toward more esoteric, inclusive, contextual, and balanced interpretations.

The persistence of formalistic and binary religious interpretations among teachers presents a major challenge to multicultural education. From a Derridean perspective, such thinking reflects logocentrism. If the state engages through social institutions such as schools, families, and mass media, it must go beyond mere socialization of national values. A more fundamental intervention is required: transforming citizens' modes of thinking through critical approaches, including poststructuralist perspectives that deconstruct intolerance.

Jacques Derrida's concept of deconstruction (18) aims to subvert logocentric thinking, which he viewed as the source of philosophical stagnation. Logocentrism relies on dichotomous and hierarchical oppositions—presence/absence, identity/difference, speech/writing—where one term is privileged over the other. Derrida argues that such hierarchies must be deconstructed through inversion and displacement. Inversion reverses hierarchies, while displacement moves beyond binary systems altogether.

In the context of anti-intolerance efforts, many initiatives stop at inversion without displacement, merely reversing positions while remaining within the same hierarchical framework. As a result, intolerance is reproduced rather than dismantled. Genuine deconstruction requires abandoning the original system of thought. Exemplary figures such as Nelson Mandela and Abdurrahman Wahid (Gus Dur) exemplify this approach by transcending binary oppositions and disrupting cycles of intolerance.

Unfortunately, educational institutions in Indonesia continue to reproduce intolerance through logocentric knowledge production. Since the post-authoritarian reform era, schools have increasingly become arenas for religious identity consolidation, facilitated by rising religious political influence. Teachers and lecturers have often served as agents of religious movements, reinforcing exclusivist identities—even under the banner of the state.

It is therefore unsurprising that studies over the past decade have reported increasing intolerance among teachers and students. Research by the Center for the Study of Islam and Society found that 63% of teachers in Indonesia exhibit intolerant attitudes in religious life. Logocentric thinking dominates educational processes, embedding intolerance within students' cognitive frameworks. Consequently, despite claims of promoting tolerance, educational institutions often reproduce intolerance through their epistemological foundations.

Thus, the state has not yet fully addressed religious radicalism and intolerance through education. Meaningful intervention requires deconstructive reforms within educational institutions to dismantle logocentric thinking and foster genuinely inclusive multicultural education.

CONCLUSION

This study reveals that interreligious intolerance in the digital era is shaped not only by online dynamics but also by teachers' constructions of religion and tolerance within school settings. The findings highlight three interconnected aspects: teachers' perceptions of digital-era intolerance, multicultural education practices as preventive strategies, and the selection of multicultural praxis models in Indonesian schools. While offline school interactions tend to remain relatively harmonious, digital spaces intensify intolerance through hate speech, misinformation, and identity polarization, exposing the limitations of conventional religious education that emphasizes formal religiosity over dialogical engagement.

Building on previous studies, this research affirms that multicultural education grounded in cultural inclusivity and critical digital literacy is a strategic pathway to fostering interreligious tolerance. However, its effectiveness depends on transforming normative and exclusivist religious understandings into contextual and dialogical approaches. By positioning teachers as agents of democratic change and students as active co-constructors of knowledge, multicultural education can contribute to sustainable social cohesion and democratic resilience in increasingly digital and plural educational environments.

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REFERENCES

37. Allport, G. W. The nature of prejudice. 1954. Addison-Wesley. (Cited by Pettigrew & Tropp, 2006 - seminal work)
38. White, F. A., & Abu-Rayya, H. M. A dual process model of intergroup contact in digital contexts. Journal of Computer-Mediated Communication, 27(1),zmab024. 2022. https://doi.org/10.1093/jcmc/zmab024 (Scopus Q1, SJR: 1.8)
39. Vygotsky, L. S. Mind in society: The development of higher psychological processes. 1978. Harvard University Press. (Seminal work in constructivism)
40. Luckin, R., Cukurova, M., Kent, C., & du Boulay, B. Empowering educators to be AI-ready. 2022 British Journal of Educational Technology, 53(4), 873-891. https://doi.org/10.1111/bjet.13206
41. Ávila, J., & Pandya, J. Z. Critical digital literacies: Boundary-crossing practices. 2023. Journal of Adolescent & Adult Literacy, 66(3), 201-211. https://doi.org/10.1002/jaal.1268
42. Wardle, C., & Derakhshan, H. Information disorder: The essential glossary. 2023. Council of Europe.
43. Sunstein, C. R. #Republic: Divided democracy in the age of social media (2nd ed.). 2021. Princeton University Press. (Cited in echo chamber research)
44. Noble, S. U. Algorithms of oppression: How search engines reinforce racism. 2018. NYU Press. (Cited in algorithmic bias research)
45. Banks, J. A. Cultural diversity and education: Foundations, curriculum, and teaching (6th ed.). 2015. Routledge. (Cited in multicultural education research)
46. Admiraal, W., Huizenga, J., Heemskerk, I., Kuiper, E., Volman, M., & ten Dam, G. Gender-inclusive game-based learning in secondary education. International Journal of Serious Games, 8(2), 89-104. 2021. https://doi.org/10.17083/ijsg.v8i2.411 (Q1 – CiteScore: 4.5, SJR: 0.8)
47. Hasler, B. S., Spanlang, B., & Slater, M. Virtual reality for reducing religious prejudice: A study of interfaith encounters. Computers & Education, 178, 104385. 2021. https://doi.org/10.1016/j.compedu..104385 (Q1 – CiteScore: 11.9, SJR: 2.3)
48. Suryowati, Estu. Asal Muasal Penelitian Kemendikbud dan Temuan Sikap Intoleransi di Sekolah. 2017 May. Available from: https://nasional.kompas.com/read/2017/05/03/14380761/asal.muasal.penelitian.kemendikbud.dan.temuan.sikap.intoleransi.di.sekolah
49. Kapisa, Hans Arnold. SD Inpres di Manokwari Larang Siswi Berhijab di Kelas. 2019 Dec. Available from: https://nasional.tempo.co/read/1280055/sd-inpres-di-manokwari-larang-siswi-berhijab-di-kelas
50. Setiawan, Riyan. Kasus Pemaksaan Jilbab di Sekolah Masif, Kemendikbud Bisa Apa? 2022 Aug. Available from: https://tirto.id/kasus-pemaksaan-jilbab-di-sekolah-masif-kemendikbud-bisa-apa-guSw
51. Wahyono, Sugeng Bayu; Budiningsih, Asri; Suyantiningsih, Rahmadonna, Sisca. Multicultural Education And Religious Tolerance Elementary School Teachers' Understanding of Multicultural Education in Yogyakarta. A l-Jāmi'ah: Journal of Islamic Studies - ISSN: 0126-012X (p); 2356-0912 (e) Vol. 60, no. 2 2022, pp.467-508, http://doi.org/10.14421/ajis.2022.602.467-508
52. Levinson, M. (2009) Ch. 23. 'Mapping Multicultural Education' in Harvey Seigel, ed., The Oxford Handbook of Philosophy of Education (Oxford University Press).
53. Banks, J. A. Cultural diversity and education: Foundations, curriculum, and teaching. Journal of Multicultural Education, 13(3), 210-225. https://doi.org/10.1108/JME-03-2019-002 (Q1 – CiteScore: 6.2, SJR: 1.1)
54. Derrida, Jacques. 1981. Position. Terjemahan Alan Bass. London: Athlone Press.

The Influence of Marketing Literacy, FOMO, Social Class, and Brand Awareness on Purchase Behavior of Generation Z

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Abstract. This study investigates the determinants of purchase behavior among Generation Z by examining the influence of marketing literacy, Fear of Missing Out (FOMO), social class, and brand awareness. A quantitative design was employed using structured questionnaires distributed to 200 active fashion consumers in Yogyakarta, Indonesia. Data were analyzed using Structural Equation Modeling (SEM) with a Partial Least Squares (PLS) approach. Results indicate that all four constructs—marketing literacy ($\beta = 0.303$, $p < 0.001$), FOMO ($\beta = 0.258$, $p < 0.001$), social class ($\beta = 0.296$, $p < 0.001$), and brand awareness ($\beta = 0.369$, $p < 0.001$)—significantly and positively affect purchase behavior. Brand awareness emerged as the most dominant predictor. The model explains 72.9% of the variance in purchase behavior. These findings offer strategic insights for marketers targeting Generation Z, emphasizing the importance of building strong brand awareness, transparent communication, and leveraging psychological drivers like FOMO in ethical ways.

Keywords: brand awareness, FOMO, generation Z, marketing literacy, purchase behavior, social class

INTRODUCTION

Generation Z, born between 1997 and 2012, represents a digitally native cohort whose consumption behavior is shaped by rapid technological advancement, social media exposure, and psychological drivers (Sari & Berlianantiya, 2022). As the most active segment in online shopping and brand interaction, understanding their purchase behavior has become a strategic priority for marketers and researchers alike (Sari & Berlianantiya, 2022).

Recent studies suggest that purchase decisions among Gen Z are influenced not only by economic considerations but also by cognitive and emotional constructs such as marketing literacy, Fear of Missing Out (FOMO), social class perception, and brand awareness (Linggasari, 2023; Sari & Berlianantiya, 2022).

Marketing literacy enables consumers to critically evaluate promotional content and make informed decisions (Hudders et al., 2023), while FOMO—amplified by social media—triggers impulsive buying due to perceived social exclusion (Boerman & van Reijmersdal, 2024). Social class, both actual and aspirational, affects preferences and brand choices (Septiani & Wahyudi, 2022), whereas brand awareness plays a pivotal role in shaping trust, familiarity, and loyalty (Zhang & Benyoucef, 2024).

Despite the growing interest in Gen Z behavior, empirical studies integrating these four constructs within a unified model remain limited, particularly in emerging markets such as Indonesia (Ismail et al., 2023).

This research aims to fill that gap by examining the simultaneous influence of marketing literacy, FOMO, social class, and brand awareness on Gen Z's purchase behavior in the fashion sector. The findings are expected to provide actionable insights for businesses targeting this segment, while contributing to the theoretical development of consumer behavior models in the digital era (Kussdyah et al., 2023).

LITERATURE REVIEW

Marketing Literacy

Marketing literacy refers to the cognitive, affective, and behavioral competencies that enable individuals to critically evaluate marketing messages and make informed decisions (Hudders et al., 2023). Generation Z, as digital natives, often display paradoxical behavior—while they are aware of persuasive tactics, they are more receptive to authentic narratives from micro-influencers than traditional corporate advertising (Boerman & van Reijmersdal, 2024). This appreciation for creativity and transparency fosters purchase intentions based on value recognition rather than manipulation (Septiani & Wahyudi, 2022).

Hypothesis H1: Marketing literacy has a positive influence on purchase behavior.

Fear of Missing Out (FOMO)

FOMO has evolved into a psychological phenomenon amplified by real-time digital interactions. Live-streaming events such as flash sales and product launches intensify impulsive buying behavior among Gen Z (Zhang & Benyoucef, 2024). Moreover, social media fatigue paradoxically increases FOMO, as individuals fear disconnection from trending information (Ismail et al., 2023). In the fashion context, FOMO drives symbolic consumption, where owning a product signifies participation in cultural conversations (Kussdyah et al., 2023).

Hypothesis H2: FOMO has a positive influence on purchase behavior.

Social Class

Social class influences consumer behavior not only through economic capital but also through cultural and symbolic capital (Farhana & Sari, 2024). Among Gen Z, aspirational consumption is prevalent—individuals from middle-class backgrounds often pursue niche brands and limited-edition items to signal upward mobility (Kapoor & Dwivedi, 2023). Fashion choices serve as non-verbal expressions of identity negotiation, especially in urban student environments like Yogyakarta (Pratama & Dewi, 2021).

Hypothesis H3: Social class has a positive influence on purchase behavior.

Brand Awareness

In the saturated digital marketplace, brand awareness has transformed into a multidimensional construct. It encompasses top-of-feed visibility, searchability, and community embeddedness (Kumar & Gupta, 2024). For Gen Z, effective brand awareness stems from contextual relevance and meme-ability, where brands engage authentically and create cultural moments (Rosenthal & Brito, 2023). This emotional resonance enhances recall and trust, making brand awareness a critical driver of purchase behavior (Aaker, 1991; Kotler & Keller, 2016).

Hypothesis H4: Brand awareness has a positive influence on purchase behavior.

Purchase Behavior of Generation Z

Gen Z's purchase behavior reflects a blend of pragmatism, value orientation, and digital immersion. They seek phygital experiences—seamless integration of online and offline shopping environments (Priporas et al., 2024). Selective authenticity guides their choices; they value transparency and social impact over promotional hype (Djafarova & Bowes, 2024). Understanding these traits is essential for developing marketing strategies that resonate with Gen Z's expectations and values.

RESEARCH METHOD

This study employed a quantitative research design with a cross-sectional approach to examine the influence of marketing literacy, Fear of Missing Out (FOMO), social class, and brand awareness on the purchase behavior of Generation Z. The research was conducted in Yogyakarta, Indonesia, targeting active fashion consumers aged 17–28 who had made at least two fashion purchases per month. Quantitative research is defined as an empirical approach that collects, analyzes, and presents data in numerical form to test hypotheses and explain variance in dependent variables (Abawi, 2008; Sekaran & Bougie, 2016).

Population and Sampling Technique

The population consisted of Generation Z individuals residing in Yogyakarta, Indonesia. Generation Z is defined as individuals born between 1997 and 2012 who actively engage in fashion purchases. A purposive sampling technique was used to select respondents who met the following criteria: (1) aged 17 years or older, (2) actively purchased at least two fashion products per month, and (3) were familiar with digital platforms (Malhotra, 2010; Hair et al., 2010). A total of 200 respondents were selected, aligning with recommendations for Partial Least Squares Structural Equation Modeling (PLS-SEM), which requires a minimum sample size of 100–200 for robust estimation (Hair et al., 2010).

Data Collection and Instrumentation

Primary data were collected through structured questionnaires consisting of five constructs: marketing literacy, FOMO, social class, brand awareness, and purchase behavior. Each construct was measured using five indicators adapted from validated scales in previous studies (Parasuraman et al., 1988; Cronin et al., 2000). Responses were recorded on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) (Sekaran & Bougie, 2016).

Measurement Model and Reliability Testing

Instrument reliability was confirmed through Cronbach's Alpha and Composite Reliability (CR), with all constructs exceeding the threshold of 0.70. Validity was assessed using Average Variance Extracted (AVE), with values above 0.50 for all constructs, indicating satisfactory convergent validity (Sekaran & Bougie, 2016;

Hair et al., 2010). The instrument grid was developed to ensure alignment between indicators and theoretical constructs (Sugiyono, 2015).

Data Analysis Technique

Data were analyzed using Structural Equation Modeling (SEM) with a Partial Least Squares (PLS) approach, utilizing SmartPLS software. The analysis included outer model testing (validity and reliability), R-square evaluation, and hypothesis testing through path coefficients and t-statistics (Hair et al., 2010).

Ethical Considerations

All respondents participated voluntarily and were informed about the purpose of the study. Data confidentiality and anonymity were maintained throughout the research process.

RESULT AND DISCUSSION

This study examined the influence of four key constructs—marketing literacy, Fear of Missing Out (FOMO), social class, and brand awareness—on the purchase behavior of Generation Z in Yogyakarta. Using Structural Equation Modeling (SEM) with a Partial Least Squares (PLS) approach, the findings revealed that all four variables significantly and positively affected purchase behavior.

Descriptive Analysis

The descriptive statistics showed that respondents generally had high levels of agreement across all indicators, with mean scores ranging from 3.575 to 4.320 on a five-point Likert scale. Standard deviations were relatively low (0.43–0.63), indicating consistent responses. This suggests that Generation Z consumers in Yogyakarta exhibit strong perceptions toward marketing literacy, FOMO, social class relevance, and brand awareness in their fashion purchasing decisions.

Gender

Table 1 shows that the total sample consisted of 203 respondents, comprising 89 males (43.8%) and 114 females (56.2%).

Table 1. Category frequency gender

Gender	Frequency	Percentage
Male	89	43,8%
Female	114	56,2%
Total	**203**	**100,0%**

Educational Background of Respondents

Table 2 shows that the majority of respondents held a senior high school or equivalent qualification, totaling 93 individuals (45.8%). This was followed by diploma-level education with 48 individuals (23.6%), undergraduate degrees with 59 individuals (29.1%), and postgraduate degrees with 3 individuals (1.5%).

Table 2. Category frequency educational background of respondents

Educational	Frequency	Percentage
Senior High School	93	45,8%
Diploma	48	23,6%
Bachelor's Degree	59	29,1%
Postgraduate Degree	3	1,5%
Total	**203**	**100,0%**

Monthly Expenditure on Fashion Products

Table 3 shows that the majority of respondents reported monthly fashion expenditures of less than Rp 500,000, totaling 131 individuals (64.5%). This was followed by expenditures between Rp 500,000 and Rp 1,000,000 with 61 individuals (30%), Rp 1,000,001 to Rp 2,000,000 with 7 individuals (3.4%), and more than Rp 2,000,000 with 3 individuals (2%).

Table 3. Category frequency monthly expenditure on fashion products

Amount	Frequency	Percentage
<Rp 500.000	131	64,5%

Rp 500.000 – Rp 1.000.000	61	30%
Rp 1.000.001 – Rp 2.000.000	7	3,4%
>Rp 2.000.000	4	2%
Total	**203**	**100,0%**

Descriptive Analysis of Research Variables

Descriptive statistical analysis was conducted to provide an overview of respondent responses across all research variables, including the independent variables—Marketing Literacy (X1), Fear of Missing Out (FOMO) (X2), Social Class (X3), and Brand Awareness (X4)—as well as the dependent variable, Purchase Behavior (Y). Table 4 shows:

Table 4. Descriptive analysis of research variables

Name	Mean	Median	Minimum Value	Maximum Value	Standard deviation
X1-1	3.920	4.000	1.000	5.000	0,630555556
X1-2	3.965	4.000	1.000	5.000	0,582638889
X1-3	3.960	4.000	1.000	5.000	0,616666667
X1-4	3.925	4.000	1.000	5.000	0,597222222
X1-5	3.905	4.000	1.000	5.000	0,5875
X2-1	3.780	4.000	1.000	5.000	0,60625
X2-2	3.885	4.000	1.000	5.000	0,621527778
X2-3	3.935	4.000	1.000	5.000	0,605555556
X2-4	3.845	4.000	1.000	5.000	0,547222222
X2-5	3.835	4.000	1.000	5.000	0,624305556
X3-1	3.810	4.000	1.000	5.000	0,606944444
X3-2	3.865	4.000	1.000	5.000	0,604166667
X3-3	3.860	4.000	1.000	5.000	0,632638889
X3-4	3.810	4.000	1.000	5.000	0,586805556
X3-5	3.800	4.000	1.000	5.000	0,577083333
X4-1	3.795	4.000	1.000	5.000	0,610416667
X4-2	3.840	4.000	1.000	5.000	0,61875
X4-3	3.910	4.000	1.000	5.000	0,581944444
X4-4	3.915	4.000	1.000	5.000	0,600694444
X4-5	3.895	4.000	1.000	5.000	0,574305556
Y1	4.320	4.000	1.000	5.000	0,51875
Y2	4.135	4.000	1.000	5.000	0,474305556
Y3	3.945	4.000	1.000	5.000	0,434722222
Y4	3.795	4.000	1.000	5.000	0,429861111
Y5	3.575	4.000	1.000	5.000	0,447222222

Overall, all indicators across the measured constructs demonstrated relatively high mean scores, ranging from 3.575 to 4.320 on a five-point Likert scale. The median value for each indicator was 4.00, indicating that most respondents expressed agreement or strong agreement with the statements provided.

The minimum and maximum values for all indicators were 1 and 5, respectively, suggesting that while the majority of responses were positive, there was still a full range of variation across the scale. The standard deviation values, ranging from 0.430 to 0.633, reflect a narrow distribution and indicate a high level of response consistency among participants.

Specifically, the dependent variable Purchase Behavior (Y) recorded the highest mean score on indicator Y1 (4.320) and the lowest on Y5 (3.575). Meanwhile, all indicators within the independent variables showed mean scores above 3.78, with several indicators—such as X1-2 and X1-3 under Marketing Literacy—exceeding 3.96.

These results suggest that respondents generally hold strong and positive perceptions toward all measured constructs, with a high degree of internal consistency in their responses.

Measurement Model Validation

Reliability and validity tests confirmed the robustness of the measurement model. All constructs achieved Cronbach's Alpha and Composite Reliability values above 0.90, and Average Variance Extracted (AVE) values exceeded 0.70, indicating excellent internal consistency and convergent validity (Sekaran & Bougie, 2016; Hair et al., 2010).

Table 5. Reliability and validity tests

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
X1 - Marketing Literacy	0,924	0,926	0,943	0,767
X2 - Fear of Missing Out _(FOMO)	0,916	0,921	0,937	0,749
X3 - Social Class	0,913	0,913	0,935	0,741
X4 - Brand Awareness	0,917	0,917	0,938	0,750
Y - Purchase Behavior of Generation Z	0,944	0,946	0,957	0,816

Structural Model and Hypothesis Testing

The R-square value of 0.729 indicates that the four independent variables can explain 72.9% of the variance in purchase behavior.

Table 6. *R-Square Test*

	R-square	**R-square adjusted**
Y-Purchase Behavior of Generation Z	0.729	0.723

Hypothesis testing on Table 7 showed that:

Table 7. Hypothesis testing results

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
X1-Marketing Literacy-> Y-- Purchase Behavior of Generation Z	0.303	0.304	0.040	7.504	0.000
X2-Fear of Missing Out _(FOMO) -> Y-Purchase Behavior of Generation Z	0.258	0.260	0.042	6.091	0.000
X3-Social Class-> Y- Purchase Behavior of Generation Z	0.296	0.299	0.045	6.599	0.000
X4-Brand Awareness -> Y- Purchase Behavior of Generation Z	0.369	0.370	0.041	9.014	0.000

- Marketing literacy significantly influenced purchase behavior ($\beta = 0.303$, $t = 7.504$, $p < 0.001$)
- FOMO had a positive effect ($\beta = 0.258$, $t = 6.091$, $p < 0.001$)
- Social class was a significant predictor ($\beta = 0.296$, $t = 6.599$, $p < 0.001$)
- Brand awareness emerged as the most dominant factor ($\beta = 0.369$, $t = 9.014$, $p < 0.001$)

These results validate all four hypotheses and confirm the multidimensional nature of Gen Z's purchase behavior.

Discussion of Key Findings

Marketing Literacy:

Gen Z consumers with high marketing literacy are more discerning and confident in evaluating promotional content. Rather than resisting advertising, they appreciate authenticity and storytelling, which enhances purchase intention (Septiani & Wahyudi, 2022; Ardyan, 2019).

FOMO:

FOMO acts as a psychological trigger, especially in fast-paced digital environments. In Yogyakarta's youth-driven fashion scene, FOMO drives symbolic consumption and impulsive buying as a means of social inclusion (Kussdyah et al., 2023; Wijaya et al., 2022).

Social Class:

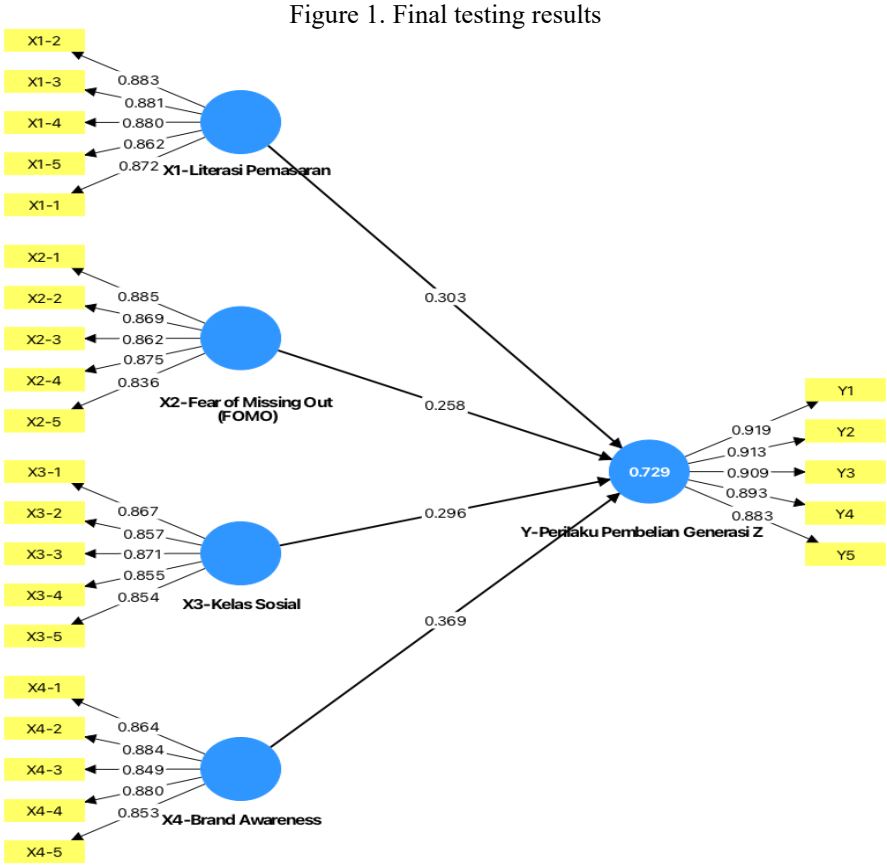
Fashion consumption among Gen Z reflects aspirational identity and social signaling. Products serve as non-verbal cues of status and mobility, particularly in diverse urban student communities (Pratama & Dewi, 2021; Veblen, 1999).

Brand Awareness:

High brand awareness fosters trust and familiarity, reducing perceived risk in online purchases. Gen Z responds positively to brands that maintain consistent, authentic digital presence and engage in cultural conversations (Aaker, 1991; Kotler & Keller, 2016).

These findings underscore the importance of integrated marketing strategies that combine educational content, emotional engagement, and social relevance to influence Gen Z consumers effectively.

Figure 1. Final testing results



CONCLUSION

This study confirms that the purchase behavior of Generation Z in Yogyakarta is significantly influenced by four key constructs: marketing literacy, Fear of Missing Out (FOMO), social class, and brand awareness. All variables demonstrated positive and statistically significant effects, validating the proposed conceptual model.

Among these, brand awareness emerged as the most dominant predictor, highlighting the strategic importance of building strong and memorable brand identities in digital environments. Marketing literacy also played a critical role, indicating that Gen Z consumers are not only digitally savvy but also value transparency and authenticity in promotional content. Social class influenced consumption patterns through aspirational signaling and identity negotiation, while FOMO acted as a psychological driver that triggered impulsive and symbolic purchases.

The findings contribute to the growing body of literature on Gen Z consumer behavior by integrating cognitive, emotional, sociological, and brand equity dimensions into a unified framework. Practically, the results offer actionable insights for marketers and fashion brands seeking to engage Gen Z audiences: prioritize brand awareness through consistent digital presence, communicate with clarity and relevance, and ethically leverage psychological triggers such as FOMO.

REFERENCE

[1] Abawi, K. (2008). Qualitative and quantitative research. World Health, 2(1), 1–10.

[2] Aaker, D. A. (1991). Managing brand equity. Free Press.

[3] Ardyan, E. (2019). Millennial consumer perception of digital marketing and online purchase decision. Journal of Consumer Sciences, 4(2), 89–102.

[4] Arikunto, S. (2010). Metode penelitian. Rineka Cipta.

[5] Boerman, S. C., & van Reijmersdal, E. A. (2024). Paradoks pengetahuan persuasi: Bagaimana literasi pemasaran mempengaruhi respons terhadap iklan native dan pemasaran influencer. Jurnal Pemasaran Interaktif. https://doi.org/10.1002/dir.1765

[6] Cronin, J. J., Brady, M. K., & Hult, G. T. M. (2000). Assessing the effects of quality, value, and customer satisfaction on consumer behavioral intentions in service environments. Journal of Retailing, 76(2), 193–218. https://doi.org/10.1016/S0022-4359(00)00028-2

[7] Djafarova, E., & Bowes, T. (2024). 'Instagram membuat saya membelinya': Generasi Z dan pembelian impulsif dalam mode cepat. Jurnal Pemasaran dan Manajemen Mode: Jurnal Internasional.

[8] Farhana, M., & Sari, D. P. (2024). Modal sosial digital dan pola konsumsi di kalangan Generasi Z Indonesia. Jurnal Pemasaran ASEAN.

[9] Hair Jr, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2010). SEM: An introduction. In Multivariate data analysis: A global perspective (Vol. 5, No. 6, p. 86).

[10] Hudders, L., De Pauw, P., Cauberghe, V., Panic, K., & Zarouali, B. (2023). Literasi pemasaran digital: Kerangka konseptual dan wawasan untuk penelitian mendatang. Jurnal Urusan Konsumen. https://doi.org/10.1111/joca.12512

[11] Ilham, I., & Hermawati, H. (2018). Pengaruh faktor kelas sosial terhadap perilaku konsumen dalam pemilihan pakaian di Desa Lagego, Kecamatan Burau, Kabupaten Luwu Timur. Dinamis: Journal of Islamic Management and Business, 1(1).

[12] Ismail, A. R., Nguyen, B., & Melewar, T. C. (2023). Sisi gelap media sosial: Kelelahan media sosial, FOMO, dan pembelian kompulsif daring. Peramalan Teknologi dan Perubahan Sosial. https://doi.org/10.1016/j.techfore.2023.122123

[13] Jin, N. P., Line, N. D., & Merkebu, J. (2015). The effects of image and price fairness: A consideration of delight and loyalty in the waterpark industry. International Journal of Contemporary Hospitality Management, 28(9), 1895–1914. https://doi.org/10.1108/IJCHM-07-2014-0351

[14] Kapoor, P. S., & Dwivedi, Y. K. (2023). Kelas aspiratif: Memodelkan konsumsi yang mencolok di era digital. Psikologi & Pemasaran. https://doi.org/10.1002/mar.21789

[15] Kotler, P., & Keller, K. L. (2013). Manajemen pemasaran (Jilid Kedua). Erlangga.

[16] Kotler, P., & Keller, K. L. (2016). Marketing management (15th ed.). Pearson Education.

[17] Kumar, V., & Gupta, S. (2024). Mengonseptualisasikan dan mengukur kesadaran merek digital. Jurnal Akademi Ilmu Pemasaran. https://doi.org/10.1177/0092070324123456

[18] Kussdyah, I., Suryani, T., & Furqon, C. (2023). The impact of social media marketing and FOMO on impulse buying behavior of Generation Z. Indonesian Journal of Business and Entrepreneurship, 9(1), 45–58. https://doi.org/10.17358/ijbe.9.1.45

[19] Linggasari, F. S. (2023). Pengaruh kelompok referensi, kelas sosial, dan kepribadian konsumen terhadap keputusan pembelian skincare product pada TikTok Shop: Studi pada Generasi Z di Kota Malang (Disertasi Doktoral, Universitas Islam Negeri Maulana Malik Ibrahim).

[20] Malhotra, N. K. (2010). Riset pemasaran (Edisi 4 Jilid 1). PT Indeks.

[21] Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1988). SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality. Journal of Retailing, 64(1), 12–40.

[22] Pratama, B., & Dewi, L. (2021). Fashion consumption as a symbol of social status among university students in Yogyakarta. Jurnal Sosial Humaniora, 14(2), 112–125.
[23] Priporas, C. V., Stylos, N., & Fotiadis, A. K. (2024). Pengalaman fisik: Tinjauan sistematis dan agenda penelitian. Jurnal Internasional Manajemen Informasi.
[24] Rahman, M. S., & Aziz, M. N. (2014). Service quality and behavioural intentions in broadband services selection. Marketing Intelligence & Planning, 32(4), 455–474. https://doi.org/10.1108/MIP-03-2013-0055
[25] Rosenthal, B., & Brito, E. P. Z. (2023). Pemasaran meme: Bagaimana merek dapat menciptakan nilai budaya. Jurnal Manajemen Pemasaran. https://doi.org/10.1016/j.jmm.2023.04.005
[26] Sari, N. E., & Berlianantiya, M. (2022). Pengaruh literasi digital terhadap perilaku belanja online pada Gen-Z di Universitas PGRI Madiun. Equilibrium: Jurnal Ilmiah Ekonomi dan Pembelajarannya, 10(2), 179–184. https://doi.org/10.25273/equilibrium.v10i2.13195
[27] Sekaran, U., & Bougie, R. (2016). Research methods for business: A skill building approach. John Wiley & Sons.
[28] Septiani, R., & Wahyudi, S. (2022). The role of digital literacy and marketing literacy on purchase decisions of Generation Z. Jurnal Ekonomi dan Bisnis, 25(1), 78–92.
[29] Sugiyono. (2015). Metode penelitian kuantitatif, kualitatif, dan R&D. Alfabeta.
[30] Sivadas, E., & Baker-Prewitt, J. L. (2000). An examination of the relationship between service quality, customer satisfaction, and store loyalty. International Journal of Retail & Distribution Management, 28(2), 73–82. https://doi.org/10.1108/09590550010315223
[31] Veblen, T. (1899). The theory of the leisure class. Macmillan.
[32] Wijaya, A., Sari, D. P., & Hidayat, R. (2022). Fear of Missing Out (FOMO) and online shopping behavior: A study on Generation Z in Indonesia. Journal of Islamic Marketing, 13(8), 1750–1765.
[33] Yuen, E. F. T., & Chan, S. S. L. (2010). The effect of retail service quality and product quality on customer loyalty. Database Marketing & Customer Strategy Management, 17(3/4), 222–240. https://doi.org/10.1057/dbm.2010.21
[34] Zeithaml, V. A., Berry, L. L., & Parasuraman, A. (1996). The behavioral consequences of service quality. Journal of Marketing, 60(2), 31–46. https://doi.org/10.1177/002224299606000203
[35] Zhang, K. Z., & Benyoucef, M. (2024). Dampak perdagangan streaming langsung terhadap ketakutan kehilangan fokus (FOMO) dan perilaku pembelian impulsif konsumen. Jurnal Ritel dan Layanan Konsumen. https://doi.org/10.1016/j.jretconser.2024.103456
[37] Zikmund, W. G., & Babin, B. J. (2011). Menjelajahi riset pemasaran. Salemba Empat.

FROM LOCAL WISDOM TO THE MODERN CLASSROOM: HOW TO DESIGN A CULTURAL LITERACY MODEL FOR PRIMARY SCHOOL STUDENTS THROUGH DESIGN-BASED RESEARCH?

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Abstract. Cultural literacy at an early age is crucial in shaping the character and identity of young generations who are rooted in local wisdom while remaining adaptive to global challenges. This study aims to design a contextual cultural literacy model for primary school students using a Design-Based Research (DBR) approach. The initial phase of the research focused on teachers' needs analysis and mapping of local cultural resources as the foundation for lesson design. The findings indicate that teachers still face limitations in integrating cultural content into classroom practices and require systematic and practical guidance. Based on these insights, this study developed a lesson design flowchart emphasising reflective, collaborative, and participatory activities that actively involve local cultural sources (such as community elders, traditional arts, and folklore). Preliminary conclusions suggest that the designed model has the potential not only to strengthen students' cultural literacy but also to support the achievement of Indonesia's Asta Cita in fostering character, national identity, and diversity. The next phase will involve classroom trials to test the model's effectiveness and refine the design through subsequent DBR cycles.

Keywords: Cultural literacy, primary education, design-based research, local wisdom, Asta Cita.

INTRODUCTION

Primary education serves as a fundamental foundation for shaping the character, identity, and sense of self of young generations amid the rapidly changing global landscape. One of the essential dimensions in character formation is cultural literacy the ability to understand, appreciate, and internalise local cultural values in everyday life [1], [2], [3]. Cultural literacy not only functions as a means of preserving cultural heritage but also as an instrument for strengthening social cohesion and enriching 21st-century competencies such as critical thinking, creativity, and cross-cultural empathy [2], [4], [5].

Education is the seedbed of a nation's culture and must contain national cultural elements [6]. This well-known principle from Indonesia's national education figure, Ki Hajar Dewantara, remains highly relevant in today's era of globalisation and digital transformation. Schools play a strategic role as the nurturing ground for cultural values. Hence, one of the vital tasks of educators and educational institutions at all levels is to develop, promote, and enhance cultural literacy [7], [8], [9].

In the context of this study, cultural literacy is conceptualised as a social practice that is inherently dialogical based on learning and knowledge acquisition through empathetic, tolerant, and inclusive interactions with others [10], [11], [12]. The implementation of cultural literacy also aligns with the eighth pillar of Asta Cita, as outlined by the Government of Indonesia under President Prabowo Subianto, which emphasises cultural resilience and the development of character rooted in national identity [13].

Cultural literacy has been identified as one of the six core literacies promoted by the Indonesian government since 2017. Its implementation in classroom settings is measured by the extent to which cultural content is integrated into learning activities. Teachers play a crucial role as key agents in embedding cultural literacy within their classrooms. However, empirical findings indicate that many teachers possess insufficient knowledge about their students' diverse cultural backgrounds and may even hold unconscious biases toward certain cultures [14], [15]. Consequently, teachers often fail to engage meaningfully with cultural differences, which in turn hinders the creation of culturally responsive learning environments [14], [16]. Furthermore, numerous studies on cultural education highlight persistent gaps and deficiencies in teachers' experiences,

attitudes, and perceptions regarding diverse cultural interactions [17], [18]. These findings underscore the need for a systematic and contextual model that equips teachers with the practical and reflective skills required to design and implement culturally responsive teaching in primary education

Culture is a crucial developmental factor for children, with research revealing its influence on children's behaviour, interpersonal and social skills, as well as prosocial tendencies [19], [20]. Certain cultural contexts can significantly contribute to the development of empathy among children (ages 6–10). Cultural literacy learning therefore serves as a key foundation for fostering tolerance, empathy, and inclusivity towards diversity [21], [22]. Consequently, speaking or more specifically, developing children's dialogical and argumentative skills becomes fundamental to promoting cultural literacy among young learners. The development of cultural literacy is essential as a basis for cultural understanding and for facilitating the learning of culture within society.

The existence of culture faces serious challenges. Primary school pupils need to be introduced early on to the richness of cultural heritage to nurture identity awareness, tolerance, and appreciation for diversity. Cultural literacy is not merely about acquiring knowledge of culture; it encompasses the ability to understand cultural meanings, appreciate cross-cultural values, and engage in inclusive interaction within a multicultural society [2], [9]. Studies have shown that cultural education at the primary school level in Indonesia remains largely ceremonial and has yet to reach a deeper level of understanding. In fact, education serves as a key medium for transmitting cultural values from one generation to the next [23]. Cultural literacy, therefore, should be designed contextually, involving authentic learning experiences and utilising social interaction as an integral part of the educational process.

Findings from research indicate that a design based research approach is effective in producing deeper, more reflective teacher learning and serves as a platform to strengthen the connection between research and practice [24], [25], [26]. In collaboration with teachers, researchers develop context-sensitive pedagogical practices and teaching strategies, with a focus on both student learning and the professional growth of teachers throughout the process. Within this context, the design-based approach becomes particularly relevant, as it emphasises an iterative process between design, implementation, and evaluation in real-world settings. This model not only produces educational products but also generates theoretical insights into effective learning practices. Hence, this approach is suitable for addressing the complex challenges of contemporary education due to its flexible, contextual, and collaborative nature [27].

In the Indonesian context, cultural literacy has become an integral part of the national effort to shape the Pancasila Student Profile, which emphasises faith, character, and personality within diversity [28], [29]. However, various studies reveal that the implementation of local cultural values in primary education remains fragmented and unsystematic [30], [31]. Teachers often encounter difficulties in integrating local wisdom into the national curriculum, particularly in designing contextual and meaningful learning activities for students [32], [33].

On the other hand, the transformation of education in the digital era demands innovation in learning design so that local culture does not remain merely passive knowledge, but can instead be actively integrated into modern and collaborative learning practices [34], [35], [36]. The Design-Based Research (DBR) approach offers a relevant methodological framework to address this challenge, as it enables the development of practice-oriented learning models that are grounded in real-life contexts and tested through iterative cycles of reflection between theory and practice [37], [38]. Through this approach, pedagogical innovations can be developed sustainably by involving collaboration between researchers, teachers, and cultural communities.

Given this background, this study aims to develop a contextual cultural literacy model for primary school students based on the Design-Based Research (DBR) approach. This model is expected to provide a systematic guide for teachers in designing learning that integrates local cultural values with the demands of 21st-century education. Furthermore, the outcomes of this research are anticipated to contribute to the national vision of Asta Cita Indonesia, particularly in strengthening the nation's character, identity, and diversity through education.

LITERATURE REVIEW

Cultural literacy refers to the competence to understand, internalise, and appreciate the cultural values that exist within society as an integral part of both individual and social identity [2], [39]. In the context of primary education, cultural literacy functions not only as a means of preserving traditions but also as a medium for shaping character, fostering social empathy, and building multicultural awareness [40]. Cultural literacy at the primary school level is crucial because children at this stage are developing their understanding of the values, norms, and symbols that surround them [41]. Cultural literacy education encourages pupils to recognise cultural differences and similarities, while cultivating openness towards diversity. This aligns with the goals of the Pancasila Student Profile, which emphasises faith, global diversity, and critical reasoning [28], [29].

However, research indicates that teachers' understanding of cultural literacy concepts remains inconsistent, and their classroom implementation is still suboptimal [42], [43], [44]. Many teachers perceive cultural literacy

merely as an additional activity, rather than as an integral component of the thematic curriculum. Therefore, a systematic learning model is needed to support teachers in integrating cultural values into classroom practices in a contextual and meaningful way.

Local wisdom encompasses systems of values, norms, and traditional knowledge that develop within a community and are passed down across generations [45], [46], [47]. In the context of primary education, local wisdom serves as an authentic learning resource that enriches pupils' learning experiences, particularly when linked to their everyday life contexts. Integrating local wisdom into the learning process provides several key benefits (1) Strengthening the relevance of learning to pupils' real-life experiences; (2) Fostering pride in cultural identity, and (3) Expanding pupils' understanding of universal values through local contexts. For instance, literacy activities based on folktales, traditional arts, or community social practices can naturally help pupils grasp moral, social, and ecological concepts [48], [49]. Nevertheless, a major challenge often encountered is the gap between local culture and the nationally oriented academic curriculum. As a result, local wisdom is frequently not explicitly integrated into lesson plans (RPP) or learning assessments.

The forces of digital transformation and globalisation have also brought significant changes to how pupils learn and interact [50], [51]. Education today demands the integration of local culture with 21st-century competencies, such as collaboration, communication, and critical thinking . Yet, many teachers face the dilemma of balancing traditional values with the demands of modern technology [52]. Technology-based learning often neglects pupils' cultural contexts, leading to cultural disconnection within classrooms. To address this issue, teachers must design learning experiences that combine technology with local cultural contexts through reflective and collaborative approaches. A cultural literacy model, therefore, should serve as a bridge between the local and global worlds. In this way, pupils will not only recognise their cultural heritage but also be able to interpret and creatively adapt it within the digital era.

RESEARCH METHOD

This study employed a Design-Based Research (DBR) approach [26], [37], hereafter referred to as DBR. The implementation of DBR was complemented by elements of cross-sectional surveys, case studies, and Participatory Action Research (PAR). DBR was utilised to develop educational interventions in the form of teaching and learning strategies and materials for cultural literacy, addressing complex educational problems. Moreover, the use of DBR aimed not only to produce practical solutions but also to contribute to the theoretical understanding of the characteristics of educational interventions and the processes involved in designing and developing them, particularly in relation to learning activities and environments. The PAR cycle comprised four key stages: planning, implementation, observation, and reflection [53]. This iterative process ensured that the research outcomes were grounded in authentic classroom contexts and continuously refined through collaborative engagement with teachers.

The research was conducted in primary schools under the supervision of the Yogyakarta City Education Office. The city of Yogyakarta consists of fourteen districts (kemantren), with one school representing each district. The participating schools were selected by the Yogyakarta City Education Office, ensuring equitable representation across districts. Consequently, the study involved 14 schools, encompassing 14 headteachers, 14 classroom teachers, and all pupils in the selected classes.

The participating primary schools were (1) SDN Vidya Qasana (Jetis District); (2) SDN Suryodiningratan 1 (Mantrijeron District); (3) SDN Keputran 2 (Kraton District); (4) SDN Pujokusuman 1 (Mergangsan District); (5) SDN Golo (Umbulharjo District); (6) SDN Baluwarti (Kotagede District); (7) SDN Baciro (Gondokusuman District); (8) SDN Lempuyangan 1 (Danurejan District); (9) SDN Margoyasan (Pakualaman District); (10) SDN Ngupasan (Gondomanan District); (11) SDN Serangan (Ngampilan District); (12) SDN Tegalmulyo (Wirobrajan District); (13) SDN Gedongtengen (Gedongtengen District); and (14) SDN Bener (Tegalrejo District).

Prior to the intervention phase, semi-structured interviews were conducted with teachers to obtain empirical data concerning their planning and implementation of cultural literacy learning designs in primary schools. This was followed by classroom observations to examine the extent to which cultural literacy activities were implemented in each school. Additionally, document analysis was carried out to capture and record the learning process. A visual representation of the overall research flow is illustrated in Figure 1 below.

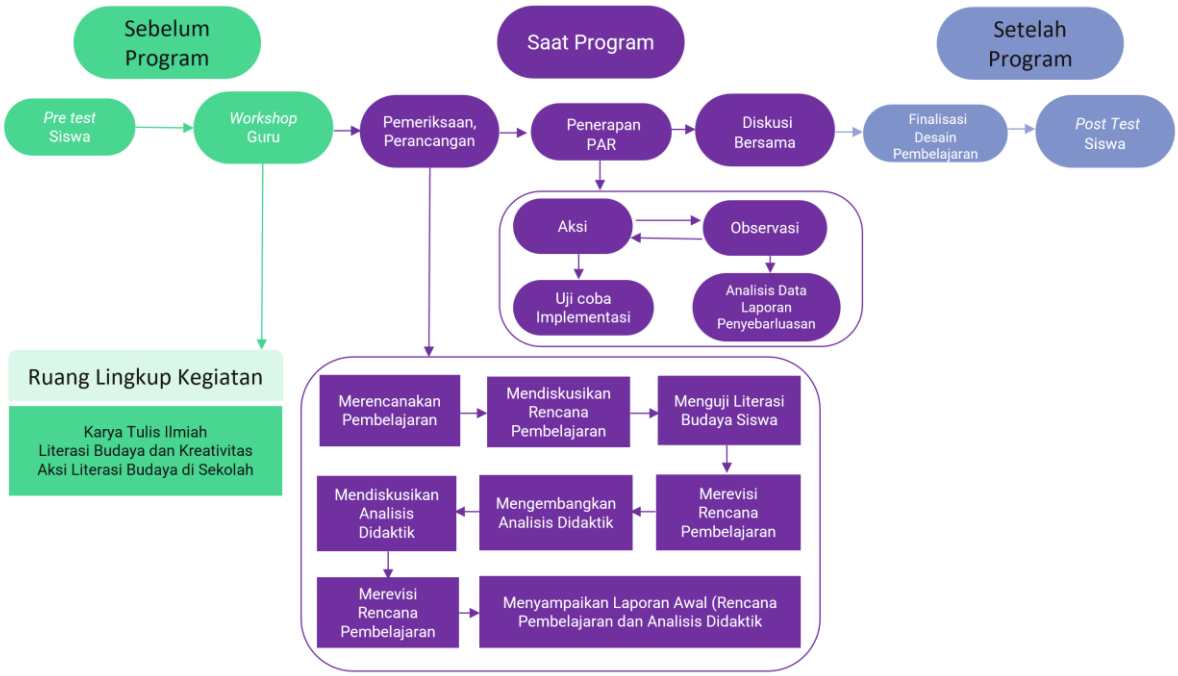

Figure 1. Research Flow Diagram

As illustrated in Figure 1, the research was conducted following a systematically structured flow. The "Pre-Programme" phase focused on analysing the research problem, with data collected through interviews, observations, and document analysis. The findings from this phase were used as the basis for developing potential solutions guided by relevant design principles. The "During Programme" phase involved the iterative implementation of design cycles aimed at testing and refining the proposed solution. At this stage, the instructional design for cultural literacy learning was drafted, validated, and revised based on feedback from expert validators before being implemented in primary school classrooms. The "Post-Programme" phase centred on the finalisation of the learning design, drawing upon data obtained during the implementation stage. This process included a comprehensive reflection on classroom practices to identify the model's strengths, weaknesses, and areas for improvement, ensuring that the final design was theoretically robust and practically feasible.

RESULTS AND DISCUSSION

Results of Needs Analysis

The needs analysis was conducted at the initial stage of the study to obtain an in-depth understanding of the actual conditions of cultural literacy learning in primary schools. This analysis aimed to identify the gap between current teaching practices and the ideal requirements for developing students' cultural literacy competencies. Data were collected through in-depth interviews with teachers, classroom observations, and curriculum document reviews.

Social changes and technological advancements have shifted young generations' values and perceptions of local culture. Primary schools, as foundational educational institutions, play a strategic role in instilling cultural values and national character from an early age. However, the initial mapping revealed that learning activities designed to foster students' cultural awareness remain sporadic, unsystematic, and not yet integrated into school literacy programmes.

This situation highlights the need for a contextual, applicable, and teacher-friendly cultural literacy model that can integrate local cultural values into everyday literacy activities through collaborative and reflective approaches. The needs analysis involved 14 primary school teachers and 14 head teachers across 14 sub-districts in Yogyakarta City. Semi-structured interviews and open-ended questionnaires were used, focusing on four main aspects: (1) Teachers' understanding of the concept of cultural literacy; (2)Teachers' experiences in integrating local culture into classroom learning; (3) Teachers' challenges and needs in the planning, implementation, and evaluation of culture-based learning; and (4) The support of the school and community environments in preserving local culture. In addition, classroom observations were conducted to identify the extent to which cultural values were reflected in students' reading, writing, and discussion activities.

The analysis yielded four key findings: **Limited Teachers' Understanding of Cultural Literacy**. Most teachers associated cultural literacy only with reading folklore or wearing traditional clothing during cultural celebrations. They lacked a deeper understanding of cultural literacy as the ability to understand, appreciate, and

express cultural values in everyday contexts. **Lack of Learning Guidelines and Resources**. Teachers reported the absence of systematic teaching guides on how to integrate local culture into thematic learning. Teaching materials used were generally national in scope, with minimal emphasis on local wisdom. This situation created difficulties for teachers in designing culturally grounded literacy activities. **Minimal Collaboration Between Schools and Cultural Communities.** Learning rarely involved cultural figures, artists, or local craftsmen. Yet, collaboration with cultural communities could enrich students' learning experiences and strengthen regional cultural identity. **Limited Evaluation of Cultural Literacy.** Most teachers still used traditional cognitive assessments focused on memorisation rather than reflective, empathetic, or expressive skills related to cultural understanding.

These findings served as a foundation for designing the Cultural Literacy Model for Primary School Students. The model aims to: (1) Help teachers gain a comprehensive understanding of cultural literacy; (2) Provide systematic and flexible step-by-step teaching guidance; (3) Encourage school–community collaboration in cultural learning; and (4) Develop a more authentic assessment system that measures students' engagement and cultural meaning-making.

Teachers' Pre-Test Results

A pre-test was also administered to teachers to measure their self-confidence in implementing culturally responsive teaching practices. The results showed that, in general, teachers demonstrated moderate to high confidence in applying instructional strategies that were responsive to students' cultural backgrounds and needs.

Item 3 indicated that 78.6% of teachers felt confident in identifying students' preferences for working individually or collaboratively. This was reflected in teachers' practices that allowed students to choose between individual or group learning. Item 1 showed that 71.4% of teachers felt confident in adapting instructions to meet students' needs, such as by providing written directions in simple language and differentiating tasks for students with special needs. In utilising students' cultural backgrounds, 42.9% reported feeling fairly confident and 28.6% confident. Examples included asking students to share local traditions, introducing regional foods, and wearing traditional attire on special occasions. Furthermore, 78.6% of teachers felt fairly confident in identifying students' academic interests through diagnostic assessments, parent interviews, and informal class discussions.

However, weaknesses were found in the reflective and critical aspects. About 50% of teachers reported low confidence in revising materials to represent cultural diversity, although some attempted to contextualise materials using local examples or language. Additionally, 42.9% expressed low confidence in reviewing the curriculum to address cultural stereotypes, even though a few had discussed this issue through teacher learning communities (KOMBEL) and "Pancasila Student Profile" projects focusing on global diversity.

The "very confident" category was nearly absent (only 7.1%), particularly regarding building trust with students. Although teachers had engaged in various positive practices—such as active listening, providing encouragement, and involving students in classroom activities—they lacked confidence in the effectiveness of these actions.

In summary, most teachers fell into the "fairly confident" range (50–78.6%) in linking learning to students' cultural backgrounds, needs, and interests. They demonstrated concrete actions such as using simple instructions, conducting initial assessments, and integrating students' local traditions into lessons. Teachers also built communication with students and parents through informal discussions and regular meetings. Nonetheless, reflective and critical aspects remained weak—especially in curriculum review and material adaptation. This finding underscores the need for further capacity-building to enhance teachers' competence in designing more inclusive, adaptive, and meaningful cultural literacy learning.

Proposed Cultural Literacy Model

Based on the findings above, the initial prototype of the Cultural Literacy Model consists of five main stages: Integration, Organisation, Facilitation, Construction, and Evaluation. Each stage was designed based on teachers' real needs in the field and reflects the reflective, collaborative, and contextual principles of the Design-Based Research (DBR) approach. The steps of this model are illustrated in Figure 2 below.

Figure 2. Steps of the Cultural Literacy Learning Model

Based on Figure 2 above, the steps are described as follows:

Stage 1: Integration

Cultural literacy learning requires teachers to integrate students' ethnic and cultural diversity and to use students' lived experiences to build the context of learning. This is important because research has shown that race, ethnicity, cultural background, and other variables (such as poverty, assessment practices, systemic issues, and institutional racism) significantly affect student achievement. Meeting each student's unique needs remains a major challenge in education today, as many teachers are not adequately prepared—whether in terms of content knowledge, experience, or training—to address diverse learning needs. Such insufficient preparation can create cultural gaps between teachers and students and limit educators' ability to select effective teaching practices or materials. Teachers must engage with students from different cultural backgrounds to develop greater self-awareness, improved interpersonal skills, and the ability to effectively challenge stereotypes and prejudice. Teachers utilize students' social and cultural knowledge to build connections between the familiar and the new, making learning more comprehensible and meaningful.

Stage 2: Organization

The cultural literacy model involves all students in learning together, fostering positive interdependence, strong commitment, and effective interpersonal skills. The organization stage provides opportunities for all students to share and learn from collective experiences and challenges. Teachers who employ direct and explicit collaborative learning approaches to deepen their understanding of students' backgrounds can enhance engagement and literacy motivation. At this stage, teachers provide a general introduction to the topic and then distribute learning tasks according to students' academic skills. Teachers collaboratively organize students into heterogeneous learning teams, grouped by learning abilities.

Stage 3: Facilitation

After reading and identifying their tasks, students discuss the topic with their group members, share knowledge, and complete all activities collaboratively. During the facilitation stage, teachers monitor and review key concepts and skills that all students must master, engaging them in strategic discussions within their respective groups about the content.

Stage 4: Construction

The teacher's role in the construction stage is to use inquiry and clarification techniques to assist students in completing their tasks and exploring the meaningfulness of the learning topic. Teachers help students understand concepts, grasp main ideas, ask and answer questions, and connect what they learn with their own cultural backgrounds. When students lack the background knowledge necessary to understand certain concepts or text sections, they are encouraged to formulate questions for comprehension, which are then discussed in small groups with the teacher facilitating understanding.

Stage 5: Evaluation

Sub-activities in the evaluation stage include providing effective and specific oral and written feedback, as well as offering additional opportunities for students who have not yet completed their tasks. Teachers respond

to students' work and participation with critical, continuous, and direct feedback. This practice of providing responsive feedback demonstrates the teacher's sensitivity to supporting students' individual and cultural performance. Such strategies involve incorporating students' responses, ideas, language, and experiences into the feedback process while inviting them to co-construct new understandings of the topic being studied.

Discussion

The results of the needs analysis indicate that cultural literacy in primary schools has not yet become an integral part of daily learning but remains positioned as an additional or seasonal celebration activity. This finding confirms that teachers' awareness and competence in integrating local cultural values are still at a weak conceptual stage. In the context of 21st-century learning, this poses a serious challenge, as cultural literacy is not merely about knowledge of culture, but the ability to interpret, appreciate, and actualize cultural values within dynamic social practices [2], [5], [54].

The teachers' limited understanding identified in this study findings on the cultural gap between teachers and students [55]. Teachers who lack cultural sensitivity tend to apply homogeneous teaching patterns that overlook students' cultural backgrounds [55]. As a result, the learning process loses contextual relevance and reduces students' opportunities to build cultural identity and local pride. In the Indonesian context, this is concerning because ethnic and cultural diversity forms the main foundation of character education, as emphasized in the Profil Pelajar Pancasila.

Another prominent finding is the absence of systematic guidelines and relevant learning resources. Teachers tend to rely on national textbooks that are generic and fail to represent regional uniqueness. This finding is consistent with a report from the Ministry of Education, Culture, Research, and Technology, which noted that more than 60% of primary school teachers still struggle to integrate local cultural content into thematic literacy activities [56], [57]. This limitation has led to cultural literacy learning lacking a clear pedagogical direction. Therefore, a conceptual model is needed — one that not only provides what to teach but also how to teach culture concretely in classrooms.

The limited involvement of cultural communities also stands out as a critical issue. Schools often operate as separate entities from society, whereas the success of cultural education largely depends on the organic relationship between schools, families, and local communities. In the ecological systems theory, children's learning cannot be separated from their sociocultural context [58]. Hence, the development of a cultural literacy model should create collaborative spaces across stakeholders, particularly between teachers and local cultural practitioners [59].

In terms of evaluation, cultural literacy learning is still dominated by cognitive approaches, focusing on factual knowledge of culture. Such evaluation fails to capture the affective and reflective dimensions that are central to cultural literacy [9]. Ideally, cultural literacy should assess how students internalize cultural values into their attitudes, empathy, and everyday behavior [60]. Therefore, the model being developed must integrate an authentic assessment system based on reflection and student participation.

Overall, the results of the needs analysis indicate that Indonesian primary schools require both conceptual and practical guidance that can bridge the national curriculum, local culture, and classroom practice. In other words, teachers need a cultural literacy model that (1) provides a clear theoretical direction regarding the concept and goals of cultural literacy; (2) offers contextual, collaborative, and reflective stages of learning; and (3) facilitates direct engagement between students and cultural resources in their environment.

These findings form a strong foundation for designing a Design-Based Research (DBR)-based Cultural Literacy Model. The DBR approach is chosen for its cyclical nature—it allows researchers to develop, test, and refine the model iteratively in real classroom contexts [61]. DBR also enables close collaboration between researchers and educational practitioners (in this case, teachers), ensuring that each reflection and feedback is directly integrated into subsequent designs.

Thus, the results of this needs analysis not only describe existing problems but also establish the conceptual foundation for an initial model of cultural literacy comprising five stages: integration, organization, facilitation, construction, and evaluation. These stages are direct responses to the empirical gaps identified in the field—teachers' limited understanding, lack of pedagogical guidance, weak cultural collaboration, and absence of reflective evaluation systems. The model is expected to foster critical awareness and cross-cultural sensitivity among primary school students while supporting Indonesia's Asta Cita vision of nurturing learners who are characterized, nationally grounded, and globally competitive.

CONCLUSION

This study affirms that strengthening cultural literacy in primary schools requires a contextual, participatory, and practice-oriented approach. The needs analysis results reveal that teachers still face challenges in integrating local cultural values into the learning process due to limited conceptual understanding, the absence of clear pedagogical guidelines, and the low level of community involvement in cultural education activities. These

conditions reinforce the urgency of developing a systematic and applicable cultural literacy model to support the early formation of students' character and cultural identity.

Through the Design-Based Research (DBR) approach, this study produced an initial design of a cultural literacy model consisting of five main stages: integration, organization, facilitation, construction, and evaluation. Each stage is designed to foster cultural awareness, social collaboration, and students' reflective capacity toward the cultural values surrounding them. This model functions not only as a learning guide but also as a bridge between local culture and global challenges through meaningful learning activities.

Preliminary findings indicate that applying DBR principles helps teachers design learning experiences that are more relevant to students' sociocultural contexts. Moreover, involving cultural figures, traditional arts, and local folklore in classroom activities can enhance student participation and strengthen their sense of belonging to their cultural identity. Thus, the developed model has the potential to contribute strategically to achieving Indonesia's Asta Cita, particularly in shaping learners who are characterized, competitive, and grounded in local wisdom.

To test its effectiveness, limited field trials need to be conducted to evaluate the model's impact and refine it based on reflection and feedback from teachers and students. The results of these trials are expected to lead to the development of broader implementation guidelines and sustainable school-based cultural literacy policies. Therefore, this study not only contributes to the development of an innovative learning model but also provides a conceptual foundation for the transformation of cultural education in Indonesian primary schools in alignment with national development goals and the spirit of diversity.

REFERENCES

[1] B. Ubertazzi, "Culture, sustainable development and UNESCO," Pravovedenie, p. 4, 2020.

[2] E. Shliakhovchuk, "After cultural literacy: new models of intercultural competency for life and work in a VUCA world," Educ Rev (Birm), vol. 73, no. 2, pp. 229–250, Mar. 2021, doi: 10.1080/00131911.2019.1566211.

[3] S. A. Sakti, S. Endraswara, and A. Rohman, "Integrating Local Cultural Values into Early Childhood Education to Promote Character Building," International Journal of Learning, Teaching and Educational Research, vol. 23, no. 7, pp. 84–101, Jul. 2024, doi: 10.26803/ijlter.23.7.5.

[4] R. Samiya, "Education through the cultural dimension: integration of knowledge with traditions and arts," STUDIES IN EDUCATION SCIENCES, vol. 6, no. 3, p. e18432, Jul. 2025, doi: 10.54019/sesv6n3-009.

[5] O.-O. Bayode, "Art and culture: The role of education in the 21st century," International Journal, vol. 13, no. 2, 2023.

[6] S. Wright, "On the Role of Education in National Cultural Identity," Journal of Educational Research and Policies, vol. 4, no. 6, Jun. 2022, doi: 10.53469/jerp.2022.04(06).28.

[7] A. Ahadiyyah et al., "Cultural globalization and education strategy to develop cultural literacy and digital," International Journal of Advanced Multidisciplinary Research and Studies, vol. 4, no. 3, pp. 1661–1665, 2024.

[8] L. Zhou, H. M. Shafique, and K. Ahmad, "The development and implementation of strategies for promoting cultural literacy Among university students in the digital environment," Information Development, Jan. 2025, doi: 10.1177/02666669251314835.

[9] A. Abdulahi, V. Andishmand, A. Bahreinizadeh, and Z. Zeinaddiny Meymand, "Examining the Components of a Curriculum Based on Cultural Literacy in Education," Iranian Journal of Educational Sociology, vol. 7, no. 4, pp. 21–30, 2024, doi: 10.61838/kman.ijes.7.4.3.

[10] T. Lähdesmäki et al., Learning cultural literacy through creative practices in schools: Cultural and multimodal approaches to meaning-making. Springer Nature, 2022.

[11] F. Maine and M. Vrikki, "An introduction to dialogue for intercultural understanding: Placing cultural literacy at the heart of learning," in Dialogue for intercultural understanding: Placing cultural literacy at the heart of learning, Springer International Publishing Cham, 2021, pp. 1–8.

[12] F. Maine, V. Cook, and T. Lähdesmäki, "Reconceptualizing cultural literacy as a dialogic practice," 2019.

[13] F. Arifin, R. Tedjabuwana, S. Wiyono, and M. K. bin Abdullah, "Indonesia's identity politics and populism: Disruption to national cohesion," Jurnal Civics: Media Kajian Kewarganegaraan, vol. 22, no. 1, pp. 166–175, 2025.

[14] S. Glock, C. Kovacs, and I. Pit-ten Cate, "Teachers' attitudes towards ethnic minority students: Effects of schools' cultural diversity," British Journal of Educational Psychology, vol. 89, no. 4, pp. 616–634, 2019.

[15] G. Gay, "Teachers' beliefs about cultural diversity: Problems and possibilities," in International handbook of research on teachers' beliefs, Routledge, 2014, pp. 436–452.

[16] D. Y. Ford and C. D. Kea, "Creating culturally responsive instruction: For students' and teachers' sakes," Focus Except Child, vol. 41, no. 9, pp. 1–16, 2009.
[17] S. Civitillo, L. P. Juang, and M. K. Schachner, "Challenging beliefs about cultural diversity in education: A synthesis and critical review of trainings with pre-service teachers," Educ Res Rev, vol. 24, pp. 67–83, 2018.
[18] N. M. Koukoulidis, N. Kotluk, and J. C. Brown, "The status of culturally relevant teacher education in the European context: A systematic review of research," Review of Education, vol. 12, no. 3, p. e70002, 2024.
[19] X. Chen and D. C. French, "Children's Social Competence in Cultural Context," Annu Rev Psychol, vol. 59, no. 1, pp. 591–616, Jan. 2008, doi: 10.1146/annurev.psych.59.103006.093606.
[20] X. Chen, M. Liu, and Q. Bian, "Culture and Children's Social Development," in The Wiley-Blackwell Handbook of Childhood Social Development, Wiley, 2022, pp. 241–259. doi: 10.1002/9781119679028.ch13.
[21] M. Alonge, "The Role of Multicultural Children's Books in Fostering Empathy and Understanding Across Diverse Cultures," J Prof Serv Mark, 2024.
[22] Chima Abimbola Eden, Onyebuchi Nneamaka Chisom, and Idowu Sulaimon Adeniyi, "CULTURAL COMPETENCE IN EDUCATION: STRATEGIES FOR FOSTERING INCLUSIVITY AND DIVERSITY AWARENESS," International Journal of Applied Research in Social Sciences, vol. 6, no. 3, pp. 383–392, Mar. 2024, doi: 10.51594/ijarss.v6i3.895.
[23] S. M. Mathews and A. Savarimuthu, "Role of education in transmitting culture in society," in Conference: Role of Education in Transmitting Culture in Society, 2020.
[24] U. Bergmark, "Teachers' professional learning when building a research-based education: context-specific, collaborative and teacher-driven professional development," Professional Development in Education, vol. 49, no. 2, pp. 210–224, Mar. 2023, doi: 10.1080/19415257.2020.1827011.
[25] S.-K. Wang, H.-Y. Hsu, T. C. Reeves, and D. C. Coster, "Professional development to enhance teachers' practices in using information and communication technologies (ICTs) as cognitive tools: Lessons learned from a design-based research study," Comput Educ, vol. 79, pp. 101–115, Oct. 2014, doi: 10.1016/j.compedu.2014.07.006.
[26] S. Fowler and S. N. Leonard, "Using design based research to shift perspectives: a model for sustainable professional development for the innovative use of digital tools," Professional Development in Education, vol. 50, no. 1, pp. 192–204, Jan. 2024, doi: 10.1080/19415257.2021.1955732.
[27] S. Bakar, "Investigating the Dynamics of Contemporary Pedagogical Approaches in Higher Education through Innovations, Challenges, and Paradigm Shifts," Social Science Chronicle, vol. 1, no. 1, pp. 01–19, 2021, doi: 10.56106/ssc.2021.009.
[28] S. Suratmi, H. Hartono, and Diana, "Literacy Character Education Planning to Strengthen the Pancasila Student Profile through Local Culture in Early Childhood Education," Golden Age: Jurnal Ilmiah Tumbuh Kembang Anak Usia Dini, vol. 9, no. 1`, pp. 145–158, Mar. 2024, doi: 10.14421/jga.2024.91-13.
[29] S. B. Andita and F. Tirtoni, "Analysis of Cultural Literacy Learning Based on Local Wisdom to Strengthen the Profile of Pancasila Students," Jurnal Paedagogy, vol. 11, no. 1, p. 102, Jan. 2024, doi: 10.33394/jp.v11i1.9616.
[30] I. Barrenechea, J. Beech, and A. Rivas, "How can education systems improve? A systematic literature review," Journal of Educational Change, vol. 24, no. 3, pp. 479–499, 2023.
[31] M. Mincu, "Why is school leadership key to transforming education? Structural and cultural assumptions for quality education in diverse contexts," Prospects (Paris), vol. 52, no. 3, pp. 231–242, 2022.
[32] E. Wahyuni, M. Tandon, and B. Jonathan, "Leveraging local wisdom in curriculum design to promote sustainable development in rural schools," Journal of Social Science Utilizing Technology, vol. 2, no. 3, pp. 446–459, 2024, doi: https://doi.org/10.70177/jssut.v2i3.1347.
[33] Ibnu Fitrianto and Muhammad Farisi, "Integrating Local Wisdom into 21st Century Skills: A Contextual Framework for Culturally Relevant Pedagogy in Rural Classrooms," International Journal of Post Axial: Futuristic Teaching and Learning, pp. 109–121, Apr. 2025, doi: 10.59944/postaxial.v3i2.444.
[34] S. C. Tan, C. Chan, K. Bielaczyc, L. Ma, M. Scardamalia, and C. Bereiter, "Knowledge building: Aligning education with needs for knowledge creation in the digital age," Educational Technology Research and Development, vol. 69, no. 4, pp. 2243–2266, 2021.
[35] G. Fischer, J. Lundin, and J. O. Lindberg, "Rethinking and reinventing learning, education and collaboration in the digital age—from creating technologies to transforming cultures," The International Journal of Information and Learning Technology, vol. 37, no. 5, pp. 241–252, 2020.

[36] N. Adera, "Innovative learning spaces and blended learning: Quest for 21st century competency teaching and learning approaches," Creating Dynamic Space in Higher Education: Modern Shifts in Policy, Competencies, and Governance, pp. 139–174, 2025.
[37] A. Asrifan, S. Sadaruddin, R. Sahabuddin, F. A. Rahman, H. Herlina, and S. Saodi, "The Evolution of Design-Based Research: Future Perspectives and Trends," Global Perspectives and Implementations of Design-Based Research, pp. 355–386, 2025.
[38] R. Sohdi, "A Design-Based Approach to Bridging the Gap between University Learning and Classroom Pedagogy in Initial Teacher Education.," Journal of Learning Development in Higher Education, 2025.
[39] G. Kobakhidze, "Theoretical background for a strategy of development of cultural literacy in schools," The Journal of Education, Culture, and Society, vol. 12, no. 1, pp. 48–58, 2021.
[40] J. A. Banks, Cultural diversity and education: Foundations, curriculum, and teaching. Routledge, 2015.
[41] H. Weshah, O. Al-Faori, and R. Sakal, "Child-friendly school initiative in Jordan a sharing experience," Coll Stud J, vol. 46, no. 4, pp. 699–715, 2012.
[42] J. Irmansyah, H. Syah, and E. Kurniawan, "Teachers' Knowledge and Understanding of Physical Literacy in Physical Education Learning: A Phenomenological Approach.," Qualitative Report, vol. 30, no. 5, 2025.
[43] E. A. Quainoo, D. Asamoah, D. Baidoo-Anu, J. Ye, and C. Akuamoah Boateng, "Examining profiles of classroom assessment literacy among basic school teachers," Cogent Education, vol. 12, no. 1, Dec. 2025, doi: 10.1080/2331186X.2025.2558163.
[44] L. B. Kelly, W. Wakefield, J. Caires-Hurley, L. W. Kganetso, L. Moses, and E. Baca, "What Is Culturally Informed Literacy Instruction? A Review of Research in P–5 Contexts," Journal of Literacy Research, vol. 53, no. 1, pp. 75–99, Mar. 2021, doi: 10.1177/1086296X20986602.
[45] S. Bihari, "Cultural heritage and indigenous knowledge: Reviving traditions for future generations," Sustainable Development Goals in SAARC Countries: Key Issues, Opportunities and Challenges, vol. 1, pp. 24–32, 2023.
[46] T. Arsal, D. L. Setyowati, and P. Hardati, "The inheritance of local wisdom for maintaining peace in multicultural society," J Aggress Confl Peace Res, vol. 15, no. 2, pp. 137–151, 2023.
[47] A. Tohari, "The role of local wisdom in creating peace and social harmony in villages: cultural and traditional perspectives," Jurnal Konseling dan Pendidikan, vol. 13, no. 1, pp. 316–325, 2025.
[48] B. Ahi, D. Yaya, and S. Ozsoy, "The concept of environment in folktales from different cultures: Analysis of content and visuals," International Electronic Journal of Environmental Education, vol. 4, no. 1, pp. 1–17, 2014.
[49] M. M. Goraya, M. U. Mehmood, N. Iftikhar, and A. U. R. Bhatti, "The Role of Folk Narratives in Moral Education: An Interdisciplinary Approach," Journal of Political Stability Archive, vol. 3, no. 2, pp. 186–205, 2025.
[50] M. N. Belousova, V. A. Belousov, and L. V Narkevich, "Digital transformation of the educational process in university in the context of globalization," in Socio-economic systems: Paradigms for the future, Springer, 2021, pp. 1267–1277.
[51] V. Voronkova, G. Vasyl'chuk, V. Nikitenko, Y. Kaganov, and N. Metelenko, "Transformation of digital education in the era of the fourth industrial revolution and globalization," 2023.
[52] A. L. O. Amissah, "The Educational Reform Dilemma: Balancing Tradition, Innovation, and Equity," Convergence Chronicles, vol. 6, no. 3, pp. 52–68, 2025.
[53] S. B. Soh, "A Critical Participatory (Action Research) adaptation in the Teaching English as a Second Language Practicum: developing individual and collective reflective practices towards equitable practices," Educ Action Res, pp. 1–26, Dec. 2024, doi: 10.1080/09650792.2024.2439980.
[54] A. L. O. Amissah, "The Educational Reform Dilemma: Balancing Tradition, Innovation, and Equity," Convergence Chronicles, vol. 6, no. 3, pp. 52–68, 2025.
[55] G. Gay, "Culturally responsive teaching in special education for ethnically diverse students: Setting the stage," International Journal of Qualitative Studies in Education, vol. 15, no. 6, pp. 613–629, Nov. 2002, doi: 10.1080/0951839022000014349.
[56] N. Kufarimani and L. Chitanana, "Primary educators' perceptions of adopting indigenous-themed digital games: insights across career stages," Discover Education, vol. 4, no. 1, p. 375, Sep. 2025, doi: 10.1007/s44217-025-00792-0.
[57] Deffita Indah Permata Sari, Harun Joko Prayitno, Laili Etika Rahmawati, and Yeni Prastiwi, "Culture of Digital Literacy in Thematic Learning at the Basic Education Level," Jurnal Ilmiah Sekolah Dasar, vol. 6, no. 3, pp. 467–475, Dec. 2022, doi: 10.23887/jisd.v6i3.46334.

[58] Y.-F. Paat, "Working with Immigrant Children and Their Families: An Application of Bronfenbrenner's Ecological Systems Theory," J Hum Behav Soc Environ, vol. 23, no. 8, pp. 954–966, Nov. 2013, doi: 10.1080/10911359.2013.800007.
[59] T. Ellis-Robinson and J. W. Coles, "School, university and community collaboration to promote equity through inclusive cultural competence," Educ Policy Anal Arch, vol. 29, no. January-July, p. 44, Mar. 2021, doi: 10.14507/epaa.29.4670.
[60] A. A. Gunn and J. R. King, "Using empathic identification as a literacy tool for building culturally responsive pedagogy with preservice teachers," Teacher Development, vol. 19, no. 2, pp. 168–186, Apr. 2015, doi: 10.1080/13664530.2014.998371.
[61] L. Tinoca, J. Piedade, S. Santos, A. Pedro, and S. Gomes, "Design-Based Research in the Educational Field: A Systematic Literature Review," Educ Sci (Basel), vol. 12, no. 6, p. 410, Jun. 2022, doi: 10.3390/educsci12060410.

DEVELOPMENT OF DIGITAL TEACHING MATERIALS FOR INDONESIAN LANGUAGE FOR FOREIGN SPEAKERS (BIPA) UTILIZING AUGMENTED REALITY

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Abstract. This development research aims to produce digital BIPA teaching materials based on Augmented Reality (AR) and test its effect on the learning outcomes of BIPA level 3 learners. The development method follows the ADDIE model. The research subjects consisted of two classes: Bintang (n=18, experimental, using AR teaching materials) and Matahari (n=19, control, digital teaching materials without AR). The instruments used included a learning outcome test (pre-post) and a learning experience questionnaire in the experimental class. The results showed equivalent initial scores, $t(\approx 35)=0.410$, $p=0.684$. The improvement in the Bintang class was significant, $t(17)=19.104$, $p<0.001$; the Matahari class also experienced an improvement, $t(18)=14.796$, $p<0.001$. The post-test mean difference test between groups showed the superiority of AR teaching materials, $t(\approx 35)=3.219$, $p=0.003$, $\bar{\Delta}=8.632$ (CI95 3.187 to 14.076). The average normalized gain $\langle g \rangle$: Bintang=0.470 vs Matahari=0.305. The reliability of the questionnaire in Bintang's class was adequate (α_motivation=0.983; α_usefulness=0.972). These findings support that AR integration in BIPA teaching materials has the potential to improve learning outcomes and learning experiences.

Key Words: Augmented reality, BIPA, digital teaching materials

INTRODUCTION

Language is inseparable from human life. Language is an arbitrary system with its own characteristics. Language functions as a means of communication. Through language, humans can interact with one another. Therefore, language plays a vital role in human life. Languages differ from country to country. Each language has its own rules and culture, and Indonesian is no exception. Indonesian is the national language of Indonesia. In accordance with Law of the Republic of Indonesia Number 24 of 2009 concerning the National Flag, Language, and Emblem, the Indonesian government strives to gradually, systematically, and sustainably enhance the function of Indonesian as an international language (Sukmawati and Wiedarti, 2019). Currently, Indonesian has gained widespread popularity internationally. It has become a crucial pillar of Indonesian cultural diplomacy and education on the international stage. Many countries, such as Australia, Thailand, China, and others, have adopted Indonesian as a subject or course. Furthermore, many institutions offer Indonesian for Foreign Speakers (BIPA) programs, both internationally and in Indonesia.

BIPA learning is Indonesian language learning for learners who have not yet mastered Indonesian, both Indonesian citizens (WNI) and foreign citizens (WNA) (Setyaningrum, et al., 2018). The learners referred to in this study are foreign citizens. One institution in Indonesia that organizes the BIPA program is Yogyakarta State University (UNY). This is evidenced by 2022 data stating that the BIPA program has been implemented in 50 countries, 428 implementing institutions, and the number of learners reached 142,484 (Wahyuni, 2022). The BIPA program, which aims to improve Indonesian language skills, is an effort by the Ministry of Education, Culture, Research, and Technology to internationalize the Indonesian language.

With the growing interest of Indonesian language learners on the global stage, Yogyakarta State University (UNY) has implemented a comprehensive Indonesian Language Learning (BIPA) program. Yogyakarta State University (UNY) has become a destination for BIPA learners from various countries, including Egypt, Sudan, China, Thailand, Yemen, India, and others, who want to learn Indonesian. In the era of globalization, BIPA learners' needs focus not only on linguistic aspects but also on understanding Indonesian culture and literature, which are integral parts of language learning, especially for Indonesian learners studying offline in Indonesia. They will undoubtedly interact with native Indonesian speakers. Similarly, the BIPA program at UNY

(Yogyakarta State University) teaches not only linguistic aspects but also an understanding of Indonesian culture and literature.

Based on interviews with intermediate-level BIPA teachers and learners at UNY, Indonesian culture and literature play a crucial role in BIPA learning because they serve as effective learning media for introducing traditions, cultural values, various traditional arts, and ways of thinking and acting in Indonesian society. This is especially important for BIPA learners studying Indonesian offline in Indonesia. They will encounter native Indonesian speakers and Indonesians from diverse ethnic, cultural, religious, and educational backgrounds. Therefore, diverse literary and cultural works can serve as authentic media for BIPA learning, as outlined in BIPA teaching materials.

Interviews with BIPA teachers at UNY revealed that BIPA teaching materials based on Indonesian culture and literature are not widely available. Kusmiatun (2020) stated that literary materials in BIPA teaching materials are not yet widely available. However, literature is considered an important teaching material (Septriani, 2021: 278). Although BIPA learning is aimed at learning Indonesian, the presence of Indonesian culture and literature can enhance students' understanding of Indonesia and facilitate direct interaction with the local community. Furthermore, cultural and literary materials are closely related to BIPA learners who study Indonesian for tourism, education, or work. They need to understand culture and literature as a step towards cross-cultural understanding while in Indonesia. This is in line with Sayuti (2017), who stated that culture and literature are important in the development of BIPA programs, positioned as materials within the context of general language learning. Language teaching requires intercultural communicative competence as its goal (Byram and Wagner, 2018). Furthermore,

Budiyanto (2022: 170) states that literary works can be used as alternative teaching materials in the context of BIPA learning, particularly from an intercultural perspective. Selecting appropriate and engaging teaching materials can increase learner interest. Indonesian Language Learning for Foreign Speakers (BIPA) aims to develop language skills for various purposes in accordance with graduate competency standards and BIPA levels which are in line with CEFR. At BIPA level 3, students are expected to master intermediate level receptive and productive skills as well as linguistic insight and Indonesian. The use of Augmented Reality (AR) has the potential to provide a multimodal and interactive context that can increase motivation, engagement, and understanding of lexical-structural meaning. Several systematic reviews show that AR in education can improve engagement and learning outcomes, despite design and technical challenges. In the realm of language learning, AR is often used to master vocabulary and authentic communication contexts.

METHOD

This research is a research and development using the ADDIE model. In the analysis stage, learning needs are based on the achievements of SKL BIPA and Level 3, accompanied by an analysis of the topic and context of the device used, namely Android. The design stage produces specifications for learning objectives, material frameworks, activity designs, and assessment instruments in the form of 30 multiple-choice questions and 5 short-answer questions. In the development stage, simple 3D objects and pronunciation audio were developed that were integrated into AR media (Vuforia/WebXR) which were then tested by content and media experts followed by revisions. The implementation stage, involved trials in two level 3 classes, namely an experimental class that used AR-based teaching materials and a control class that used equivalent digital teaching materials without AR. The evaluation stage was carried out formatively in each cycle and summatively through a comparison of pretests and posttests as well as a learning experience questionnaire in the experimental class. The effectiveness test used a quasi-experimental pretest-posttest design with a non-equivalent control group. Data analysis included descriptive statistics, assumption checks (normality with Shapiro–Wilk and homogeneity of variance), pre-post and inter-group difference tests, reporting of effect sizes (dz and Hedges g), and calculation of normalized gain ⟨g⟩. The instruments used consisted of: (1) a 35-item learning outcome test (30 multiple-choice and 5 short-answer items) with content validity by experts that included level 3 indicator representation and language clarity, and (2) a 10-item Likert scale learning experience questionnaire (1–5) in the experimental class that covered two aspects, namely motivation (5 items) and usefulness (5 items); internal reliability (Cronbach's α) was reported.

CONCLUSION

The field test involved two Level 3 classes: Bintang, the experimental class using AR-based learning materials (n=18) and Matahari, the control class using equivalent digital learning materials without AR (n=19). At the beginning of the study, the pretest means for both classes were equivalent (Bintang 51.611±6.581; Matahari 50.737±6.376), and an independent t-test at baseline confirmed no significant difference ($t \approx 0.410$; $df \approx 35$; $p=0.684$). A check of the assumptions indicated a near-normal distribution of scores (Shapiro–Wilk

p>0.05) and homogeneity of variance for the final scores (Levene p=0.484), allowing for comparative analysis between groups using the appropriate t-test.

After four sessions, the posttest scores for the experimental class increased to 74.000±7.623, while the control class's score was 65.368±8.674. The final mean difference between groups ($\bar{\Delta}$=8.632) was statistically significant based on a Welch t-test (t≈3.219; df≈35; p=0.003; 95% CI [3.187; 14.076]). The Welch t-test was chosen to maintain robustness of inferences when sample sizes are not exactly equal or there are indications of variance differences, as recommended in recent methodological literature.

Practically, the magnitude of the experimental group advantage is reflected in Hedges' g=1.032, which falls within the large effect category; reporting g as the standardized mean difference, which corrects for small sample bias, is recommended to clarify the practical significance of the t-test findings.

Frontiers

The within-group analysis revealed a consistent pattern. In the Bintang class, the post-pre difference of 22.389±4.972 was highly significant (t(17)=19.104; p<0.001) with Cohen's d_z=4.503; in the Matahari class, the difference of 14.632±4.310 was also significant (t(18)=14.796; p<0.001) with d_z=3.394. These very large d_z values indicate that both approaches effectively improved achievement, but the AR-based class achieved more pronounced improvements. Reporting effect sizes for paired (d_z) and between-group (Hedges' g) designs follows practical guidelines for reporting effect sizes for t/ANOVA tests, making the results more communicative and cumulative for future research.

To assess the relative effectiveness of equivalent starting points, normalized class gain (⟨g⟩) was also calculated. The Bintang class achieved a ⟨g⟩ of 0.470±0.123, while the Matahari class achieved a ⟨g⟩ of 0.305±0.109. According to Hake's criteria, both values fall into the moderate gain category, with the difference favoring the AR class. The ⟨g⟩ measure is widely used in science

education research to compare the effectiveness of classroom learning with varying initial conditions, so this finding strengthens the t-test results and effect sizes that suggest AR integration has a positive pedagogical impact.

Substantively, the trend of AR class superiority in learning outcome scores aligns with international evidence syntheses on AR in education—including recent cross-disciplinary meta-analyses and systematic reviews reporting positive effects of AR on academic performance and learning engagement—as well as AR in language learning, which demonstrates improved performance and motivation compared to non-AR approaches. Thus, the pattern of local findings in the context of BIPA Level 3 is consistent with global trends that position AR as a medium that enriches context, increases attention, and facilitates learning transfer, especially when the material requires interaction with objects/spaces that are difficult to physically present.

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From an R&D implementation perspective, these results confirm that the developed AR-based teaching materials are empirically valid for improving learning outcomes compared to non-AR digital equivalents in the tested scenarios. Notable limitations include the moderate sample size, the relatively short intervention duration (four sessions), and the quasi-experimental design with non-equivalent groups. Therefore, replication in a larger cohort and across BIPA levels, along with mid-term retention tracking and component analysis (e.g., the contribution of pre-task/task/post-task activities), would strengthen the generalizability of the findings. Despite these limitations, the consistency between statistical tests, effect sizes, and normalized gain provides a strong basis for concluding that AR integration is an effective and scalable strategy for BIPA Level 3 learning.

Key methodological and contextual references: reporting effect sizes for t-tests/ANOVAs (Lakens, 2013), justification for using Welch's t-test as a robust default for two-group comparisons (Delacre, Lakens, & Leys, 2017; Ruxton, 2006), rationale and practice of normalized gain (Hake, 1998; PhysPort), and evidence synthesis on the effectiveness of AR in language education and learning (recent meta-analyses/systematic reviews).

PEMBAHASAN

Hasil menunjukkan bahwa bahan ajar digital ber-AR memberikan peningkatan hasil belajar yang lebih tinggi daripada bahan ajar non-AR yang setara. Secara teoretis, keunggulan ini selaras dengan karakteristik AR yang meningkatkan keterlibatan, menyediakan konteks situasional, dan dukungan multimodal untuk memori kosakata/struktur.

Praktisnya, desain tugas yang mengintegrasikan pemindaian marker ke aktivitas komunikatif (menamai objek, menyusun dialog, pemecahan masalah berbasis skenario) berkontribusi pada ⟨g⟩ yang lebih tinggi pada kelas eksperimen. Tantangan teknis yang muncul (stabilitas tracking, kompatibilitas perangkat) perlu dikelola pada tahap pengembangan & implementasi (briefing teknis, opsi offline, materi alternatif

The AR-based digital BIPA teaching materials developed effectively improved the learning outcomes of grade 3 BIPA learners. There was a significant difference in post-test scores between the experimental and

control classes, with a large effect size. Best practices for development are recommended to adhere to the ADDIE model and prioritize expert validation and phased trials.

Based on the results of the research and development conducted, it can be concluded that: The development process for Augmented Reality (AR)-based BIPA digital teaching materials was conducted using the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) development model. Each stage followed established procedures and successfully produced interactive digital teaching materials that integrate learning text and AR technology. The developed digital teaching materials include Indonesian language learning materials for non-native speakers, complemented by interactive AR-based features such as 3D visualizations, pronunciation audio, and simulations of language use contexts. These features have been proven to enhance students' understanding of cultural and linguistic contexts in a more concrete and engaging manner.

Overall, the AR-based BIPA digital teaching materials developed have proven to be innovative, educational, and adaptive to the needs of language learning in the digital age. This product can be an effective alternative learning medium for improving Indonesian language competency for non-native speakers, particularly in vocabulary, cultural understanding, and communication skills.

DAFTAR PUSTAKAREVERSKIN

1. Branch, R. M. (2009). Instructional Design: The ADDIE Approach. New York: Springer.
2. Molenda, M. (2003). In Search of the Elusive ADDIE Model. Performance Improvement, 42(5), 34–36.
3. Bacca, J., Baldiris, S., Fabregat, R., Graf, S., & Kinshuk. (2014). Augmented Reality Trends in Education: A Systematic Review. Educational Technology & Society, 17(4), 133–149.
4. Akçayır, M., & Akçayır, G. (2017). Advantages and Challenges Associated with Augmented Reality for Education: A Systematic Review. Educational Research Review, 20, 1–11.
5. Tsai, C.-C. (2020). The Effects of Augmented Reality on Motivation and Performance in EFL Vocabulary Learning. International Journal of Instruction, 13(4), 987–1004.
6. Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey. American Journal of Physics, 66(1), 64–74.
7. Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. International Journal of Medical Education, 2, 53–55.
8. Kemdikbud. (2017). Permendikbud No. 27 Tahun 2017 tentang Standar Kompetensi Lulusan Kursus dan Pelatihan (termasuk BIPA).
9. Badan Bahasa (2019). Pelajar BIPA 3. Jakarta: Kemdikbud.
10. Sukkmawati, Riyadhotu dan Pangesti Wiedarti. 2019. Kesalahan Gramatikal dalam Tulisan Laporan Mahasiswa Program Darmasiswa di Universitas Negeri Yogyakarta Tahun 2018. E-Journal Student: Sastra Indonesia, 8(2), 46—46.
11. Setyaningrum, Linda Wahyu, dkk. 2018. Pembelajaran Afiks Bahasa Indonesia bagi Penutur Asing (BIPA) di Provinsi Daerah Istimewa Yogyakarta. Jurnal IMAJERI, 1(1), 49-61.
12. Sayuti, Suminto A. 2017. Suminto: Sastra dan Budaya Penting dalam Pengembangan BIPA. Universitas Tidar. https://untidar.ac.id/suminto-sastra-budaya-penting-dalam-pengembangan-bipa/ (Berita 9 September 2017. Diakses
13. pada 5 Mei 2025).
14. Budiyanto, Dwi. 2021. Sastra sebagai Materi Pembelajaran BIPA Berwawasan Interkultural. Jurnal Bahasa Indonesia bagi Penutur Asing (JBIPA), 4(2), 168-179. DOI: https://doi.org/10.26499/jbipa.v4i2.4964
15. 6 Miles, M. B., & A. Michael Huberman, Qualitatve Data Analysis, (Sage Publications, 1994) hal. 43.
16. Septriani, Hilda. (2021). Peran bahan ajar karya sastra dalam pengajaran BIPA (bahasa Indonesia bagi penutur asing) di Moscow State University, Rusia. Proceeding ISOLEC: Internasional Seminar on Language, Education, and Culture. Vol. 5 (1) 31 Juli- 1 Agustus, hal. 278-282. http://isolec.um.ac.id/proceeding/index.php/issn/article/view/124
17. Kusmiatun, A. (2020). BIPA Teachers' and Learners' Perspective on Indonesia-Thailand Culture Parities. DOI 10.4108/eai.9-11-2019.2294956
18. Byram, M. & Wagner, M. (2018). Making a difference: Language teaching for intercultural and international dialogue. American Council on the Teaching of Foreign Languages (ACTFL), vol. 51, 140-151. DOI: 10.1111/flan.12319
19. Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey… (pengantar dan kriteria normalized gain). jgravesedu.com
20. PhysPort. Normalized gain: What is it and when and how should I use it? (ringkas praktik pelaporan ⟨g⟩). PhysPort.
21. Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science (pelaporan d_z/d/g, interpretasi).

FROM 'GLOWING' TO 'BEING': A CRITICISM OF HUMAN REDUCTION IN THE AESTHETIC NARRATIVE OF PERSONAL CARE ADVERTISING

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Abstract. This study critiques the narratives of body care advertisements that, in contemporary visual culture, reduce humans to mere aesthetic objects. Terms like "glowing," "seamless," and "perfect skin" are not merely marketing strategies but also tools of hegemony that standardize beauty while ignoring the psychological, intellectual, and existential dimensions of human existence. Using qualitative literature research methods and semiotic and hermeneutic approaches, this study analyses visual data and advertising narratives through Gramsci's theories of hegemony, representation, Heidegger's existentialism, Baudrillard's critique of simulation, and cultural capitalism. The results show: (1) body care advertisements reproduce and normalize hegemonic beauty standards; (2) the term "glowing" has become a symbol of cultural capital that reduces human identity to appearance; (3) the dominance of body aesthetics creates a crisis of existence, reducing the body to merely a stage for images. This study emphasizes the need to uncover narrow beauty paradigms and develop alternative, more inclusive and humanistic discourses, while also promoting media literacy to liberate the body from the tyranny of images.

INTRODUCTION

In the digital era dominated by cultural capitalism, the beauty industry has undergone significant transformation through technology and media in shaping public perceptions of beauty[1]; [2]. This evolution is not a neutral or spontaneous process, but rather the result of the articulation of power, capital, and symbols within a global political-economic system increasingly oriented toward aesthetics as a commodity.

Digital technology, particularly through social media, reinforces the homogenization of beauty standards and narrows the scope for human bodily expression to a single ideal form that is continuously reproduced visually [3].

Beauty has become a never-ending consumer project, where bodies—particularly those of women and now men—are viewed as objects to be continually repaired and displayed. Bodies lose their existential or spiritual meaning and become visual and economic displays, governed by algorithms and market interests. Bodies that do not conform to dominant visual standards are categorized as "unworthy" or "not beautiful," demonstrating the colonization of the body by capital.

These standards emphasize certain physical attributes, such as fair skin and a slim figure, which serve as benchmarks of ideal beauty in popular culture [4]. Beauty has become a never-ending consumer project, where bodies—especially women's and now men's—are subject to constant refinement and display. Personal identity is dissolved into a uniform aesthetic, while diversity of bodies and expressions is marginalized by market pressures and the logic of digital capital.

Social media such as Instagram, TikTok, and YouTube have become primary agents for the dissemination of aesthetic standards, with algorithms that push dominant content to virality, creating visibility bias (visibility politics). Influencers and celebrities serve as aesthetic role models, marketing not only products but also lifestyles, bodies, and faces as “visual aspirations” [5]. This narrative creates intense social pressure for individuals to conform to these standards, even at the expense of physical and mental health. Tsai [6] notes that this pressure is directly linked to increased body image disturbances, low self-esteem, and social anxiety, particularly among adolescents and young women.

The excessive focus on physical appearance in media and advertising creates a subtle dehumanization, where a person's worth is measured by their body's conformity to popular imagery, rather than their mind or integrity. As Parens [7] notes, "When a person's worth is measured solely by visual attractiveness, humanity is reduced to

an object of observation. The body becomes a passive medium for social manipulation, where likes, shares, and comments serve as symbolic capital that determines relationships and status."

This reduction has profound psychological and social consequences: young people in digital visual culture often experience self-distortion. Surface culture emphasizes the "perfect" image and suppresses authentic expression, making skin more important than substance, impression more powerful than reality, thus fostering alienation from the body, honest expression, and the essential meaning of life.

When an individual's worth is measured solely by visual attractiveness and conformity to aesthetic standards, intellectual aspects, personality, and moral integrity are neglected. Human identity is reduced to a commercialized object of observation, with skin and image more important than substance. This reduction alienates individuals from their intellectual and spiritual potential, creates psychological distress, especially for younger generations who live in the logic of "likes" and "followers," and reinforces a surface culture that discourages reflection, empathy, and self-development.

The dominant aesthetic narrative in advertising is exclusionary and often gender and racially biased. Terms like "glowing," "flawless," or "whitening" establish specific beauty standards while also embodying historical and political biases related to skin color, age, and body shape [8]. Advertisements like Garnier Sakura White emphasize the standard of "bright skin like cherry blossoms," embodying racial bias and an exclusive, homogenizing narrative. These representations minimize bodily diversity and ignore the psychological, intellectual, and spiritual dimensions of human beings [9].

The pressure to meet narrow beauty standards has significant social impacts, including anxiety, depression, and feelings of marginalization. Advertising's focus on physical appearance overlooks internal qualities such as intelligence and personality, reducing human worth to mere visual objects [10].

Based on these key ideas, this research will examine how narratives in personal care advertisements shape hegemonic concepts of beauty, creating narrow visual standards that dominate public perception. Furthermore, this study critiques the use of terms such as "glowing" in advertisements, which contribute to reducing human identity to a mere aesthetic object, ignoring intellectual, moral, and spiritual dimensions.

Furthermore, this study also reveals the impact of the hegemony of body aesthetics on the concept of being and the balance of human identity, including psychological distress, self-alienation, and distorted perceptions of deeper self-worth.

This study is crucial for critiquing the narrow beauty paradigm that diminishes human existence. Analysis of beauty representations in advertising reveals biases, stereotypes, and social constructs that suppress identity diversity. The impacts of aesthetic hegemony are real, including anxiety, depression, and low self-esteem, as well as cultural and ethnic exclusion. This research is relevant to academic literature and is practical for the beauty industry, media, and society, encouraging inclusivity, critical awareness, and appreciation of the full complexity of human beings.

METHOD

The research method used is qualitative, oriented towards natural, holistic-contextual data collection [11], particularly regarding the narrow paradigm of beauty that diminishes human existence. Specifically, the qualitative research model used in this study utilizes a critical "weltanschauung" perspective, which encompasses the intention of "challenging" certain socio-cultural realities or phenomena, to then construct a new, or better, concept [12]. The "challenging" of socio-cultural realities or phenomena referred to in this study is the narrow paradigm of beauty that diminishes human existence.

Regarding the data and data sources in this study, they can be explained as follows. First, the type of advertisements studied is limited to advertisements published in the digital mass media category, specifically those originating from internet sites and also some advertisements found in the field, which fall into the category of outdoor advertising. One consideration is that internet advertising is more widespread in its distribution, thus also having a very broad and significant socio-cultural impact on society. Second, the subject matter of the advertising sign system that is the focus of this research is limited to types of advertising data that demonstrate the meaning of a narrow paradigm of beauty construction and reduce human existence. Third, regarding the time period of the advertising data being studied, the advertisements fall into the contemporary category, meaning more closely related to the domain of "current time" [13]; [14], namely advertisements from approximately the most recent year (2023-2024). This time period is expected to provide fairly comprehensive data information.

The data collection technique in this study employed purposive sampling, during which the researcher selectively analyzed specific data characteristics. The primary instrument in this study was the researcher herself as a human instrument [15], assisted by documentation guidelines and various relevant mechanical devices (checklists, etc.).

The data analysis technique of this research uses descriptive analysis techniques [16], specifically the model developed by Miles & Huberman [17]. The Miles and Huberman descriptive analysis model in its application

process is carried out simultaneously and continuously, from the beginning to the end of the research, which includes three main things, namely, data reduction, data display (presentation), and drawing conclusions.

RESULTS AND DISCUSSION

1. Narrative Representation of Body Care Advertisements Shapes a Hegemonic Concept of Beauty

Research findings show that advertising not only sells products but also shapes the worldview of the female body, with uniform beauty standards: fair skin, flawless faces, slender bodies, and feminine movements. These representations are repeated repeatedly in various media, from television to social media.

The dominance of these representations creates hegemony, where industry beauty standards are considered normal and natural, when in fact they are merely ideological socio-cultural constructions. Within Antonio Gramsci's [18] framework, hegemony emerges not only through coercion but also through voluntary consent shaped by popular culture. In this regard, personal care advertising becomes an effective tool of cultural hegemony, enveloping dominant norms in a seemingly neutral, glamorous, and attractive aesthetic. The following are some examples of problematic representations.

Figure 1. Example of a Glowing Narrative-Based Cosmetic Advertisement from “MS Glow”.
(Source: https://www.akurasi.id/etalase/kecantikan/lengkapi-kebutuhan-kulitmu-dengan-ms-glow-putri-skincare/)

Figure 1 The MS Glow “Red Jelly” advertisement features a woman with fair skin and the slogan “glow on!”, promoting a skincare package designed to achieve a “glowing” complexion. The visual of the flawless-skinned model, elegant design, and white and gold colors create an image of luxury and exclusivity, making glowing not just skin condition but a confident lifestyle.

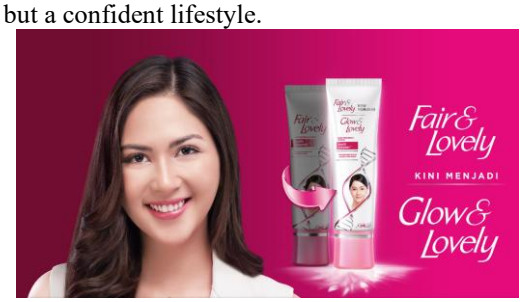

Figure 2. Example of a Glowing Narrative-Based Cosmetic Advertisement from Glow & Lovely
(Source: https://www.facebook.com/photo/?fbid=286030790764378&set=ecnf.100080723762267&locale=gl_ES)

The advertisement for Fair & Lovely's transformation into Glow & Lovely continues to highlight the image of a young, bright skinned, smiling woman, emphasizing light skin as the standard of beauty. The rebranding, with its pink color, arrow symbol, and clean design, conveys a modern and feminine feel, but the visual message remains the same: promising "glow" and "lovely" skin through cosmetic products

Figure 3. Examples of Glowing Narrative-Based Cosmetic Advertisements for Men.
(Source: https://shopee.co.id/MS-Glow-for-Men-Paket-Skincare-untuk-Pria-Paket-Ms-Glow-Men-5in1-Skincare-Cowok-Wajah-Glowing-Putih-i.3)

The MS Glow for Men advertisement, with the slogan "For All Skin Types," features a well-groomed man with a clean face and "before-after" testimonials, promoting facial wash, sunscreen, brightening cream, and body lotion and perfume. The black-metallic design conveys a masculine impression, while the inclusive message emphasizes skincare as a lifestyle for urban men, with "bright and clean skin" as a symbol of grooming, professionalism, and modern appeal.

Figure 4. Examples of Glowing Narrative-Based Cosmetic Advertisements for Children.
(Source: https://www.instagram.com/p/C5xCnzoyGY8/)

The “GLOWING” advertisement emphasizes safety claims like “Natural Ingredients” and “SLS-FREE,” utilizing images of surprised children and bright colours to attract attention. The visual of the “Herby KIDS 3 in 1” tube, with its natural motifs and clean background, conveys a healthy and modern impression, but the dramatic visuals and claims lacking scientific context exploit parental concerns, reducing the need for children’s skin to a “glowing” trend, and encouraging overconsumption.

The data above demonstrates that in contemporary visual culture, the representation of the body—both female and male—has shifted from authentic expression to an aesthetic project driven by market logic. Beauty advertisements, through slogans like “get your glow now!” or “flawless in 15 minutes,” construct the body as an object that must be managed to meet aesthetic standards.

The term “glowing” becomes a symbol of self-worth and social success, while the images portrayed are often simulations created by technology and imagery. Following Baudrillard’s concept of simulacra, the reality of the body is replaced by idealized images that turn the body into a visual commodity, alienating humans from their diversity and existential experiences.

According to Antonio Gramsci's (2020) framework, the beauty standards repeated by the media are the cultural hegemony of global capitalism, creating the impression that glowing is a natural need, when in fact, these standards are narrow and exclusive. Nonconforming bodies are erased from visual space, triggering identity crises in women, men, even children and the elderly.

Cultural psychology research shows that internalizing these extreme standards can trigger body image disorders, anxiety, and depression. The glowing narrative is closely linked to the values of modernity—efficiency, productivity, and instant achievement—making the body a managerial project that must be managed quickly, in line with Byung-Chul Han's (2015) critique of the "performance society."

2. The Use of the Term Glowing in Advertising and Its Contribution to the Reduction of Human Identity

The use of the term "glowing" in beauty advertising reflects the shift of the body from an authentic expression to an aesthetic project subject to market logic. This term is not simply a promotional slogan, but rather a symbol of social and existential success that shapes hegemonic consciousness. Understanding its impact requires a critical reflection on the ideologies and aesthetic logics that underpin contemporary visual culture, not just a superficial analysis of advertising visuals or language.

a. Glowing Aesthetics and Symbolic Economy

The term "glowing" in beauty advertising stems from a symbolic economy that places value on cultural meanings. It carries an ideological charge that links glowing skin to cleanliness, health, success, and even morality, while also signalling social status through access to self-care products and knowledge (Bourdieu, 1984). However, this meaning encourages the homogenization of the body: reducing the diversity of natural skin tones and textures to a single idealized standard rooted in the logic of whitening and the legacies of colonialism and racism.

b. Identity Reduction in Aesthetic Simulation

The term glowing in advertising is part of a “simulated world” (Baudrillard), where glowing skin is merely a technological construct that replaces the reality of the body. It reduces existential experience to visual consumption, making surface beauty a social capital that controls consciousness. In Heidegger's perspective, the body should be a space of existence, but the aesthetics of glowing erases human vulnerability and depth, reducing it to a mere object of performance [19].

This pressure extends to all genders, children, and the elderly, creating a “society of exhaustion” [20]. The critique of glowing is not a rejection of self-care, but rather an attempt to free the body from the tyranny of market images and logic, and return it to a whole, vulnerable, and dignified existence—from glowing to being.

3. The Impact of the Hegemony of Body Aesthetics on the Concept of Being and the Balance of Human Identity

In contemporary visual culture, the human body has shifted from an authentic expression to an aesthetic project driven by market logic. Beauty advertisements both construct and commodify the body, instilling a uniform, hegemonic consciousness.

The term "glowing" appears as a symbol of self-worth, social status, and existential success, not simply skin tone. Therefore, critical reflection beyond the analysis of a single advertisement is needed to uncover the ideological structures that underpin the aesthetic logic of contemporary visual culture.

a. Body Aesthetics as a Symbolic Power Project

In consumer society, the body becomes an arena for struggles over meaning and symbolic power. Ideal standards—including glowing skin—serve as a passport to social acceptance, instilling a hierarchy of values that appear “natural.” Within the framework of Gramsci's hegemony and Foucault's biopolitics, beauty advertising normalizes surveillance and control over the body, leading individuals to judge themselves through market images. As a result, the body transforms from a space of existence into a performative stage [21], reflecting aesthetic demands rather than presenting authentic selfhood.

b. Crisis of Being and Fragmentation of Identity

The hegemony of body aesthetics in a visual society shifts humans from being to seeming existing for the sake of being seen. In Heidegger's framework, the body, which should be a space of existence, becomes an ontological mask, giving rise to a distorted self-image and fragmented identity. Advertising and social media force individuals to develop a glowing persona, marginalizing wisdom and integrity. This pressure gives rise to existential anxiety—life is reduced to a visual spectacle.

Nevertheless, resistance movements such as body positivity and body diversity seek to restore the meaning of being. The body deserves to be respected as an existential space, not an object of capital; aesthetics should be an expression, not a prison. In a world that glorifies image, authenticity is the most radical form of resistance.

CONCLUSION

Based on the previous discussion, it can be asserted that in the contemporary visual cultural landscape, imbued with surface aesthetics and the logic of consumption, the human body is increasingly treated not as an existential space but as a visual project that must conform to market demands.

This study demonstrates how the narrative of body care advertisements—through symbols such as glowing—not merely offers a product, but shapes, normalizes, and enforces hegemonic beauty standards. This narrative contributes to the reduction of human identity and disrupts the balance between the body as a visual phenomenon and the body as an existential subject.

Through an examination of visual data, promotional texts, and theoretical frameworks from Gramsci, Foucault, Bourdieu, Baudrillard, Heidegger, and Bell Hooks, this study formulates three main, interrelated conclusions.

First, personal care advertisements function as a means of producing meaning, instilling certain aesthetic norms through linguistic and visual repetition. Within Gramsci's framework of symbolic hegemony, the beauty industry shapes public perceptions of "beauty," diminishing diversity, and marginalizing bodies that don't conform to the glowing standard, across gender and age.

Second, the term glowing has become a symbol of self-worth and cultural capital [22], linking bodily aesthetics to morality and social status. In Baudrillard's logic of simulation, glowing reduces human identity to visual imagery and endless aesthetic projects, pressuring all groups—including men, children, and the elderly—to perform according to social demands, not for the sake of their health or existential experience.

Third, the hegemony of bodily aesthetics serves humanity's connection to its authentic being. In Heidegger's view, the body should be a home for being, but in a society that worships images, it becomes a stage. The dissonance between image and inner experience breeds anxiety and alienation, turning aesthetics into symbolic violence. The solution is not to reject beauty, but to restore the body's relationship with being and celebrate human uniqueness and diversity.

This research emphasizes the need for an ethical and inclusive visual culture that values wrinkles, dark skin tones, disabled bodies, and other human expressions. Glow is allowed, but it shouldn't suppress authenticity. In a society that worships image, the courage to be true to oneself is both radical resistance and an ethical step to maintain human dignity and balance the body and being amidst the flood of images.

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REFERENCES

[1] R. Elias, A. S., & Gill, “Beauty surveillance: The digital self-monitoring cultures of neoliberalism,” Eur. J. Cult. Stud., vol. 21, no. 1, pp. 59–77, 2018, doi: 10.1177/1367549417705604.

[2] A. Y. Peng, “A techno-feminist analysis of beauty app development in China’s high-tech industry,” J. Gend. Stud., vol. 30, no. 5, pp. 596–608, 2021, doi: 10.1080/09589236.2021.1929091.

[3] K. Shen, B., & Bissell, “Social media, social me: A content analysis of beauty companies’ use of Facebook in marketing and branding,” J. Promot. Manag., vol. 19, no. 5, pp. 629–651, 2013, doi: 10.1080/10496491.2013.829160.

[4] R. Engeln–Maddox, “Cognitive responses to idealized media images of women: The relationship of social comparison and critical processing to body image disturbance in college women,” J. Soc. Clin. Psychol., vol. 24, no. 8, pp. 1114–1138, 2005, doi: 10.1521/jscp.2005.24.8.1114.

[5] E. Duffy, B. E., & Hund, “‘Having it all’ on social media: Entrepreneurial femininity and self-branding among fashion bloggers,” Soc. media+ Soc., vol. 1, no. 2, p. 2056305115604337, 2015, doi: 10.1177/2056305115604337.

[6] W. H. S. Tsai, “‘ There Are No Ugly Women, Only Lazy Ones’: Taiwanese Women’s Social Comparison with Mediated Beauty Images,” Advert. Soc. Rev., vol. 13, no. 4, 2013, doi: 10.1353/asr.2013.a497054.

[7] E. Parens, Enhancing human traits: Ethical and social implications. Washington, D.C.: Georgetown University Press, 2000.

[8] I. Sarwer, S., Ahmed, F., Zain-ul-Abideen, M., & Sagheer, “Proclivity Towards Beauty Procedures: Reflection of Societal Perception Through Aesthetic Commercials and Dermatological Advertisements,” J. Asian Dev. Stud., vol. 13, no. 2, pp. 1127–1143, 2024, doi: 10.62345/jads.2024.13.2.89.

[9] A. Danto, The Transfiguration of the Commonplace A Philosophy of Art. Cambridge, Massachusetts: Harvard University Press, 1983.

[10] A. E. P. (AEP) Education Commission of the States, “ESSA: Mapping Opportunities for the Arts,” Educ. Comm. States, pp. 1–36, 2016, [Online]. Available: http://ezproxy.lib.utexas.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=ED570121&site=ehost-live.

[11] U. Flick, Ed., The SAGE handbook of qualitative data analysis. London: SAGE Publications Inc., 2013.
[12] P. Alasuutari, L. Bickman, and J. Brannen, Eds., The SAGE Handbook of Social Research Methods, 1st Editio. London: SAGE Publications Inc., 2009.
[13] J. Elsom, Is Shakespeare still our contemporary? London: Routledge, 2003.
[14] P. Boucher, D., & Kelly, Ed., Political thinkers: from Socrates to the present. Oxford, England: Oxford University Press, 2017.
[15] R. Ritchie, J., Lewis, J., Nicholls, C. M., & Ormston, Ed., Qualitative research practice: A guide for social science students and researchers. London: SAGE Publications Inc., 2013.
[16] R. Maykut, P., & Morehouse, Beginning qualitative research: A philosophical and practical guide. London: Routledge, 2002.
[17] M. B. Miles, A. M. Huberman, and J. Saldaña, Qualitative Data Analysis : A Methods Sourcebook. Los Angeles: SAGE publications Inc, 2015.
[18] A. Gramsci, "Selections from the prison notebooks," in The applied theatre reader, T. Prentki and N. Abraham, Eds. London: Routledge, 2020, pp. 141–142.
[19] G. Debord, The society of the spectacle. Unredacted Word, 2021.
[20] B. C. Han, The burnout society. California: Stanford University Press, 2015.
[21] J. Butler, Excitable speech: A politics of the performative. London: Routledge, 2021.
[22] P. Bourdieu, "The field of cultural production," in The Book History Reader, A. Finkelstein, D., McCleery, Ed. London: Routledge, 2002, pp. 77–99.

The Future of Artificial Intelligence and Critical Reading: Global Research Trends

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Abstract. Studies in the field of artificial intelligence are increasingly being conducted in the digital technology era. Its role in education cannot be denied, particularly in the integration of AI into learning. One of the essential skills that learners need to master is critical reading. Therefore, the role of AI in critical reading activities needs to be further explored. Such exploration requires a research perspective that highlights novelty in the topics of AI and critical reading. Research novelty can be determined through bibliometric analysis using the Vosviewer application. The research method employed is descriptive qualitative. Data were obtained from research articles published in Scopus between 2020–2025. Using the keywords artificial intelligence and critical reading, a total of 35 related research articles were analyzed based on cluster, network visualization, overlay visualization, and density visualization. The findings indicate topics that remain underexplored in the field of artificial intelligence and critical reading, namely collaboration, literature, and learner. These results have the potential to serve as a foundation for further research topics.

Keywords: artificial intelligence, critical reading, bibliometric, Vosviewer

INTRODUCTION

The development of artificial intelligence in today's digital era is occurring massively. This growth does not only take place in the sectors of technology, economy, and industry but has also entered the realm of education. In education, various AI-based applications and tools have emerged to facilitate tasks, particularly in learning. AI systems are able to respond and provide feedback quickly and constructively, thereby contributing to a positive learning environment 1. Various applications can be utilized as innovative learning media that simplify the delivery of materials for mastering 21st-century skills, namely communication, collaboration, critical thinking, and creativity.

Alongside technological advancements, the spread of information has also become faster and undergone transformation. Almost every day, and even at any given time, information can be accessed easily and instantly. The digital world is flooded with information and content from multiple directions, the sources of which are not always clear. This condition inevitably affects the study of reading literacy in society. Reading is essentially the process of interpreting and understanding written language 2.

People today should not merely comprehend the content of texts, but they are also required to possess higher-order thinking skills to critically evaluate every piece of information they encounter through reading. This activity is called critical reading, which refers to the ability to analyze, evaluate, and reflect on information in depth. Critical reading functions as a safeguard that equips individuals to face the abundance of unverified information. University students generally hold very positive attitudes toward critical thinking; however, their levels of critical thinking and their ability to reflect such thinking in critical reading skills have not yet been fully realized 3.

Critical reading is closely related to higher-order thinking skills (HOTS), which are not only important for students or researchers but also for society today, living in the digital era. Critical thinking is used as a means of evaluating information and self-regulation so that individuals can process information, even though human dependence on AI tools is increasingly growing nowadays 4. By practicing critical reading, one can obtain credible information amid the abundance of content generated by AI. Therefore, studies on critical reading and the sophistication of AI need to be further examined.

In the context of global research, the relationship between AI and critical reading needs to be mapped before conducting further studies. Such mapping serves as a basis for researchers to identify opportunities in

understanding the direction, development, and gaps in AI and critical reading topics that remain open for further exploration.

One approach that can be used to map global research trends is bibliometric analysis. Bibliometric analysis can identify interconnections between topics, enabling researchers to recognize those that have already been extensively studied and those that are still underexplored. The results of such mapping allow researchers to identify potential new topics as ideas for future research.

In practice, bibliometric analysis is often supported by software such as Vosviewer. This application is capable of generating global research network visualizations. Visualizations in Vosviewer are classified into three types: network visualization, overlay visualization, and density visualization. Network visualization displays a network map that illustrates the relationships between research items based on various keywords. Overlay visualization shows a network map of keyword relationships, enhanced with color gradients to indicate the development of keyword characteristics. Density visualization presents a map that illustrates the density of research based on specific keywords, indicated by variations of light and dark colors. The lighter the color of a keyword, the more frequently it has been studied. Conversely, the darker the color, the less frequently it has been researched.

By utilizing the Vosviewer application, global research trends in AI and critical reading can be mapped, allowing researchers to identify new topics for deeper investigation in the future. This article is expected to provide an overview of research directions, underexplored topics, and offer a conceptual foundation for further studies.

LITERATURE REVIEW

Artificial intelligence (AI) is a branch of computer science that enables machines (computers) to perform tasks in ways similar to, and as effectively as, humans. AI is a field of computer science aimed at developing systems and machines capable of carrying out tasks that typically require human intelligence 5. Artificial intelligence is a subfield of computer science that serves as a software technique in which programming is carried out through the representation of data, data processing, and symbolic problem-solving rather than numerical computation. Symbolic problems are those commonly encountered in daily life, as they are more closely related to symbols and concepts than to numbers. The goal of artificial intelligence is to make computers appear capable of thinking intelligently. AI can be applied in areas such as control, forecasting, planning, and image processing. AI literacy is considered crucial, encompassing both an understanding of AI technology and its broader social impacts 6.

Critical reading is a reading activity carried out with deep comprehension, involving not only the understanding of explicit information but also implicit meaning. This aligns with the taxonomy of reading comprehension, in which at the critical reading stage, the activity is not only aimed at recalling information explicitly stated in the text but also involves the ability to reorganize, infer, and evaluate its content. These three abilities fall under the domain of critical reading because, through such processes, readers are able to uncover hidden information beyond what is directly stated in the text. Critical thinking has been identified as an essential skill for the 21st century; however, few studies have investigated its role in reading comprehension 7.

When readers attempt to comprehend a text, they are essentially engaging in a process of connecting the information they read with the knowledge already stored in their minds. The reading process is often characterized primarily as a psychological, cognitive, and individual process 8. Through critical reading, readers attempt to link and compare the author's ideas with their own knowledge and experiences in order to make judgments about the accuracy and relevance of the content 9. Critical thinking involves both analysis and evaluation: analysis is carried out by identifying parts of a problem, separating them, and examining their interrelationships, while evaluation is done by assessing the usefulness of assumptions and the strength of supporting evidence 10.

RESEARCH METHODE

The research method used is descriptive qualitative. This study aims to describe the results of topic trend analysis using Vosviewer. The data used in this research consist of 35 scientific articles related to the keywords artificial intelligence and critical reading. The articles were collected through a literature retrieval method from Scopus within the time span of 2020–2025. The data were analyzed bibliometrically using Vosviewer to obtain information on item clusters, network visualization, overlay visualization, and density visualization.

RESULTS AND DISCUSSION

The research trends on artificial intelligence and critical reading were obtained from the analysis of articles retrieved from Scopus metadata within the last six years. Based on bibliometric analysis using Vosviewer, four classifications of data were identified: item clusters, network visualization, overlay visualization, and density visualization. These four classifications are explained as follows.

Item Cluster

In the bibliometric analysis using Vosviewer, there is cluster information that contains several keywords. These keywords can be linked with other keywords, indicating topical proximity that can be explored further. The keywords appearing in each cluster are generated through a keyword selection process carried out in the Vosviewer application. The more keywords selected, the more clusters Vosviewer produces. In this study, four clusters were identified and are detailed as follows.

Table 1. Cluster and Keywords

Cluster	Keywords
Cluster 1 (28 items)	addition, ai chatbot, assessment method, assignment, authorship, chatbot, critical thinking skill, evaluation, experience, exploration, frequency, generative ai, improvement, inaccuracy, individual, lack, learner, learning, limitation, motivation, observation, output, quantitative data. Reference, situational awareness, support, sustainable development, task
Cluster 2 (23 items)	area, author, awareness, community, contrast, corpus, creation, critical reading, design methodology approach, distant reading, experiment, image, information, interview transcript, large language, model, methodology, originality value, place, relation, sense, topic, work, writing.
Cluster 3 (17 items)	collaboration, communication, construction, creativity, decade, educational setting, future, gai, gai tool, generative artificial intelligence, interaction, literature, literature review, new approach, reflection, representation, science
Cluster 4 (9 items)	case, child, concept, content, framework, imaginary, knowledge, privacy, scholar

Network Visualization

The results of the network visualization can indicate research topics that remain underexplored. The smaller the circle representing a keyword, the fewer studies exist on that topic. This visualization also allows researchers to observe the relationships between keywords. Such insights help researchers determine a unique focus or scope for their studies. In this way, these keywords can serve as the basis for new research topics. In Figure 1 below, each keyword is color-coded according to its cluster or group, as explained in Table 1. This helps researchers visually understand the position and relationships of each topic.

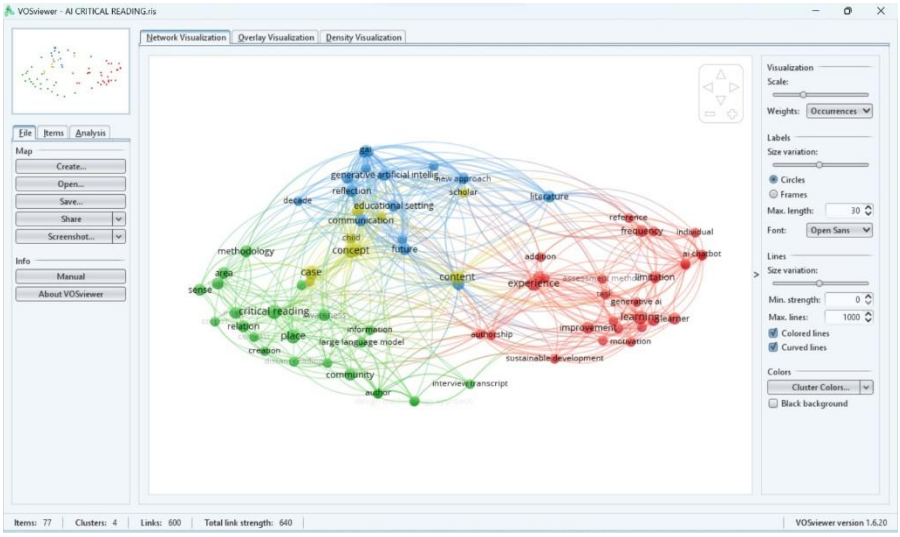

Figure 1. Network Visualization of Bibliometric Analysis on Artificial Intelligence and Critical Reading

Based on Figure 1, the results of the bibliometric analysis on the topics of artificial intelligence and critical reading show no significant disparities. This can be seen from the relatively similar sizes of the circles. Therefore, it can be stated that research on the topics of artificial intelligence and critical reading is still relatively limited. According to Figure 1, the research topics most frequently studied, as indicated by larger circle sizes, are learning, experience, content, critical reading, and concept. Meanwhile, the less-explored topics include child, addition, scholar, decade, and creator.

Overlay Visualization

The results of the overlay visualization show research topic trends over the years. The brighter the color of a keyword, the more recent the research. This visualization displays a color gradient from dark to light, with the timeline shown at the bottom. The colors represent research trends over the past five years. Since the data used is limited to 2020–2025, this feature displays trends from 2020 to 2025.

In the visualization, the network appears purple for the period before 2023 up to mid-2023, shifting to blue in the second half of 2023. In 2024, the color changes to green, and by the latter half of 2024, it turns yellow. These color changes serve as parameters indicating the novelty of a topic. The brighter the color of a keyword, the newer and more relevant the research topic is.

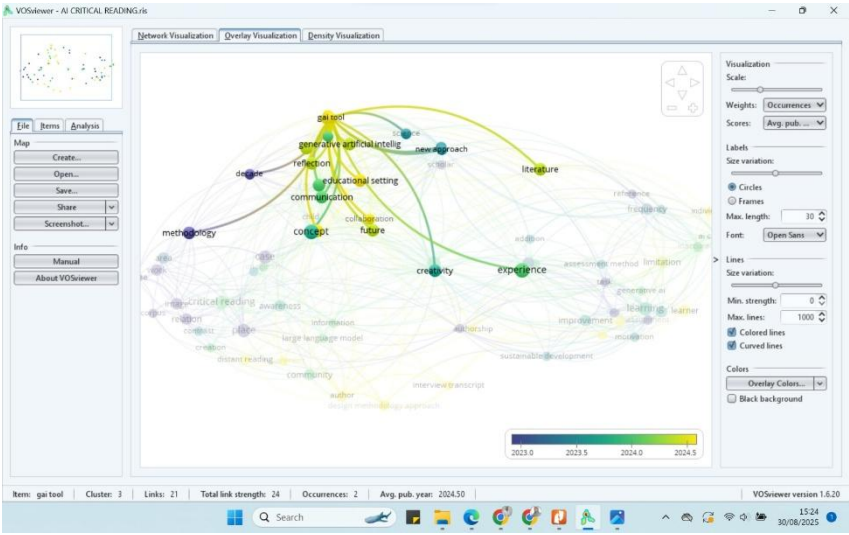

Figure 2. Display of GAI Tool Keywords in Overlay Visualization

Referring to Figure 2, the keyword *gai tool* still presents opportunities for research in connection with several other topics. The topic *gai tool* shares the same color yellow with the topics *framework*, *collaboration*, and *educational setting*. This indicates that these topics represent new and relevant research within the latter half of 2024.

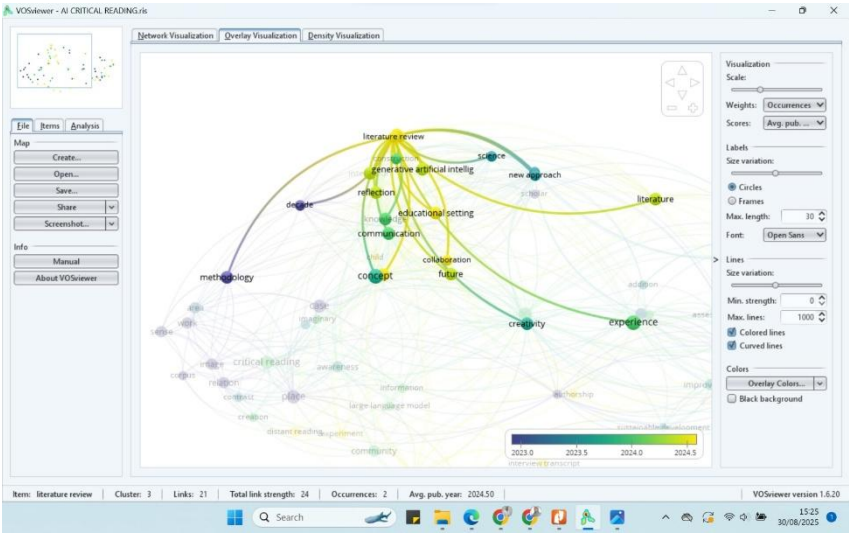

Figure 3. Display of Literature Review Keywords in Overlay Visualization

Based on Figure 3, *literature review* is identified as a new topic in research related to *artificial intelligence* and *critical reading*. This is indicated by the yellow color of the keyword *literature review*. The topic *literature review* shares the same yellow color as *educational setting*, *framework*, and *collaboration*. This shows that these topics remain a trend during the latter half of 2024.

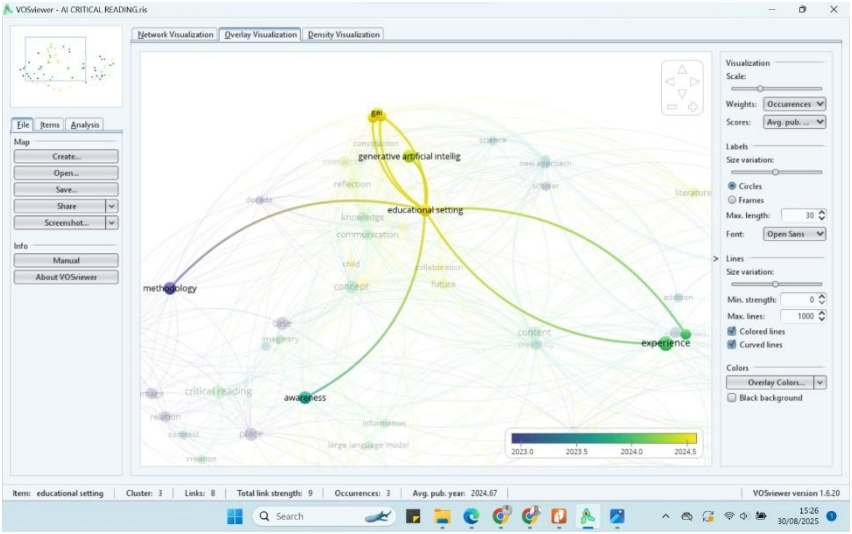

Figure 4. Display of Educational Setting Keywords in Overlay Visualization

As shown in Figure 4, the topic *educational setting* in research related to *artificial intelligence* and *critical reading* has not been extensively studied during the 2020–2025 period. Within this timeframe, the topic *educational setting* is only associated with *methodology*, *awareness*, *experience*, *generative AI tools*, *GAI*, *literature review*, and *exploration*. The topics *educational setting*, *generative AI tools*, *literature review*, and *GAI* share the same yellow color, indicating that these topics have become a trend in the latter half of 2024.

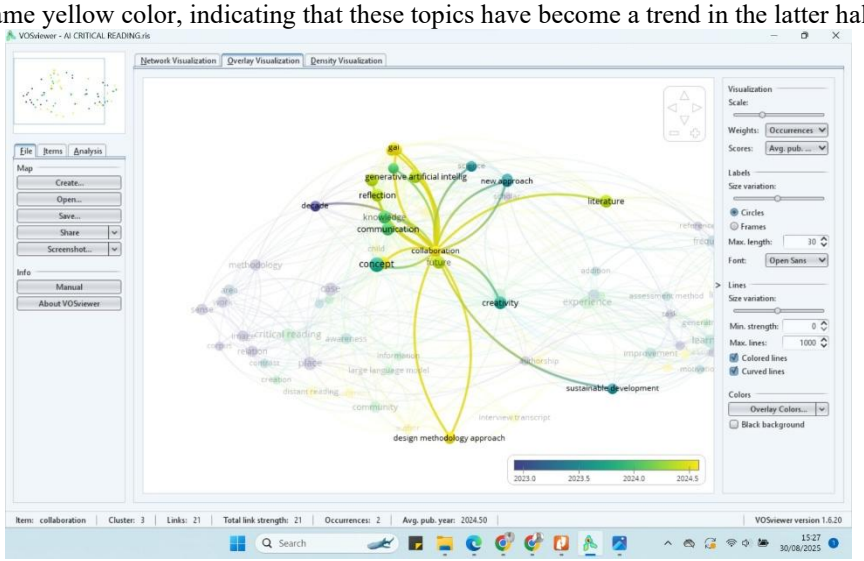

Figure 5. Display of Collaboration Keywords in Overlay Visualization

Berdasarkan Gambar 5, kata kunci *collaboration* masih memiliki banyak potensi untuk diteliti lebih lanjut, terutama dalam kaitannya dengan topik lain. Secara khusus, topik ini memiliki warna yang sama (kuning) dengan *generative AI tools, GAI, literature review, design methodology approach, originality value* dan *framework*. Hal ini menandakan adanya peluang penelitian yang baru di area-area tersebut.

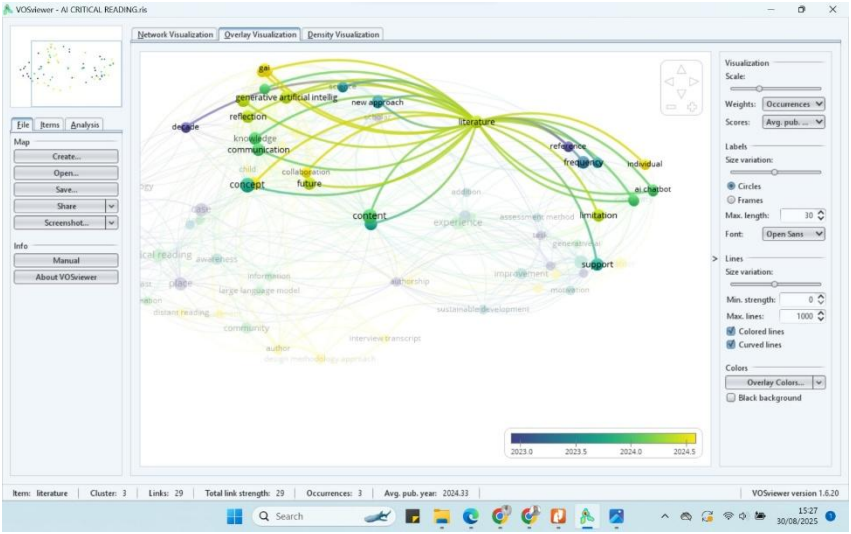

Figure 6. Display of Literature Keywords in Overlay Visualization

From Figure 6, it can be seen that the topic literature in research related to artificial intelligence and critical reading became a trend in the early half of 2024, as indicated by its light green color. The topic literature holds many opportunities to be explored in connection with other topics during the 2020–2025 period. Novel research can be conducted by linking it with topics such as generative AI tools, GAI, literature review, individual, collaboration, and framework. These topics became a trend in the latter half of 2024, as indicated by their yellow color.

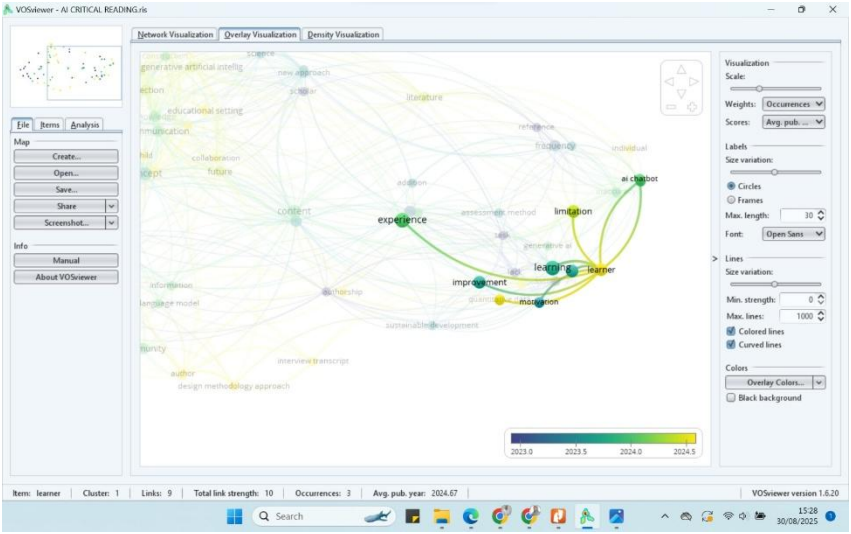

Figure 7. Display of Learner Keywords in Overlay Visualization

Referring to Figure 7, the topic learner in research related to artificial intelligence and critical reading has only been explored to a limited extent. During the 2020–2025 period, the topic learner was connected with nine other topics: experience, limitation, AI chatbot, chatbot, learning, improvement, motivation, quantitative data, and support. Among these, quantitative data was the only topic that became a trend in the latter half of 2024, as indicated by its yellow color.

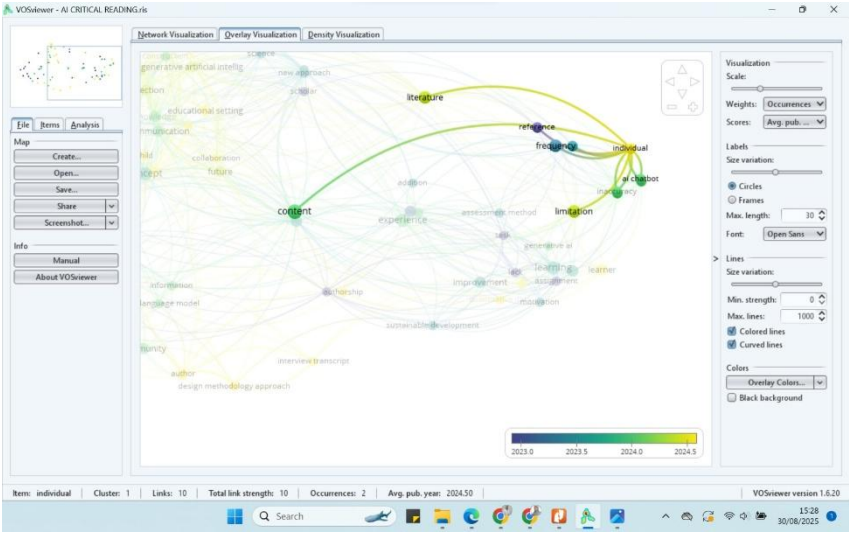

Figure 8. Display of Individual Keywords in Overlay Visualization

Based on Figure 8, the topic individual in relation to artificial intelligence and critical reading has remained underexplored. Between 2020 and 2025, this topic was only linked to ten other topics: literature, content, reference, frequency, AI chatbot, chatbot, inaccuracy, limitation, observation, and output. By the end of 2024, no topic connected to individual had emerged as a trend, as indicated by the absence of any yellow color. The most recent trends were found in the topics literature and limitation in early to mid–2024, as shown by their light green color.

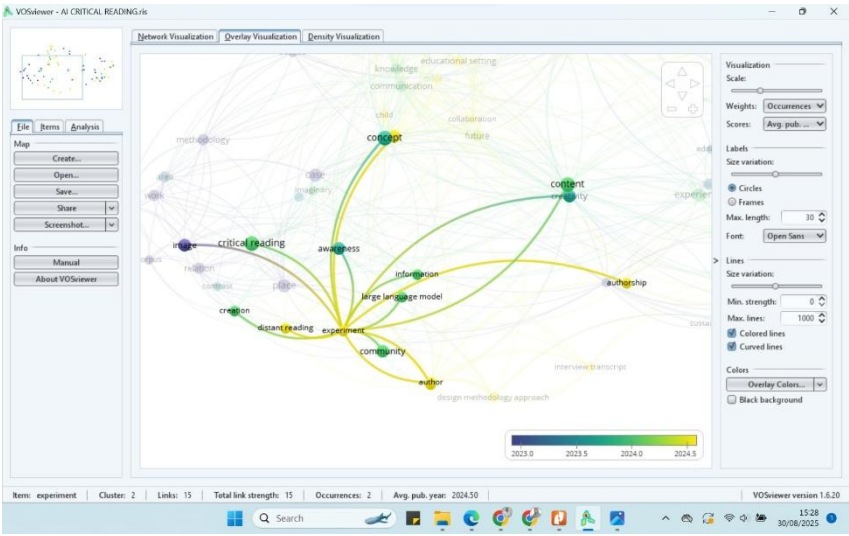

Figure 9. Display of Experiment Keywords in Overlay Visualization

Based on Figure 9, the topic experiment holds significant potential for further research in conjunction with other topics. Some relevant topics include distant reading, framework, authorship, author, and writing. Since they share the same yellow color, this indicates that these topics have emerged as research trends in the latter half of 2024.

Density Visualization

Density Visualization can be interpreted as an analysis showing that the darker the color of the visualized keyword map, the less frequently the keyword has been studied. Conversely, the brighter and wider the keyword map, the more extensively the keyword has been researched.

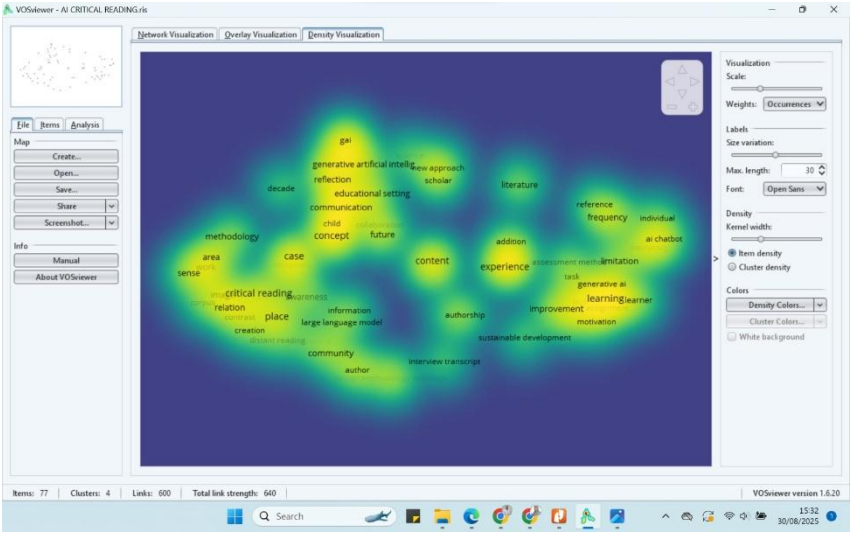

Figure 10. Display of Density Visualization

Based on the density visualization in Figure 10, the darker the color of a keyword, the fewer studies exist on that topic. Conversely, brighter colors (yellow) indicate that the topic has been more extensively researched and has become more common. In Figure 10, it is evident that the topics most frequently studied include generative AI tool, literature review, and educational setting, which are marked in yellow. On the other hand, less-explored topics include collaboration, literature, and learner, which are indicated by light green.

CONCLUSION

Based on the bibliometric analysis using the Vosviewer application, four keyword clusters related to artificial intelligence and critical intelligence were identified. The keywords that emerged within each cluster were then visualized through network visualization, overlay visualization, and density visualization. According to the network visualization, the most frequently researched topics are learning, experience, content, critical reading, and concept, while the less-studied topics include child, addition, scholar, decade, and creator. Meanwhile, the overlay visualization indicates nine trending research topics, namely GAI tool, literature review, educational setting, collaboration, literature, learner, individual, and experiment. Referring to the density visualization, the topics that have been widely researched are generative AI tool, literature review, and educational setting, whereas the less-explored topics are collaboration, literature, and learner. This exploration of topics and research trends is intended to encourage other researchers to be more creative in exploring new areas of study.

ACKNOWLEDGMENTS

The author would like to express sincere gratitude to Yogyakarta State University as the host institution of this international conference for providing a platform for researchers to contribute to the advancement of science. The author also extends appreciation to fellow lecturers who have offered valuable input for the completion of this article.

REFERENCE

1 Y. Fu, Z. Weng, and J. Wang, “Examining AI Use in Educational Contexts: A Scoping Meta-Review and Bibliometric Analysis,” Int J Artif Intell Educ, 1–57 (2024).
2 A. khamouja, “Exploring Students’ Perceptions towards the Impact of Artificial Intelligence on their Reading Skills: The Case of S6 Students at the English Language Department,” International Journal of Linguistics and Translation Studies 6(1), 167–175 (2025).
3 M. Din, “Evaluating university students’ critical thinking ability as reflected in their critical reading skill: A study at bachelor level in Pakistan,” Think Skills Creat 35, 100627 (2020).
4 A. Salido, I. Syarif, M.S. Sitepu, Suparjan, P.R. Wana, R. Taufika, and R. Melisa, “Integrating critical thinking and artificial intelligence in higher education: A bibliometric and systematic review of skills and strategies,” Social Sciences & Humanities Open 12, 101924 (2025).

5 E. S. Eriana, and A. Zein, Artificial Intelligence (Eureka Media Aksara, Purbalingga, 2023).
6 Y. Walter, "Embracing the future of Artificial Intelligence in the classroom: the relevance of AI literacy, prompt engineering, and critical thinking in modern education," International Journal of Educational Technology in Higher Education 21(1), 1–29 (2024).
7 D. Paige, W.H. Rupley, and L. Ziglari, "Critical Thinking in Reading Comprehension: Fine Tuning the Simple View of Reading," Education Sciences 2024, Vol. 14, Page 225 14(3), 225 (2024).
8 C. Wallace, Critical Reading in Language Education (Palgrave Macmillan, New York, 2023).
9 Martutik, and Abdul Rani, Membaca Intensif (Surya Pena Gemilang, Malang, 2013).
10 S. Barnet, and H. Bedau, Critical Thinking, Reading, and Writing: A Brief Guide to Argument (Bedford, Boston, 2011).

RELATIONAL CONCEPTUALIZATION IN PRAGMATICS: A METAPRAGMATIC STUDY OF GERMAN IN RONYA OTHMANN'S NOVEL DIE SOMMER

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Abstract. Critical metaphors in German are related to the moral message content in language, making metapragmatic studies in German and Indonesian very interesting. The objectives of this study are to describe (1) the metapragmatic forms of German and Indonesian, and (2) the metapragmatic meanings of German and Indonesian in Othmann Ronya's novel Die Sommer through a conceptual approach to relations in pragmatics. Othmann Ronya's novel Die Sommer was chosen for this study because it contains very strong moral messages.

This research uses a qualitative descriptive method with metapragmatic analysis through an in-depth study of relational conceptualization in pragmatics. The data sources for this research are the novel Die Sommer by Othmann Ronya and its Indonesian translation entitled Musim Panas. Data analysis uses semantic analysis through a metapragmatic approach in both German and Indonesian. The research data was validated using distribution and matching (Sudaryanto, 2015). Data validity was assessed using inter-rater reliability, while the validity of the research results was assessed through discussions in a focus group discussion (FGD) by lecturers of Linguistics at the Department of German Language Education, FBSB.

The results of the study show that (1) mapping the metapragmatic form of explicit expressions such as “er sagte höflich” and “sie antwortete kühl” or implicit strategies (greetings, intonation in narration); (2) a relational description of how characters build closeness, distance, power, or resistance through language; (3) a cross-linguistic comparison showing that German tends to be more explicit in metapragmatic evaluation, while Indonesian is more implicit and contextual; (4) moral and cultural implications can show how Othmann uses metapragmatics to assert certain values, such as family solidarity, identity conflicts, or generational differences; and (5) applied contributions can provide insights for learning German in Indonesia, particularly in the aspect of cross-cultural pragmatics, and can also be a reference for the development of comparative German-Indonesian metapragmatic studies, which are still rarely conducted.

Keyword: Critical metaphors, mapping the metapragmatic, moral and cultural implications.

INTRODUCTION

This GB assignment research is a study to produce research that is in line with the field of science so that the research roadmap in the study programme becomes focused. Research in the field of science must be integrated into the study programme curriculum so that the study programme can produce research that can support the success of graduates in that study programme. This RG research is at the forefront of supporting graduate achievements in study programmes because the scientific clusters, scientific trees, and scientific branches can be narrowed down to completion. The German Language Education study programme is divided into three scientific clusters, namely linguistics, literature, and German language teaching.

The purpose of the GB assignment research is to produce excellent products that are relevant to the research team's field of expertise and can be used to improve the implementation of the Tridharma Perguruan Tinggi (Three Pillars of Higher Education). This RG roadmap is in line with the research team's field of study, referring to the 2025-2030 DRPM UNY Research Strategic Plan. The research team's roadmap includes conducting research in 2018 entitled Substitution in German and its realisation in Indonesian, German Elepsis and its equivalents in Indonesian (2019), Nominalisation forms in German textbooks and their equivalents in Indonesian (2020), The Use of Corpus Linguistics for German Language Learning (2021), Cohesion Devices in

German Sentences and Their Equivalents in Indonesian (2022), Relativsatz in German and Indonesian: A Contrastive Analysis (2023), and The Use of Articulation in German and Indonesian (2024). Thus, it can be said that the research roadmap is always oriented towards applied linguistics and the research team are also graduates of the Humanities Study Programme, concentration in Linguistics, FIB UGM.

A common problem encountered by people learning German is difficulty in understanding German texts, co-texts and contexts. German language learners do not immediately think using German logic, but rather use Indonesian logic and translate it into German. Of course, there are many disadvantages when someone has to express themselves in German via Indonesian first, then translate it into German. Many German language norms and rules cannot be translated from a foreign language. This way of thinking hinders someone from learning German. This is due to the differences between German and Indonesian. Difficulties arise because learners are accustomed to using Indonesian, which is agglutinative, in a language that is inflectional. Thus, the difficulty increases when learning to construct German sentences based on Indonesian thinking patterns because the choice of vocabulary used will not be appropriate. Therefore, this research is necessary to determine the form and type of German and Indonesian articulation and to understand the meaning attached to the article that accompanies the noun.

The objectives of this study are to describe (1) the metapragmatic forms of German and Indonesian, and (2) the metapragmatic meanings of German and Indonesian in Othmann Ronya's novel Die Sommer through a conceptual approach to relations in pragmatics. Othmann Ronya's novel Die Sommer was chosen for this research assignment by the Professor because it contains very strong moral messages. Research on critical metaphors in German is related to the moral messages in language, making the study of metapragmatics in German and Indonesian very interesting.

This research is in line with the Strategic Plan of Yogyakarta State University, which includes creativity and innovation enhancement in 2022. In 2023, it must carry out research output and networking excellence, in 2024 it must have international recognition, and in 2025 UNY, which is already a PTNBH, will become a world-class university. In addition, this research is also in line with the 2021-2025 Research and Community Service Directorate Roadmap of Yogyakarta State University with the main theme of Post-Covid-19 Education. The research roadmap begins with FBSB and DRPM research from 2025 to 2030 and has published research results in national Sinta 2 journals and reputable international journals.

The following is the research team's roadmap from 2017 to 2024.

Metapragmatic theory in language can be categorised into two things, namely conceptualisation metapragmatic theory and relational metapragmatic theory in German and Indonesian novels, and factual metapragmatic theory which is determined by cognitive aspects. This was conveyed by George Lakoff and Mark Johnson because these two linguists are pioneers of metaphor theory. They also explain how metaphors are not only linguistic tools, but also cognitive frameworks that shape the way people think and experience the world. In the context of this critical metaphor research, the cognitive theory framework is useful for understanding how metaphors are used in German in Karl May's novels. Cognitive frameworks that can develop a person's thinking power may reflect certain cultural or social views.

Metapragmatic analysis, which is also developing rapidly and diversely, can assist in the development of critical discourse analysis. This combines critical discourse analysis with conceptual metaphor theory, focusing

on how metaphors reflect and shape representations of ideology and power in texts. This study will use a cognitive framework to explore ideological themes in the novel Friede auf Erden.

Critical Discourse Theory (CDT) has been explored by linguists such as Van Dijk, Fairclough, Miles, Jogensen & Phillip, Barker & Galasinski, Paltrige, Renkema, Guy Cook, Terry Locke, Jim Miller, etc. However, the most active researchers in critical discourse are Teun A. van Dijk and Norman Fairclough. These two figures in CDT believe that CDT can help analyse how language (including metaphors) is used to express and maintain power relations and ideology in texts.

Metapragmatics undoubtedly helps to examine critical metaphor research in depth because, with a linguistic approach, research can integrate other sciences that will help solve the problem. The corpus linguistic approach is used to obtain and analyse language data on a large scale because corpus data can be found in various sources. It can be taken from sources originating in cyberspace and can also be used to analyse novels in various languages. In the context of researching the conceptualisation of relationships in pragmatics, the metapragmatic linguistic approach can help to systematically examine the frequency, usage patterns, and context of metaphors in texts, coherence, semantic prosody, and semantic references in the novel Die Sommer.

Narrative theory in language research can facilitate finding equivalents between German and Indonesian in the novel Die Sommer by Othmann Ronya, which has been translated into Indonesian with the title Musim Panas. This translation can help facilitate the exploration of understanding to express and maintain power relations and ideology in a text in a novel. Does the understanding of both languages regarding the metapragmatics found in the novel Die Sommer remain in line with the original work in terms of understanding the language structure in both languages?

Consider how the narrative structuring in Ohtmann Ronya's novel helps to construct meaning through metaphrastic language devices. This can help to link the use of metaphors to the plot or character development.

Thus, the novel was published in two languages, German and Indonesian. Based on the source, the data can be divided into two types, namely primary data sources and secondary data sources. The primary data source is the novel Die Sommer in German, while the secondary data source is the Indonesian translation Musim Panas.

The main instrument of this research is the researcher because in this research, the researcher is a planner, language speaker, data collector, and data analyst. The data collection technique in this research uses the observation and note-taking technique. This technique is carried out by carefully reading all data sources (Sudaryanto, 2015). Furthermore, careful notes were taken on all the collected data corpus in the form of German language devices and their equivalents in Indonesian obtained from primary and secondary sources in the novel.

The object of this study is linguistic units constructed as metaphors in German and Indonesian. The data subject is all German metaphors found in the novel Die Sommer, and the secondary data source is a translation entitled Musim Panas. The data source in this study is all linguistic units that have critical metaphorical meanings in German and Indonesian. The research data analysis uses BUL, namely for direct elements found by Sudaryanto (2015). This is very suitable for examining articulation in German and Indonesian.

The validity of the research data was obtained through intra-rater and inter-rater. The steps are as follows. First, observe the data repeatedly at different times. Second, collect data until saturated data is obtained. Next, the researcher describes the data carefully, clearly and accurately, so that the results obtained reflect the data being studied. Another step is to explain the research results systematically so that they can be easily understood by readers. For reliability, the researcher takes steps, namely peer assessment within a research team. This assessment is carried out by asking them to read the research data in Roman and discuss it. The target output of this research is a scientific article published in a reputable international journal with the URL: Journal: International Journal of Corpus Linguistics

METHOD

This research is a qualitative descriptive study. It uses a document or text study approach. Document or text study is an approach that focuses on the analysis or interpretation of written material based on its context. The research data consists of text from the novel die Sommer by Othmann Ronya, which has been translated into Indonesian with the title Musim Panas. The translation can help facilitate the exploration of understanding to express and maintain power relations and ideology in a text in a novel. The understanding of both languages regarding the critical metaphors contained in the novel Die Sommer is still in line with the original work in understanding the language structure in both languages.

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In practical terms, the results of this research contribute positively to the development of disciplines such as linguistics and the humanities because they take the form of scientific articles published in reputable international journals. In this case, the research results can be read in detail by academics, education practitioners, and students. URL: https://benjamins.com/catalog/ijcl or other international journals equivalent to the main target journal.

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RESEARCH RESULTS

Metapragmatics is a reflection on how language is used to comment on, control, or interpret language use itself. This is based on the theory of Silverstein (1993): Metapragmatic Functions and Indexicality. Verschueren's theory (1999): Understanding Pragmatics — which emphasises that metapragmatics is the reflective awareness of language users of the context of language use. As for Agha's (2007) theory: Language and Social Relations — it introduces the idea of metapragmatic typification (how people assess language style as a social identity).

Relational conceptualisation here refers to how social relationships, identities, and positions between characters are constructed through language practices — not merely the content of speech, but how language builds social relations and power.

The theoretical basis is from Haugh's theory (2013, 2018): Relational Work and Interactional Pragmatics. Spencer-Oatey (2008): Face, Identity, and Interactional Goals in Pragmatics. Then Locher & Watts (2005): Politeness Theory and Relational Work — emphasising that linguistic interaction is relational work that is continuously negotiated. Ronya Othmann's Roman Die Sommer is replete with themes of identity, diaspora, and intergenerational relationships. Thus, the theoretical framework can combine:

Pragmatic and metapragmatic analysis (exploring the communicative awareness between characters). Relational analysis (mapping social dynamics, power, and identity through language). An interpretive-hermeneutic approach to interpreting the socio-cultural context of the characters' utterances.

Based on References: 21 books/journals developed into 57 books/journals

Die Sommer 77,873 words, 479,229 characters, 124,960 syllables, 13,484 sentences. The novel The Summers was translated by translator Hendarto Setiadi from a German-language fiction novel with the original title Die Sommer 79,203 words, 491,289 characters, 126,036 syllables, 13,227 sentences.

Analysis of Direct Elements: Van Dijk, Fiarclough, Miles, Jogensen & Phillip's theory. Semantics: Metapragmatics that will help to deeply examine critical metaphors. Interpretation: After critical metaphors, the results are interpreted.

CONCLUSSION

Based on the metapragmatic context in the novel, the following conclusions can be drawn.

1. Strong Metapragmatic Representation

   The characters in Die Sommer display a high level of linguistic awareness of their social and cultural context (e.g. between family language and public language, between German and minority languages).

2. RelationsLanguage becomes a means of negotiating identity — for example, between emotional closeness and cultural distance, or between European modernity and Middle Eastern roots.
3. Indexicalisation of Identity
   Metapragmatic actions demonstrate indexicality (social marking) towards the social class, gender, and ethnic origins of the characters.
   4. Social Meaning Construction through Language — Language is not only a means of communication, but also a mechanism of relational positioning — a way for figures to negotiate their place in social networks and identities.
5. Theoretical Contribution — This research has the potential to enrich literary pragmatics studies by introducing the concepts of relational pragmatics and metapragmatic awareness in the analysis of contemporary German literary texts.

REFERENCES

3. Andersen, G. (2014). Relevance. In Corpus Pragmatics: A Handbook. https://doi.org/10.1017/CBO9781139057493.008
4. Baker, A. (2016). Sign languages as natural languages. In The Linguistics of Sign Languages. https://doi.org/10.1075/z.199.01bak
5. Banta, F. G., & Erben, J. (1971). Deutsche Grammatik. The German Quarterly. https://doi.org/10.2307/404256
6. Deutsche Grammatik in Theorie und Praxis. (2012). In Deutsche Grammatik in Theorie und Praxis. https://doi.org/10.1515/9783110933932
7. Duden. 2024. Grammatik. Berlin: © Cornelsen Verlag GmbH, 2024. https://www.duden.de/hilfe/grammatik.
8. Graefen, G., & Liedke, M. (2008). Germanistische Sprachwissenschaft. In UTB Sprachwissenschaft.
9. Green, C. (2012). Noun Phrase Cohesion in English Discourse: a Corpus-based Analysis of Patterns and Influences. International Journal of English Linguistics. https://doi.org/10.5539/ijel.v2n4p44
10. Halliday, M. A. K. (2014). An Introduction to Functional Grammar. In An Introduction to Functional Grammar. https://doi.org/10.4324/9780203783771
11. https://mijil.id/t/mengenal-artikula-dan-jenis-jenisnya/680
12. Kridalaksana, Harimurti, dkk. 1985. Tata Bahasa Deskriptif Bahasa Indonesia: Sintaksis. Jakarta: Pusat Pembinaan dan Pengembangan Bahasa Departemen Pendidikan dan Kebudayaan.
13. Leiss, E. (2009). Konstruktionsgrammatik versus Universalgrammatik. In Wie wir sprechen und schreiben: Festschrift für Helmut Glück zum 60. Geburtstag.
14. Leuschner, Mortelmans and De Groodt, 2011. Grammatikalisierung im Deutschen. Edited by: Torsten. Volume 9 in the series Linguistik – Impulse & Tendenzen. Published: March 1, 2011. ISBN: 9783110925364. https://doi.org/10.1515/9783110925364
15. Moeliono, Anton M., dkk. 2017. Tata Bahasa Baku Bahasa Indonesia Edisi Keempat. Jakarta: Badan Pengembangan dan Pembinaan Bahasa.
16. Primus, B. (1993). Sprachnorm und Sprachregularität: Das Komma im Deutschen. Deutsche Sprache.
17. Schmidt, W., Langner, H., & Wolf, N. R. (2007). Geschichte der deutschen Sprache : ein Lehrbuch für das germanistische Studium. In Geschichte der deutschen.
18. Sebastian Löbner. (2015). Semantik: Eine Einführung. In De Gruyter Studienbuch.
19. Spencer, A., & Zwicky, A. M. (1998). The Handbook of Morphology (Blackwell Handbooks in Linguistics). https://doi.org/10.1002/9781444343069 https://doi.org/10.22146/jh.v15i3.79
20. Mills, Sara. 2004. Discourse. London: Routledge
21. Slembrouck, Steff. 2009. What is Meant by Discourse Analysis.
22. Cook, Guy. 1989. Discourse. Oxford: Oxford University Press.
23. Fairlough, Norman. 1995. Language and Power. London: Longman.
24. Renkema, Jan. 1993. Discourse Studies.
25. Barker, Chris; Âski, Dariusz Galasin. 2001. Cultural Studies and Discourse Analysis. A Dialogue on Language and Identity. London: SAGE Publications Ltd.
26. Jørgensen, Marianne; Phillips, Louise. 2002. Discourse Analysis as Theory and Method. London: SAGE Publications.
27. van Dijk, Teun A. 2014. Discourse and Knowledge. A Sociocognitive Approach. United Kingdom: University Printing House, Cambridge CB2 8BS.
28. Gee, James Paul. 2001. An Introduction to Discourse Analysis. Theory and Method. London and New York: Routledge is an imprint of the Taylor & Francis Group.
29. Paltridge, Brian. 2006. An Introduction to Discourse Analysis. Great Britain: MPG Books Ltd, Bodmin, Cornwall.

30. Stubbs, Michael. 1983. Discourse Analysis The Sociolinguistic Analysis of Natural Language. Chicago: The University of Chicago Press
31. Fairlough, Norman. 2015. Critical Discourse Analysis The Critical Study Language. Singapore: Longman Singapore Publishers.
32. Brown, Gillian and George Yule. 2005. Discourse Analysis. Cambridege: Cambridege University Press.
33. Fairlough, Norman. 1995. Critical Discourse Analysis. Longman: Longman Group Limited.
34. Gumperz, John J. 2008. Discourse Strategies. Cambridge: Cambridge University Press.
35. Nunan, David. 1993. Introducing Discourse Analysis. Penguin English.
36. Fairclough, Norman. 1995. Critical discourse analysis : papers in the critical study of language. Singapore: Longman Singapore Publishers (Pte) Ltd.
37. van Dijk, Teun A. 2004. Ideology and discourse. A Multidisciplinary Introduction. Barcelona: Pompeu Fabra University.
38. Locke, Terry. 2004. Critical Discourse Analysis. New York: Continuum International Publishing Group.
39. Locke, Terry. 2004. Critical Discourse Analysis. New York: Continuum International Publishing Group.

ADOLESCENT RESILIENCE IN PREVENTING SOCIAL RISKS: UNDERSTANDING, URGENCY, AND STRATEGIES

Dwi Agustina, Aris Martiana, Datu Jatmiko, Nur Hidayah

Abstract. Adolescents are an age group vulnerable to psychosocial stress due to the dynamics of personal development and the demands of the social environment. In this context, resilience is an important competency that acts as a protective factor in facing various social risks, such as academic stress, peer pressure, and interpersonal relationship disorders. This study aims to: (1) describe adolescents' understanding of resilience; (2) analyze the urgency of resilience in adolescents; and (3) analyze strategies for increasing resilience in adolescents. This study uses a qualitative approach with descriptive methods. The research location is in the Special Region of Yogyakarta with 31 adolescent informants selected through a purposive sampling technique. Data collection was carried out through an open questionnaire, while data analysis was carried out using Atlas.ti software with the interactive analysis technique of the Miles and Huberman model. The findings of this study highlight that adolescents' understanding of resilience encompasses three main aspects, namely psychological, social, and environmental, which demonstrate the ability to think positively, adapt, and recover from stress

Adolescents' perceptions of the importance of resilience are divided into eight dimensions: helping them cope with pressure/stress, supporting decision-making, developing mental and emotional resilience, developing superior human resources, achieving academic and personal success, anticipating future risks, enhancing adaptability, and increasing productivity and performance. The resilience-building strategies used by adolescents include psychological, social, and physical approaches. These findings imply the need to strengthen adolescent resilience through an integrated psychological, social, and physical approach to prepare adolescents to face current and future social risks.

Keywords: resilience, social risks, adolescents

INTRODUCTION

Adolescents today face a variety of complex pressures from their social environment (Rosawati et al., 2025; Florensa et al., 2025). These pressures encompass both internal and external factors, such as academic, emotional, mental, and social pressures, which can trigger withdrawal, stress, anxiety, and other mental health disorders (Aminah et al., 2024; Putri et al., 2024; Rosawati et al., 2025). This situation has been further exacerbated by the COVID-19 pandemic, which has significantly increased cases of psychosocial disorders among adolescents and seriously impacted their mental preparedness to face life's challenges (Afiffah, 2021). This situation highlights the urgent need to understand the factors that can help adolescents survive and adapt in stressful situations.

The concept of social risk management is relevant for understanding the various challenges faced by adolescents (Yendra et al., 2024). Social risk is the potential danger that can cause damage to the social structure and environment in which individuals interact (Hadi et al., 2023), such as the rise of juvenile delinquency: brawls, drug use, and promiscuity (Putri & Hidayat, 2023). These social pressures have the potential to significantly lead to risky behavior that is detrimental to both individuals and their social environment (Intania et al., 2020; Anggrainy & Maddusa, 2021). Therefore, strengthening adaptive abilities and psychosocial resilience, known as resilience, is crucial as a protective factor to mitigate the impact of social risks (Nizsa & Nur, 2025).

Resilience is a concept in psychology that describes an individual's ability to maintain a healthy mental state despite facing severe stress (Irianto et al., 2021). Herdiana (2019) explains that resilience is an individual's active process of recovering, adapting to change, overcoming traumatic experiences, and continuing life adaptively. High resilience is associated with a healthy lifestyle, excellent physical condition, good adaptability, independence, optimism, and good mental health. Conversely, low resilience is often associated with a tendency to blame oneself and increased anxiety and depression (Irianto et al., 2021). Therefore, resilience is an important protective factor for adolescents in dealing with various social and emotional stressors.

Several previous studies have revealed that resilience plays a significant role in various aspects of adolescent self-development, such as academic, emotional, social, and spiritual (Ramadhani & Nur, 2025). Self-management skills are also considered to have a positive impact on increasing adolescent resilience in various

situations (Florensa et al., 2025). Adolescents with high resilience are generally able to view challenges as opportunities for growth, rather than as threats. Conversely, adolescents with low resilience are more vulnerable to stress, give up easily, and experience difficulties in managing emotions and making decisions (Wiratmaja et al., 2023; Florensa et al., 2025). Furthermore, recent studies on adolescent resilience in the context of social risks are increasingly being conducted. The research includes factors that form resilience (Annisa & Nur, 2025; Isnayanti & Nur, 2025), coping mechanisms (Annisa & Nur, 2025), the impact of social risks (Annisa & Nur, 2025; Isnayanti & Nur, 2025), and resilience development strategies (Isnayanti & Nur, 2025).

However, studies on adolescent resilience in the context of social risk prevention that discuss the understanding, urgency, and strategies of resilience from the adolescent perspective are scarce, so this study is still very necessary. Therefore, this study aims to: (1) describe adolescents' understanding of resilience; (2) analyze the urgency of resilience for adolescents; and (3) analyze strategies for increasing resilience in adolescents. Thus, this study is expected to contribute to the development of effective interventions in strengthening adolescent resilience to prevent social risks in a sustainable manner.

METHODS

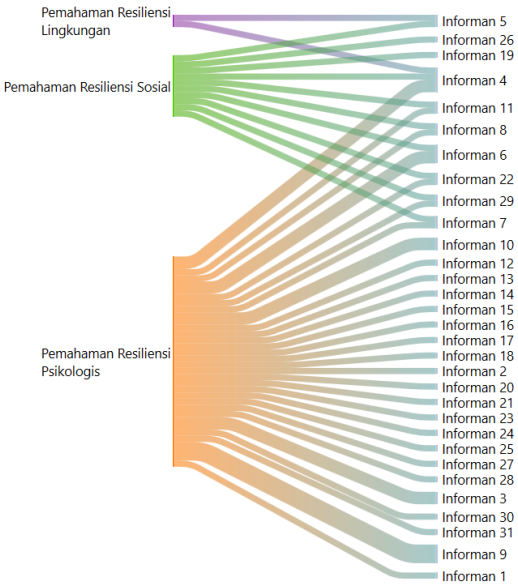
This research uses descriptive qualitative methods to explore in-depth the understanding, urgency, and resilience strategies in preventing social risks in adolescents. Yogyakarta was chosen as the research location because this region still faces various psychological, social, and cultural challenges faced by adolescents. These conditions make Yogyakarta a relevant and strategic context for examining the role of resilience in building adolescent resilience.The research informants consisted of 31 adolescents selected using purposive sampling techniques. Data collection was conducted through an open-ended questionnaire that allowed respondents to provide free and in-depth answers. This approach supports the achievement of the research objectives, namely: (1) describing adolescents' understanding of resilience; (2) analyzing the urgency of resilience in adolescents; and (3) analyzing strategies for increasing resilience in adolescents.

The data obtained was analyzed using Atlas.ti software to facilitate systematic organization, coding, and mapping. The analysis followed the stages of Miles and Huberman, which include data condensation, data presentation, and conclusion drawing. Through this technique, the research generated meaningful findings related to the understanding, urgency, and resilience strategies of adolescents in Yogyakarta.

RESULTS AND DISCUSSION

Understanding of Resilience Among Adolescents

Adolescents' understanding of resilience is a crucial aspect in understanding how they interpret, face, and overcome various challenges in daily life. Adolescents' understanding of resilience is mapped in the Sankey diagram in Figure 1.



This diagram shows the distribution of each informant's contribution to the emerging themes. Three themes emerged in understanding adolescent resilience: (1) psychological resilience, (2) social resilience, and (3) environmental resilience.

The first theme to emerge was psychological resilience. Psychological resilience was not only the most frequently encountered but also the most widespread, as nearly all informants connected to this theme (see Sankey diagram in Figure 1). This indicates that psychological resilience was a dominant aspect in the informants' experiences when facing pressure, challenges, or difficulties in their lives. Psychological resilience, in the understanding of adolescents, is understood as the ability to maintain a positive mindset, persist under pressure, adapt to change, and recover from failure or difficult situations (see Figure 2).

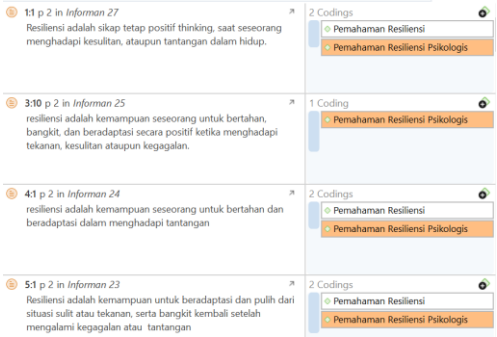


FIGURE 2. Quote from the Statement on Understanding Psychological Resilience

As stated by informant 27, resilience is the ability to maintain positive thinking when facing difficulties or challenges in life. This statement demonstrates that positive thinking is an important element in maintaining psychological resilience. This aligns with the findings of Salnabila et al. (2025) who explained that adolescents who are able to interpret difficulties positively have a greater chance of surviving and recovering from stress. Meanwhile, informant 25 explained that resilience is a person's ability to survive, recover, and adapt positively when facing pressure, difficulties, or failure. This statement reinforces the understanding that resilience involves an active process of adapting to challenging situations, not just passively accepting the situation. This aligns with the definition of resilience as a dynamic process that includes positive adaptation in the context of significant adversity (Luthar et al., 2000; Leys et al., 2020). Furthermore, informant 23 added that resilience is the ability to adapt and recover from difficult situations or stress, as well as bounce back after experiencing failure or challenges.

This aspect of recovery demonstrates that resilience is a process that enables individuals to return to a stable psychological state after experiencing adversity. This aligns with the concept of bouncing back as part of "ordinary magic," the general ability possessed by all individuals to recover from stress or adversity (Masten, 2001; Ilmi et al., 2025). Therefore, psychological resilience, from the perspective of adolescents, is not merely a static mental state, but a dynamic process influenced by experience and an individual's perception of stress. Windle (2011) also explains that resilience requires the capacity to endure stress and recover from setbacks. This is consistent with the research findings of Nasution (2022), which explains that every individual needs to adapt well when facing stress or loss.

The second resilience theme that emerged was social resilience, as depicted in the Sankey diagram in Figure 1. This indicates that although social resilience emerged in the data and was not as strong or as broad as psychological resilience in terms of the distribution of contributions from informants, the presence of this theme remains important because it indicates the collective and contextual dimensions of resilience. Based on interview excerpts, several informants provided an understanding that points to social resilience (see Figure 3), namely the individual's ability to survive and adapt in a social context, including support from the environment, sensitivity to others, and group dynamics.

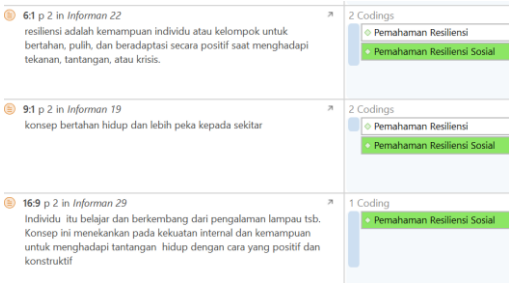


FIGURE 3. Quote from the Statement on Understanding Social Resilience

Informant 22 also stated that "resilience is the ability of an individual or group to survive, recover, and adapt positively when facing stress, challenges, or crises." This statement broadens the understanding of resilience from the individual to the realm of groups or communities, reflecting the main characteristics of social

resilience. Social resilience does not only refer to individuals, but also to communities that support each other in facing shared difficulties (Dillashandy & Pandjaitan, 2018). Furthermore, Informant 19 stated that resilience is also related to "the concept of survival and being more sensitive to others." This shows that resilience is not only centered on internal strengths.

but also on social sensitivity, namely the ability to read and respond to the surrounding social conditions. In this context, social resilience encompasses the dimensions of empathy and social solidarity. This is reinforced by research by Anwaruddin (2020), which shows that social and emotional support from the surrounding environment is an important predictor of building long-term resilience. Furthermore, social resilience also encompasses how individuals use available social resources to navigate difficult situations in culturally and socially acceptable ways (Dillashandy & Pandjaitan, 2018; Bakarbessy, 2024).

The third theme that emerged was environmental resilience, which was only mentioned by two informants (see Sankey diagrams in Figures 1 and 4). Understanding environmental resilience is also related to understanding social resilience. This theme emphasizes the ability of individuals or communities to adapt and recover from difficult external conditions, such as natural disasters or environmental crises. Informant 5 explained that resilience is "the ability of an individual or group to adjust after facing difficult conditions such as a natural disaster." Meanwhile, Informant 4 stated that resilience includes "the ability of an individual or community to survive, recover, and thrive after experiencing stress, hardship, or disaster." This finding supports the study by Rahmi & Syamwil (2023) which demonstrated the ability of communities to recover after traumatic events, maintaining the continuity of social life functions, even in disaster-prone locations. In the context of disaster-prone Indonesia, research by Rahmawti & Faris (2024) also emphasized the importance of building community adaptive capacity to disasters so that recovery can take place sustainably

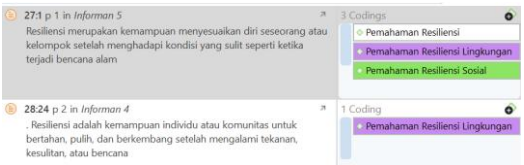


FIGURE 4. Quote from the statement of understanding environmental resilience

Thus, adolescents' understanding of resilience is divided into three main themes: psychological, social, and environmental resilience. Psychological resilience is the most dominant theme, understood as the ability to think positively, persist, and recover from adversity, reflecting the dynamic process of coping with life's stresses. Meanwhile, social and environmental resilience demonstrates that social support and the ability to adapt to external conditions such as disasters also play a significant role in adolescent resilience, although they appear to be less intense than the psychological theme.

Adolescents' Perceptions of the Urgency of Resilience

The importance of resilience for adolescents is not singular or narrow; instead, they view resilience as a multidimensional capacity related to readiness to face life's challenges, whether mentally, academically, socially, or professionally. Table 1 presents a mapping of the importance of resilience from 31 informants across seven main dimensions. Each dimension was analyzed based on two aspects: the number of citations (narrative frequency) and the number of informants mentioning it.

Table 1. Distribution of the Urgency of Resilience for Adolescents

	Peta Urgensi Resiliensi Remaha								
Informan	Membantu menghadapi tekanan/stree (21**)	Membantu pengambilan keputusan (2**)	Membentuk mental dan emosional yang tangguh (16**)	Membentuk SDM Unggul (47**)	Mencapai keberhasilan akademik dan personal (4**)	Mengantisipasi Resiko Masa depan (16**)	Meningkatkan kemampuan adaptasi (22**)	Meningkatkan produktivitas dan kinerja (9**)	Total
Informan 1	0***	0***	0***	0***	0***	0***	2***	0***	2***
Informan 2	0***	0***	0***	1***	0***	2***	0***	0***	3***
Informan 3	1***	0***	0***	1***	1***	0***	0***	0***	3***
Inform	2***	0***	0***	1***	0***	1***	1***	0***	5***

an 4									
Informan 5	2***	0***	2***	2***	0***	1***	0***	0***	7***
Informan 6	0***	0***	0***	1***	0***	0***	1***	0***	2***
Informan 7	2***	0***	1***	3***	0***	1***	2***	1***	10***
Informan 8	0***	0***	0***	2***	0***	0***	0***	0***	2***
Informan 9	0***	0***	1***	4***	1***	3***	0***	0***	9***
Informan 10	1***	0***	2***	2***	0***	1***	0***	0***	6***
Informan 11	0***	1***	0***	2***	0***	0***	1***	0***	4***
Informan 12	2***	0***	0***	1***	1***	1***	1***	0***	6***
Informan 13	0***	0***	2***	1***	0***	0***	0***	0***	3***
Informan 14	1***	0***	3***	0***	0***	1***	0***	0***	5***
Informan 15	0***	0***	0***	1***	0***	0***	1***	1***	3***
Informan 16	3***	0***	0***	1***	1***	0***	2***	0***	7***
Informan 17	0***	0***	0***	1***	0***	0***	0***	0***	1***
Informan 18	0***	0***	2***	3***	0***	0***	0***	1***	6***
Informan 19	2***	0***	1***	2***	0***	0***	3***	1***	9***
Informan 20	1***	0***	0***	3***	0***	1***	2***	1***	8***
Informan 21	0***	0***	0***	2***	0***	0***	1***	0***	3***
Informan 22	0***	0***	1***	2***	0***	0***	1***	0***	4***
Informan 23	0***	0***	0***	1***	0***	0***	0***	0***	1***
Informan 24	1***	0***	0***	3***	0***	0***	2***	1***	7***
Informan 25	0***	0***	0***	0***	0***	1***	0***	0***	1***
Informan 26	0***	0***	0***	2***	0***	1***	0***	1***	4***
Informan 27	1***	0***	0***	2***	0***	1***	2***	2***	8***
Informan 28	0***	0***	1***	0***	0***	1***	0***	0***	2***
Informan 29	1***	1***	0***	1***	0***	0***	0***	0***	3***
Informan 30	0***	0***	0***	1***	0***	0***	0***	0***	1***
Informan 31	1***	0***	0***	1***	0***	0***	0***	0***	2***
Total	21	2	16	47	4	16	22	9	137

Note: **= citation; ***= frequency distribution

Of the 137 categorized quotes, five categories had the most dimensions: developing superior human resources (47 quotes), followed by improving adaptability (22 quotes), helping to cope with pressure/stress (21 quotes), developing mental and emotional resilience (16 quotes), and anticipating future risks (16 quotes). This suggests that adolescents view resilience not only as resilience to stress but also as a long-term self-development strategy.

Dimensions of Forming Superior Human Resources

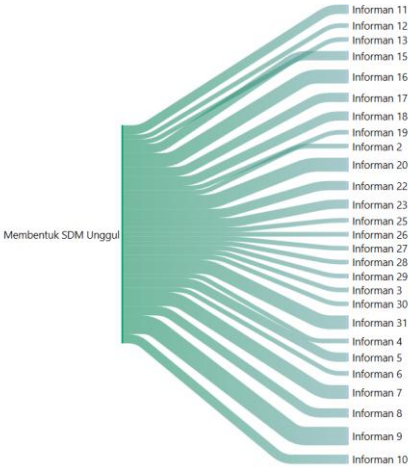


FIGURE 5. Dimensions of Developing Superior Human Resources

The dimension of developing superior human resources is the most dominant aspect of adolescent perceptions. Based on the Sankey diagram visualization findings, 27 of 31 informants stated that resilience contributes significantly to the process of developing individual qualities, leading to resilience, adaptability, and readiness to face future challenges. As quoted in the following informant's statement: "Resilience, or the ability to recover from adversity, plays a crucial role in improving the quality of superior human resources (HR). Resilient HR are better able to adapt to change, overcome challenges, and maintain high performance amidst pressure, which ultimately contributes to the productivity and overall success of the organization."

This statement reflects that adolescents view resilience as a strategic quality that not only helps individuals face challenges but also sustainably enhances their potential. In the context of social risk, this ability is crucial for maintaining psychological balance while enhancing an individual's capacity to contribute positively. This finding reinforces the idea of Rahmawati & Fariz (2023), who emphasized the importance of strengthening human capacity as adaptive capital in facing environmental and social changes. This finding also aligns with the study by Bakarbessy (2024), who stated that resilient human resources play a crucial role in accelerating recovery. The implications of this finding suggest that building resilience among adolescents is not only crucial for individual well-being but also for creating a competent and competitive generation.

Dimensions of Increasing Adaptability

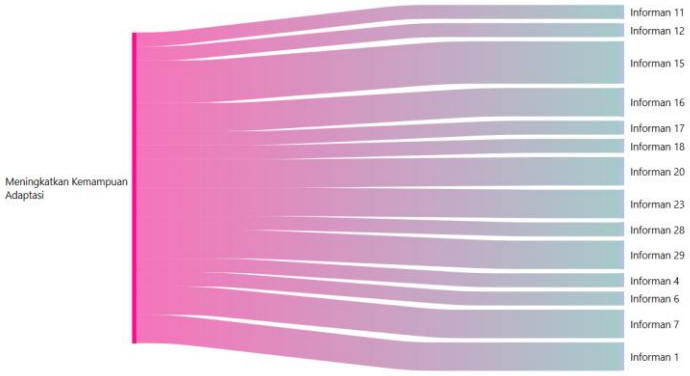


FIGURE 6. Dimensions of Improving Adaptability

The findings of this study indicate that resilience plays a crucial role in improving adolescents' adaptability, particularly in the face of complex and rapid change. This is illustrated in the Sankey diagram, where 13

informants linked the urgency of resilience to adaptability. As informant 20 stated: "Because resilient resources are able to adapt to changes in business, technology, and work..."

This statement reflects a deep understanding that resilience is not just about surviving pressure but also the ability to adapt quickly to the surrounding environment. Adaptability is a crucial asset in the lives of adolescents today, faced with the uncertainties of this era. As Windle (2011) stated, resilience involves the capacity to withstand pressure and bounce back with renewed strength. This finding supports research by Lubis et al. (2024) that found that individuals with resilience adapt more quickly to various difficult life challenges.

Dimension: Helping to cope with pressure/stress

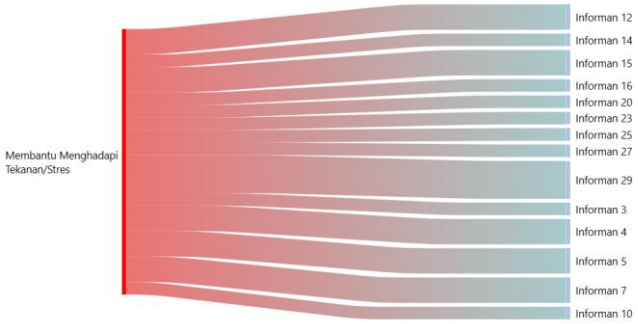


FIGURE 7. Dimensions of Helping to Cope with Stress

One crucial dimension of resilience urgency expressed by informants is the ability to help individuals cope with stress. In the Sankey diagram visualization, this dimension is connected by 13 informants, indicating a strong perception among adolescents that resilience plays a role in managing mental stress. As informant 7 put it: "...being able to face challenges, then being able to learn from mistakes, and then being able to manage emotions and stress well..."

This statement emphasizes not only the ability to persevere but also the reflective and adaptive process where individuals learn from negative experiences to manage stress constructively. Nasution's (2022) study explains that adolescents with resilience demonstrate better stress and emotional management skills when facing various pressures. This can be achieved through social support and spiritual development to help calm the mind and manage stress.

Dimensions of Building Mental and Emotional Resilience

These findings align with Windle's (2011) assertion that resilience is a dynamic process involving mental and emotional adaptation to adversity. In the context of adolescents, Satyaninrum's (2025) study also revealed that adolescents with a strong internal locus of control are able to recover more quickly from emotional stress. Furthermore, Dipayanti & Chairani (2012) also explained that strong internal control significantly influences adolescent resilience.

Dimensions of Addressing Future Risks

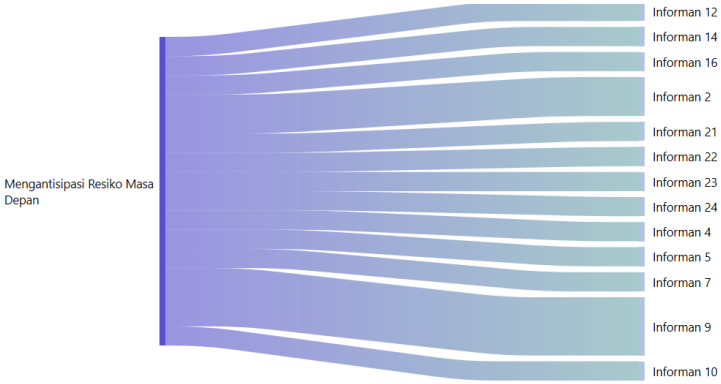


FIGURE 9. Dimensions of Coping with Future Risks

The dimension of coping with future risks emerged as a distinctive and meaningful manifestation of resilience. Several informants defined resilience as the ability to look ahead and prepare for various possibilities that have not yet occurred. This view is reflected in informant 21's statement that "society can prepare in advance for possibilities that will occur in the future." This statement emphasizes the importance of long-term awareness as part of a healthy psychological response. Similarly, informant 22 stated that this ability is "clearly essential, especially in highly uncertain times like these." These two statements emphasize that resilience is not only defined as the capacity to withstand emotional or social stress, but also as the ability to think proactively and prepare oneself mentally, emotionally, and even practically for potential crises that may occur.

These findings align with previous research, which revealed that adolescents who possess the adaptive capacity to map risks and develop strategies tend to recover more quickly and are better prepared to face uncertainty (Lubis et al., 2024). Furthermore, a study by Setyawan (2025) also revealed that resilience significantly contributes to adolescents' educational success, readiness for change, and their role as the future golden generation.

Non-Dominant Dimensions in the Urgency of Adolescent Resilience

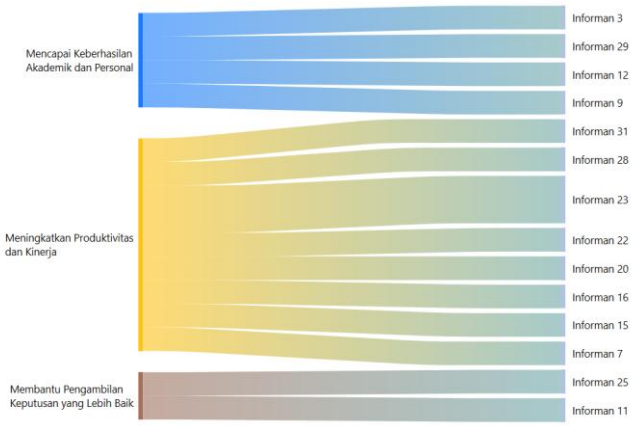


FIGURE 10. Non-Dominant Dimensions

In addition to the major dimensions that have been identified, this study also identified several non-dominant dimensions that contribute to the importance of resilience for adolescents: achieving academic and personal success, increasing productivity and performance, and assisting in decision-making. The dimensions of achieving academic and personal success are reflected in several informants who emphasized the importance of success in the educational realm as part of the resilience-building process. This aligns with the findings of Satyaninrum's (2025) research, which showed that academic success is a protective factor in increasing adolescents' psychological resilience in dealing with life's pressures.

The dimension of increasing productivity and performance also emerged from the data, with several informants linking resilience to the ability to remain productive and maintain good performance, despite facing challenges. Finally, the dimension of assisting decision-making emerged as a non-dominant but important dimension, where resilience enables individuals to make wise and informed decisions under stressful conditions. This finding is supported by research by Masten (2001), which confirms that resilience plays a role in improving cognitive abilities and adaptation in the decision-making process, particularly during times of crisis. This finding supports research by Lubis et al. (2024) that individuals with resilience adapt more quickly amidst various difficult life challenges.

Strategies for Increasing Resilience Among Adolescent

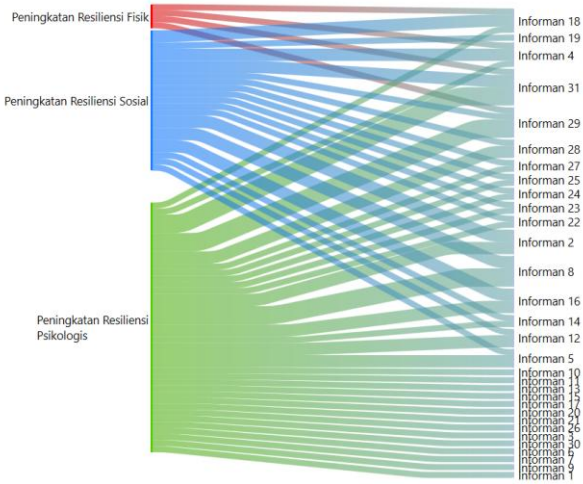


FIGURE 11. Strategies for Increasing Resilience

Adolescent resilience is a crucial aspect that needs to be developed, especially in facing increasingly complex social challenges. Adolescents are in a vulnerable developmental phase, so the capacity to withstand and recover from stress is a crucial factor in shaping their psychosocial well-being. Based on the results of this study, visualized in a Sankey diagram, three main strategies were identified: psychological resilience, social resilience, and physical resilience. These three serve as complementary adaptive systems and form the foundation of resilience in the face of social stress.

Strategies for increasing psychological resilience were the most frequently expressed by informants. Adolescents who have the capacity to manage stress, build self-awareness, and maintain a positive mindset tend to be better prepared to face tough social challenges. As informant 22 expressed, "By getting used to positive thinking, building healthy social networks, developing self-awareness, and learning from experiences and challenges," adolescents equip themselves with important personal skills to avoid environmental pressures, whether from family, social circles, or social media. This finding aligns with previous research showing that resilience helps individuals cope with emotional stress through affective regulation and positive thinking strategies (Windly, 2011; Florensa et. al., 2025; Salnabila et. al., 2025).

Strategies for increasing social resilience also play a crucial role in adolescents' adaptation to social risks. Social support from their environment, including family, friends, and educational institutions, can be a crucial buffer for adolescents facing external pressures. Informant 27 mentioned that "expanding relationships or participating in social activities" is a way to increase social resilience, a finding reinforced by informant 25's statement, "seek support from a supportive environment." This finding corroborates the findings of Ungar's (2011) study, which emphasized that a supportive social context plays a key role in shaping resilience, particularly in collectivist cultures like Indonesia.

Meanwhile, physical resilience strategies emerged as strategies that, while not dominant, still demonstrated relevance within the framework of holistic resilience strategies. Informant 4 emphasized the importance of maintaining physical health as part of a resilience strategy by stating, "Maintaining a balance in life to be physically and mentally healthy through exercise." This approach indicates that balance between body and mind is part of an adaptive strategy for dealing with social stress and academic pressure. In line with this, research by Supriyadi & Kartini (2022) found that a healthy lifestyle positively contributes to emotional stability and mental resilience in adolescents.

Overall, these three strategies demonstrate that adolescent resilience is shaped by both internal and external forces. Adolescents who are self-aware, think positively, are supported by a healthy social environment, and maintain physical health are better prepared to face various forms of unexpected social risks. These findings confirm the importance of a multi-strategy approach to strengthening adolescent resilience. In the long term, integrated resilience-building strategies will help adolescents not only withstand social pressures but also develop into adaptive, mentally and socially healthy individuals who are able to contribute positively to society.

CONCLUSION

Adolescents' understanding of resilience encompasses three main aspects: psychological, social, and environmental. Psychological resilience reflects an individual's ability to think positively, persist under pressure, adapt to change, and bounce back from failure. The social aspect refers to the ability to survive and adapt in social interactions through support from the surrounding environment. Meanwhile, the environmental aspect describes the capacity to adapt to challenging external conditions, such as natural disasters or environmental crises.

The challenges of life are complex and full of uncertainty. This perception is reflected in eight main dimensions that are considered important, namely: (1) the ability to deal with pressure and stress, (2) support for the decision-making process, (3) the formation of mental and emotional resilience, (4) the development of superior human resources, (5) the achievement of academic and personal success, (6) the ability to anticipate future risks, (7) increasing adaptability, and (8) increasing productivity and performance.

Adolescents strive to build resilience through three strategic approaches: psychological, social, and physical. Psychological strategies include stress management and strengthening positive mindsets. Social strategies involve building healthy interpersonal relationships and accessing support from their environment. Physical strategies, meanwhile, are realized through activities that maintain physical fitness, such as regular exercise. These three strategies complement each other to build strong resilience, helping adolescents not only overcome daily challenges but also preparing them to become resilient and adaptive individuals for the future.

REFERENCE

1. Afiffah, N. (2021). Hubungan antara Resiliensi Akademik dengan Tingkat Stres, Kecemasan dan Depresi pada Remaja di Masa Pandemi COVID-19. *Jurnal PPNI*, 12(3), 45-52.
2. Aminah, I., et. al. (2024). *Kecemasan sosial pada remaja yang mengalami perundungan di Desa Ragajaya*. Jurnal Inovasi Kesehatan, *6*(1), 1–8.
3. Anggrainy, N. E., & Maddusa, S. S. (2021). Tekanan teman sebaya terhadap perilaku berisiko mahasiswa. JIVA: Journal of Behaviour and Mental Health, 2(1), 1–10.
4. Annisa, S. W., & Nur, H. (2025). Resiliensi Remaja dari Keluarga Broken Home: Kajian Literatur tentang Faktor, Mekanisme, dan Implikasi Psikologis. PESHUM : Jurnal Pendidikan, Sosial Dan Humaniora, 4(4), 5696–5716.
5. Anwaruddin, H. (2020). Dukungan sosial dan kecerdasan emosi dengan resiliensi korban banjir. *Persona: Jurnal Psikologi Indonesia, 6*(1), 1-10.
6. Bakarbessy, D. (2024). Resiliensi komunitas dalam menghadapi bencana: Literature review pendekatan kesejahteraan sosial di wilayah rawan bencana. *Jurnal Ilmiah Ilmu Pendidikan (JIIP), 7*(4), 1860–1868.
7. Dillashandy, N. A., & Pandjaitan, N. K. (2018). Kapasitas adaptasi dan resiliensi komunitas menghadapi bencana erupsi Gunung Merapi. *Jurnal Sains Komunikasi dan Pengembangan Masyarakat (JSKPM), 2*(5), 617–626.
8. Dipayanti, N., & Chairani, D. (2017). Hubungan antara lokus kontrol internal dan resiliensi pada remaja dari keluarga bercerai. *Psikostudia: Jurnal Psikologi*, 6(1), 35–42.
9. Florensa, F., Hidayah, N., Yousriatin, F., Sari, L., & Kirana, W. (2025). Efektivitas manajemen diri terhadap resiliensi remaja. *Manajemen Bina Insani*, *19*(12), 6401-6405.
10. Hadi, H. A. F. R., Zakiyah, Z., & Sajidah, I. H. (2023). Nasionalisme dan budaya di Indonesia dalam masyarakat risiko. *Sinar Dunia: Jurnal Riset Sosial Humaniora dan Ilmu Pendidikan*, 2(2), 107–122.
11. Herdiana, I. (2019). RESILIENSI KELUARGA : TEORI, APLIKASI DAN RISET. Proceeding National Conference Psikologi UMG 2018, 1(1), 1–12. Tersedia di https://journal.umg.ac.id/index.php/proceeding/article/view/891
12. Ilmi, A. M., et. al. (2025). The Ordinary Magic of Religiosity in the Resilience and Relevance for Psychoeducational Services in Schools. Pamomong: Journal of Islamic Educational Counseling, 6(1), 78–103.
13. Intannia, R., et. al. (2020). Lingkungan keluarga, tekanan teman sebaya dan perilaku berisiko remaja di Kota Bandung. *Jurnal Psychological Science and Profession*, 4(2), 137–148.
14. Irianto, M. A., et. al. (2021). Konsep diri sebagai prediktor resiliensi pada mahasiswa. Psikostudia: Jurnal Psikologi, 10(1), 1–10.
15. Isnayanti, N., & Nur, H. (2025). Faktor-faktor resiliensi remaja korban cyberbullying: Studi literatur. *JPK: Jurnal Pendidikan dan Kebudayaan*, 2(2), 43-54.
16. Leys, C., et. al. (2020). Perspectives on resilience: Personality Trait or Skill?. Europan Journal of Trauma and Dissociation, 4-2.
17. Lubis, A. H. et. al. (2024). RESILIENSI : Kemampuan Beradaptasi Dan Bertahan Dalam Menghadapi Tantangan Hidup Yang Sulit. Jurnal Pendidikan Sosial Dan Konseling, 2(3), 1203–1208.

18. Luthar, S. S., et. al. (2000). The construct of resilience: A critical evaluation and guidelines for future work. *Child Development*, 71(3), 543–562.
19. Masten, A. S. (2001). *Ordinary magic: Resilience processes in development. American Psychologist, 56*(3), 227-238.
20. Nasution, E. S. (2022). *Resiliensi terhadap kedukaan masyarakat Indonesia dalam menghadapi pandemi COVID-19.* Jurnal Psikologi Pendidikan dan Pengembangan SDM, 10(2), 28-37.
21. Nisza, N. M., & Nur, H. (2025). Faktor-faktor pendukung resiliensi remaja pada konteks krisis psikososial. *Liberosis: Jurnal Psikologi dan Bimbingan Konseling*, 11(4), 1-12.
22. Putri, M., & Hidayat, W. (2023). Strategi pengelolaan risiko dalam menangani kenakalan remaja di sekolah SMA Setiadharma Pekanbaru. *Ejurnal Sekolah Tinggi Agama Islam (STAI) Bumi Silampari Lubuklinggau*, 6(1), 75–88.
23. Putri, T. H., et. al. (2024). *Faktor yang Berhubungan dalam Perkembangan Efikasi Diri pada Remaja di Indonesia: Kajian Literatur*. Jurnal Keperawatan Jiwa, 12(3), 513–524.
24. Rahmawati, D., & Fariz, T. R. (2023). Kajian kapasitas masyarakat dalam menghadapi dampak perubahan iklim berbasis pendekatan penghidupan berkelanjutan di wilayah pesisir Kota Semarang. *Desa-Kota: Jurnal Perencanaan Wilayah, Kota, dan Permukiman, 6*(2), 150-161.
25. Rahmi, M., & Syamwil, I. B. (2023). Mekanisme adaptasi masyarakat korban tsunami di Kecamatan Meuraxa Kota Banda Aceh. *Jurnal Permukiman, 18*(2), 72-82.
26. Ramadhani, A., & Nur, H. (2025). Peran resiliensi dalam pengembangan diri remaja: Studi literatur. *Socius: Jurnal Penelitian Ilmu-Ilmu Sosial*, *2*(9), 122–133.
27. Rosawati, Y. A. O., Winta, M. V. I., & Pratiwi, M. M. S. (2025). *Kecemasan sosial pada remaja awal: Sebuah tinjauan literatur tentang faktor penyebab dan dampaknya*. Psikofusi: Jurnal Psikologi Integratif, *7*(6), 45-57.
28. Salnabila, A., et. al. (2025). *Menumbuhkan harapan dan memelihara optimisme: Studi psikologi positif*. Humanitis: Jurnal Humaniora, Sosial dan Bisnis, 3(1), 172-181.
29. Satyaninrum, A. (2025). Pengaruh locus of control terhadap resiliensi akademik siswa SMA. *Tazkiya Journal of Psychology*, 23(1), 15–29.
30. Setyawan, B. (2025). Pentingnya meningkatkan resiliensi remaja dalam mewujudkan Indonesia emas tahun 2045. *Proceedings Series of Educational Studies. 453-457.*
31. Supriyadi, & Kartini, M. (2022). Intervensi untuk meningkatkan resiliensi pada remaja. *Jurnal Keperawatan Karya Bhakti*, 8(1), 16–25.
32. Ungar, M. (2011). The social ecology of resilience: Addressing contextual and cultural ambiguity of a nascent construct. *American Journal of Orthopsychiatry*, 81(1), 1–17.
33. Windle, G. (2011). What is resilience? A review and concept analysis. *Reviews in Clinical Gerontology, 21*(2), 152-169.
34. Wiratmaja, F. A., et. al. (2023). Tinjauan Terhadap Faktor-Faktor Peningkatan Resiliensi Pada Remaja Akhir. Concept: Journal of Social Humanities and Education, 2(4), 319–327.
35. Yendra, N., et. al. (2025). Manajemen risiko sosial di kalangan remaja: Strategi pencegahan pergaulan bebas di lingkungan Sekolah IT Widya Cendekia Kota Serang. *YUME: Journal of Management*, 8(1), 1

Development of a Digital Literacy-Based Lecture Model Assisted by Interactive Technology for PGSD Students

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Abstract. This research is motivated by the importance of digital literacy for PGSD (Primary School Teacher Education) students in the digital era. PGSD students need to be able to search for, evaluate, and critically utilize digital information and use technology to support learning. Preliminary studies show that PGSD students are already familiar with technology, but the application of technology in an academic context requires a more structured approach. Innovative, technology-based learning models are needed to bridge the gap between everyday technology use and its academic application. This study is developmental research focused on the procedure of a lecture model, referring to the research framework developed by Lee J.L. and Jang, classified as F2–O1+O2–S1+S5+S6–A3 type research. The product developed is a digital literacy-based lecture model supported by interactive technology (Litera-Tech). The validation results from experts, both conceptual and practical, indicated that the product is feasible for implementation. The practicality test showed an average score of 3.9, which falls within the 3.41–4.00 range, categorized as "Very Good" (Highly Practical). The main trial obtained an average score of 3.94 on a four-point scale, while the field trial achieved an average score of 3.95, both classified as "Very Good."

INTRODUCTION

Digital literacy is an essential competency that must be mastered by university students, especially by prospective elementary school teachers in the Primary School Teacher Education (PGSD) program, in today's digital era. Digital literacy is also a set of attitudes and understandings in managing and communicating information and knowledge effectively through various media and formats[1]. Literacy is not merely defined as the ability to read; it also encompasses the ability to read with understanding and meaning [2], [3], [4]. Literacy is a fundamental cognitive act. Digital literacy reflects using digital tools effectively and efficiently [5], [6]

Digital literacy competencies include using, understanding, accessing, managing, collecting, organizing, estimating, providing, and evaluating information derived from ICT-based technologies [7], [8], [9]. Digital literacy is also a technical skill in operating digital devices such as computers, smartphones, smartboards, projectors, social media, and website or blog design [10]. Based on a survey involving more than 1,600 respondents across 34 provinces in Indonesia, the level of digital literacy among Indonesians in 2020 was still moderate and required improvement [11]. Enhancing literacy skills can pave the way for educational success and improve overall quality of life [12], [13].

Several studies have revealed that implementing technology in academic contexts requires a more structured approach. For example, concluded that the development of digital competency frameworks must be aligned with the dynamics of digital society, making learning strategies that integrate digital literacy crucial for improving competencies. The PGSD program must adopt innovative technology-based learning models to meet these demands.

A digital literacy-based learning model supported by interactive technology, referred to in this study as LITERA-TECH, is expected to bridge the gap between the use of technology in everyday life and its application in academic contexts. According to[14], the development of a digital literacy learning model based on the Merdeka Belajar (Independent Learning) concept for rural communities showed a fulfillment rate of 95.5%, indicating that the model met the criteria and was deemed feasible for implementation. The development study conducted by [15] introduced a highly viable blended learning model that improved students' argumentation

skills. Instructional design research aims to systematically analyze, design, and evaluate educational interventions to produce research-based solutions to complex problems in academic practice.

Online learning, however, has several limitations, such as a lack of social presence, delayed feedback, low participation, impersonality, and decreased motivation and engagement [16], [17], [18], [19]. Through a systematic review, [20] found that integrating technology into the learning process can improve students' learning outcomes, particularly in creativity and problem-solving. These findings highlight the importance of implementing learning models that comprehensively integrate digital approaches.

According to [21], using interactive technology in education can help address various challenges, such as low motivation and student engagement in the learning process. The use of digital storytelling methods in teaching has been proven to enhance students' digital literacy, regardless of their initial level of digital competence [22]. Interactive learning models incorporate technological approaches in the learning process, including multi-directional communication and student collaboration [23].

Furthermore, demonstrated that using digital technology in teacher education can improve teaching skills while enriching students' learning experiences. These findings further strengthen the argument that the LITERA-TECH model can create a more interactive and contextual learning environment while preparing PGSD students to meet the demands of 21st-century education. Through interactive technologies such as online learning platforms, augmented reality (AR), and artificial intelligence (AI), this model is expected to optimally develop students' knowledge, competencies, social skills, and practical abilities.

LiTERATURE REVIEW

A. Digital Literacy-Based Learning Model

A digital literacy-based learning model is an educational approach that integrates interactive technology to enhance students' digital literacy skills. Digital literacy is the key to improving the skills and knowledge of students who will enter the workforce [24]. Digital literacy refers to a person's ability to utilize information and communication technology to locate, evaluate, create, and communicate information, which requires cognitive and technical skills [1], [25]. Students with good digital literacy skills will strive to search for and select important information and understand, communicate, and convey ideas in digital spaces[26]. Therefore, developing a learning model that supports the mastery of digital literacy through interactive technology is essential.

According to [27], digital competence (Level I) emphasizes the importance of situational embedding, which involves successfully using digital media in everyday situations. Digital usage (Level II) is the application of digital competence in specific professional contexts, where its use becomes "embedded and developed" within the community. Digital storytelling can effectively develop digital literacy . Digital transformation (Level III) is viewed as an achievement in contributing to the use of digital tools through innovation and creativity in a profession or field of knowledge.

Research by [21] further shows that using interactive technology in education can help overcome various limitations, such as a lack of student motivation and engagement in the learning process. Moreover, learning approaches that utilize interactive technology can enhance students' critical thinking skills. Using digital storytelling methods in teaching can improve students' digital literacy, regardless of their prior knowledge of digital competence [22].

An interactive learning model involves integrating technology in organizing the learning process, including multilateral communication and student collaboration [23]. By leveraging technologies such as augmented reality (AR) and virtual reality (VR), students can experience more immersive and engaging learning, which in turn can increase their motivation and involvement in the learning process [21], [28].

B. Interactive Technology

Interactive technology has become one of the key innovations in education, providing new ways to enhance student engagement and motivation in the learning process. The use of interactive technology in learning improves the overall learning experience and enables personalization and adaptation of instruction to meet individual student needs. Interactive digital storytelling as a medium for language learning offers an active and engaging experience, which is highly important in modern education [29].

Technological developments compel educators to create more active and interactive learning environments, considering that students tend to prefer learning methods that involve them directly [30]. Interactive learning using Canva, for example, allows students to assimilate information visually and improve their learning outcomes [31]. Augmented Reality (AR) in education also demonstrates great potential. Aripin and

Suryaningsih developed a biology learning application using AR, which can present abstract concepts more concretely and engagingly for students.

Developing specific interactive content and providing teacher training in technology is also emphasized, as these efforts can significantly improve student achievement [32]. However, many teachers are still less capable of utilizing technology as an evaluation tool, making training in interactive assessment tools such as Wondershare Quiz Creator highly essential [33].

C. Instructional design

Instructional design, as defined by [34], is a systematic design process aimed at creating learning experiences that are more effective and efficient, making learning activities easier, and based on what we know about learning theories, information technology, systematic analysis, educational research, and management methods. The instructional design model developed by Jerold E. Kemp is one of the most commonly used models. According to[35], there are four interrelated and prioritized fundamental elements analyzed by educators: learner characteristics, learning objectives to be achieved, teaching methods and learning activities, and evaluations aligned with the learning objectives.

RESEARCH METHOD

A. Subject

The trial subjects in this study were conducted in three stages, namely: (1) the preliminary trial, which involved six learning experts and five students; (2) the main trial, which was applied to 50 undergraduate students of PGSD, Faculty of Education, Yogyakarta State University (FIP UNY); and (3) the operational field trial, which was applied to 100 undergraduate students of PGSD, FIP UNY.

B. Research design

This research is a development study aimed at developing and validating a product used in the learning process within education to achieve specific goals. According to Lee and Jang [36], there are several types of procedural instructional design development models: theory-driven procedural instructional design models, practice-driven conceptual instructional design models, and hybrid procedural instructional design models.

The type of development model used in this study is a development of procedural models employing a hybrid procedural design model approach. Based on the instructional design development research procedure proposed by Lee, J.L., and Jang, S.[15], [36], [37], the development procedure in this study applies the F2–O1+O2–S1+S5+S6–A3 type. The selection of this type aims to facilitate the development of a procedural instructional design model using a hybrid approach, in which data sources are first determined through a theory-driven process and then followed by a practice-driven process through the integration of expert and practitioner opinions.

C. Data collection technique

The data collection techniques used in this study include: (1) Focus Group Discussion (FGD), (2) questionnaires, (3) interviews, and (4) documentation studies. This research was conducted in the Undergraduate Program of Primary School Teacher Education (PGSD), Faculty of Education, Yogyakarta State University (FIP UNY). The research subjects were determined using a purposive sampling technique.

D. Data analysis techniques

Descriptive analysis was done using questionnaires from the design, subject matter experts, and learning experts. The measurement scale used was a Likert scale. The Likert scale measures an individual or group's attitudes, perceptions, and opinions regarding an object's potential and problems, the product's design, the process of product development, and the product itself. The validation process consists of two stages: concept validation and practitioner validation. The practicality of the product is assessed through practitioner validation. The data collection instruments used in this study include interview guidelines, also called interview protocols, employing the Delphi approach as the data collection method. The data were analyzed using a modified spiral model commonly used in design and development research.

RESULTS AND DISCUSSION

A. Results developing

The stages of developing a **digital literacy-based lecture model assisted by interactive technology (LITERA-TECH)** for elementary school teacher education (PGSD) students are as follows:

1. **Determining Data Sources**

   At this stage, data sources are determined to establish the sequence of the **theory-driven** approach, which the practice-driven approach will then follow. In this step, the researcher collects various sources such as research journals and books related to procedural model development, digital-based lecture models, interactive technology, students' digital literacy skills, and other relevant references. Determining data sources is carried out to identify data that have the potential to support the development process of the digital literacy-based lecture model assisted by interactive technology (LITERA-TECH). Therefore, a needs analysis is conducted beforehand to identify what is required in the development process.

2. **Collecting Data**

   At this stage, the researcher seeks and gathers relevant data for the study from various sources such as books, journals, articles, and other related references concerning the development of the digital literacy-based lecture model assisted by interactive technology (LITERA-TECH). This stage aims to obtain valid and relevant data to form an initial conceptual foundation regarding the model development and the types of instructional models that support the LITERA-TECH development process. The collected data include learning paradigms, digital-based lecture models, strengths and weaknesses of digital-based lecture models, syntax of digital-based lecture models, interactive technology, digital literacy skills, and other related studies.

3. **Generating Ideas**

   At this stage, patterns of integration are identified from the collected data and then transformed into the syntax of the digital literacy-based lecture model assisted by interactive technology (LITERA-TECH) in the form of a product that can be used in the learning process. The model design includes planning and prototyping a digital literacy-based model that integrates interactive technology into the lectures for PGSD (Elementary School Teacher Education) students at UNY.

4. **Designing the Model**

   This stage involves creating the syntactical design of the digital literacy-based lecture model assisted by interactive technology (LITERA-TECH), following the established structure. The syntax design serves as the initial product of the learning model development. After creating the product, the next step is to conduct validation to assess its feasibility and practicality. Expert teams carry out feasibility validation, while practitioners perform practicality validation.

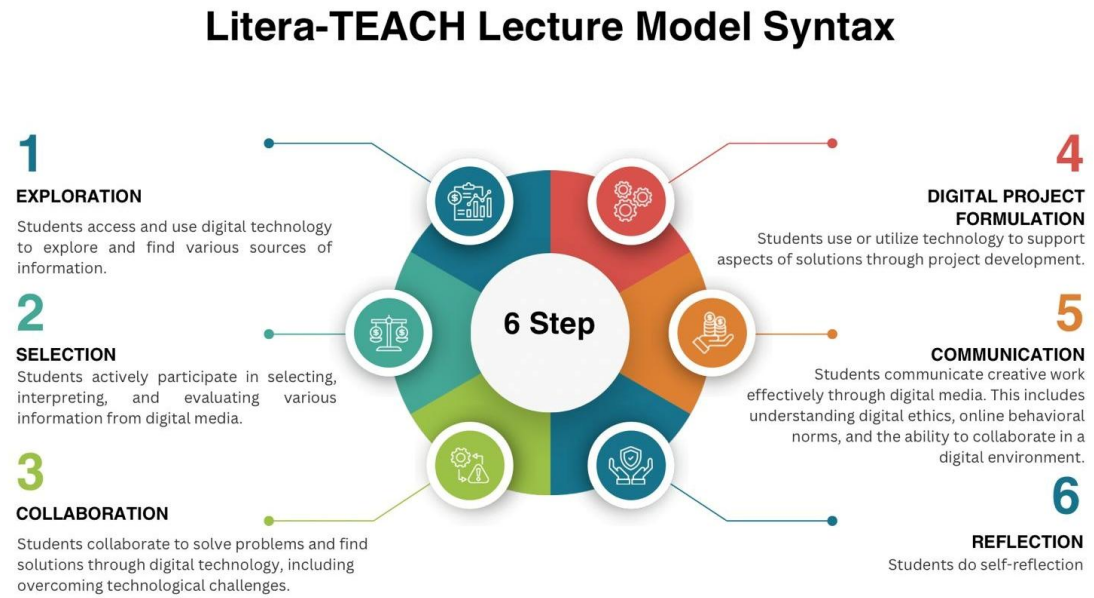

Figure 1. Litera-Teach Model

5. Conducting Concept Validation

Concept validation aims to assess the theoretical feasibility of the product, which is carried out by two instructional design experts and one material and media expert. Validation data are collected through interview sheets that evaluate various aspects of feasibility. In the model validation conducted by Dr. Unik Ambarwati, Ph.D., several revisions were suggested to improve the quality and feasibility of the developed learning model. The data obtained were analyzed using descriptive percentage techniques and then presented quantitatively. Based on the calculations, the average score obtained was 4.45. Compared to the conversion criteria, this score falls within the 4.21–5.00 range, categorizing the developed product as Excellent (Very Good).

Thus, the developed product is highly feasible and of high quality based on the validation by instructional design experts. Based on the validation results from the model and media experts, it can also be concluded that the LITERA-TECH Lecture Model, developed through six syntactic stages — exploration, selection, collaboration, digital project formulation, communication, and reflection — has been validated, is feasible, and of high quality in terms of both model and lecture content.

6. Conducting Practitioner Validation

The practicality test of the LITERA-TECH lecture model was conducted with PGSD students and lecturers of the Basic Literacy Learning Course in the PGSD undergraduate program. This test aimed to determine the responses of students and lecturers who had implemented the LITERA-TECH lecture model in real classroom settings.

This practicality test also aimed to ensure no significant shortcomings in the flow of the LITERA-TECH model, which had already been validated by experts and was deemed highly feasible for use in lectures. The test was carried out by gathering responses from lecturers and students regarding the syntax of the LITERA-TECH lecture model.

The results of the practicality test included comments and suggestions from lecturers and students about the LITERA-TECH model. Lecturers emphasized that student interaction should be strengthened in the digital literacy-based LITERA-TECH model to recreate an offline classroom atmosphere within the Learning Management System (LMS). Moreover, online learning requires digital skills and knowledge on using online tools effectively, as well as access to necessary technological equipment and stable internet connectivity.

The lecturers also stated that the integration and implementation of the model were easy to understand. The LITERA-TECH lecture model was considered engaging and interactive for students. It has the potential to increase student motivation and support independent learning, as students are encouraged to utilize various available digital learning resources. It also enhances interaction among students, lecturers, and the learning environment.

The digital literacy-based LITERA-TECH model helps students manage knowledge independently according to their learning styles. The activities in each model stage foster critical and creative thinking skills. Moreover, the model meets the learning needs of prospective elementary school teachers, positively impacting their basic literacy skills.

Based on the data analysis, the total score obtained from the assessments of two lecturers teaching the Basic Literacy Learning course was 117 out of a maximum of 120. This results in an average score of 58.5 out of 60, equivalent to a conversion value of 3.9 on a four-point scale. Compared with the product practicality conversion guidelines, the average score of 3.9 falls within the 3.41–4.00 range, categorized as Excellent (Strongly Agree).

Therefore, the developed product is declared very good and practical for use in lectures for prospective elementary school teachers.

The main trial was conducted with 50 undergraduate PGSD students at the Faculty of Education, UNY. The average respondent score was 59.1 or 3.94 on a four-point scale, categorized as Very Good. However, some suggestions were provided regarding the implementation features of the LITERA-TECH model — specifically, that the instructions and interface design were sometimes confusing. Therefore, improvements are needed to make the model more user-friendly, such as providing clearer instructions, simple usage examples, and visual guides to facilitate understanding.

The field trial was conducted with 100 PGSD undergraduate students at the Faculty of Education, UNY. The average respondent score was 59.27 or 3.95 on a four-point scale, also categorized as Very Good. Suggestions from this stage included adding more interactive media (such as online quizzes, simulations, or digital discussion forums).

B. Discussion and Findings

The LITERA-TEACH lecture model that has been developed consists of several stages, which can be explained as follows:

A. Exploration

At this stage, students access and use digital technology to explore and discover various sources of information. The current learning process cannot be separated from technological developments. State that in the "digital age," almost all available information is in digital form. The current generation, born as **digital natives** within the sophistication of ICT (Information and Communication Technology), tends to be interested in learning using devices such as smartphones, laptops, tablets, and similar tools. They can easily use platforms such as Google Search, YouTube, Google Play Store, and others to access various kinds of information connected to the internet. Undeniably, lecturers are no longer the sole source of information delivery. Interactive learning processes are considered ideal [32], and such interactivity can be built through technological and informational advancements.

B. Selection

In the selection stage, students actively select, interpret, and evaluate various types of information from digital media. They critically and creatively filter multiple sources across different media platforms. Students also seek alternative sources for comparison to assess the accuracy of the data. They evaluate information critically to recognize credible sources, identify bias, and determine the reliability of the information. These activities contribute to enhancing students' digital literacy skills.

C. Collaboration

In the collaboration stage, students work together to solve problems and find solutions through digital technology, including overcoming technological challenges. Explain that digital literacy helps students develop a critical and creative mindset [38]. They are less likely to be influenced by provocative issues, fall victim to hoaxes, or be deceived by digital-based fraud. Developing soft skills, such as digital literacy, the ability to work collaboratively in virtual environments, and emotional intelligence, is a crucial aspect that educational institutions must consider. Universities should serve as environments that foster and strengthen these abilities [39].

D. Digital Project Formulation

In this stage, students use or leverage technology to support problem-solving aspects through project development. They use digital media as tools for solving learning-related problems. Students apply critical thinking skills toward information while demonstrating creativity in using technology to create new products or solutions. They can balance analytical skills with creativity.

State that students should be trained to use digital technology to consume content and create it [40]. They can be encouraged to develop personal projects using technology, such as building websites, developing applications, or producing digital content. These activities sharpen technical abilities and foster innovation skills. Additionally, students must understand that innovation often involves risks and failures. They must be courageous in experimenting with new ideas and viewing failure as part of the learning process. This mindset prepares them for a rapidly changing world that demands innovative solutions. Personal digital projects allow students to apply theoretical knowledge in practical situations.

E. Communication

In this stage, students communicate their creative works effectively through digital media. This includes understanding digital ethics, online behavioral norms, and the ability to collaborate in digital environments. Digitally literate students can easily use and optimize digital tools to search for information, and they can also identify reliable websites because they understand the characteristics of credible online sources [38].

F. Reflection

Students are expected to engage in self-reflection and take responsibility for their ethical use of digital technology. They can improve their performance by reflecting on their learning activities and experiences. In this reflective activity, students are guided through a reflective approach that helps them understand and improve their learning experiences. The stages of reflection in this lecture model are as follows:

a) Connection. Reflection begins by recognizing and connecting experiences with prior knowledge, emphasizing the importance of linking new experiences with existing understanding.

b) Challenge. Reflection requires the ability to identify and challenge existing assumptions and beliefs. This activity encourages students to recognize the challenges and difficulties they encounter.

c) Concept. At this stage, students learn to understand relevant concepts and theories, emphasizing the importance of grasping these ideas within their social and cultural contexts.

d) Change. Reflection should lead to action to achieve desired improvements. The LITERA-TECH Lecture Model emphasizes the importance of planning changes and improvements based on the reflections conducted.

Thus, reflection in the LITERA-TECH lecture model helps students understand and improve their learning experiences systematically and effectively.

CONCLUSION

This study produced a product in the form of a lecture model, syntax, and interactive media. Based on the research results and discussion, it can be concluded that the Litera-Tech model syntax, which is based on digital literacy, was developed using a procedural model by Lee, J.L., and Jang, S., modified according to the research needs. The stages include identifying data sources, collecting data, analyzing data, generating model ideas, designing the model, and conducting conceptual and practical validation.

Based on expert evaluations, the lecture model design received a "Very Good" rating. The practicality test showed an average score of 3.9, which falls within the 3.41–4.00 range and is categorized as “Very Good” (Highly Practical). The main trial resulted in an average score of 3.94 on a four-point scale, and the field trial obtained an average score of 3.95, both classified as “Very Good”.

REFERENCES

[1] R. Hendaryan, T. Hidayat, and S. Herliani, “Pelaksanaan literasi digital dalam meningkatkan kemampuan literasi siswa,” Literasi J. Bhs. dan Sastra Indones. serta Pembelajarannya, vol. 6, no. 1, pp. 142–151, 2022.

[2] D. Bawden, “Information and digital literacies: a review of concepts,” J. Doc., vol. 57, no. 2, pp. 218–259, 2001.

[3] G. J. Clifford, “Buch und lesen: Historical perspectives on literacy and schooling,” Rev. Educ. Res., vol. 54, no. 4, pp. 472–500, 1984.

[4] P. Gilster, “Digital Literacy. New York: Wiley&Sons,” 1997, Inc.

[5] S. Sukarno and M. El Widdah, “The Effect of Studentsâ€TM Metacognition and Digital Literacy in Virtual Lectures during the Covid-19 Pandemic on Achievement in the â€œMethods and Strategies on Physics Learningâ€ Course,” J. Pendidik. IPA Indones., vol. 9, no. 4, pp. 477–488, Dec. 2020, doi: 10.15294/jpii.v9i4.25332.

[6] D. H. Suwarto, B. Setiawan, and S. Machmiyah, “Developing Digital Literacy Practices in Yogyakarta Elementary Schools,” Electron. J. e-Learning, vol. 20, no. 2, pp. pp101-111, Feb. 2022, doi: 10.34190/ejel.20.2.2602.

[7] S. Purnama, M. Ulfah, I. Machali, A. Wibowo, and B. S. Narmaditya, “Does digital literacy influence students’ online risk? Evidence from Covid-19,” Heliyon, vol. 7, no. 6, p. e07406, Jun. 2021, doi: 10.1016/j.heliyon.2021.e07406.

[8] E. F. Rusydiyah, E. Purwati, and A. Prabowo, “HOW TO USE DIGITAL LITERACY AS A LEARNING RESOURCE FOR TEACHER CANDIDATES IN INDONESIA,” J. Cakrawala Pendidik., vol. 39, no. 2, pp. 305–318, Jun. 2020, doi: 10.21831/cp.v39i2.30551.

[9] E. P. Yildiz, “Opinions of academicians on digital literacy: A phenomenology study,” Cypriot J. Educ. Sci., vol. 15, no. 3, pp. 469–478, Jun. 2020, doi: 10.18844/cjes.v15i3.4913.

[10] F. Fauzan, F. Arifin, M. A. Lubis, and F. M. Firdaus, “Lecturer’s digital literacy ability in the pandemic,” Cypriot J. Educ. Sci., vol. 17, no. 4, pp. 1130–1142, Apr. 2022, doi: 10.18844/cjes.v17i4.7122.

[11] K. KIC, Status Literasi Digital Indonesia 2020 Hasil Survei di 34 Provinsi. . 2020.

[12] F. Nasihah and I. Tabroni, “Fostering Literacy Culture through Reading and Writing Movement,” J. Pengabdi. Masy. Bestari, vol. 1, no. 8, pp. 779–792, 2022.

[13] I. M. Putrayasa, I. G. Suwindia, and I. M. Ari Winangun, “Transformasi literasi di era digital: tantangan dan peluang untuk generasi muda,” Educ. Soc. Sci. Rev., vol. 5, no. 2, pp. 156–165, Dec. 2024, doi: 10.29210/07essr501400.

[14] E. Kuntarto, “Pengembangan Model Pembelajaran Literasi Digital Berbasis Merdeka Belajar untuk Masyarakat Pedesaan,” SAP (Susunan Artik. Pendidikan), vol. 7, no. 1, pp. 34–42, 2022.

[15] Y. Ramadani, S. P. Erly, and I. Rosyida, “Procedures for Developing Inquiry-Flipped Classroom Models to Improve Argumentation Skills,” AL-ISHLAH J. Pendidik., vol. 15, no. 3, Sep. 2023, doi: 10.35445/alishlah.v15i3.2717.

[16] H. Han, “Do nonverbal emotional cues matter? Effects of video casting in synchronous virtual classrooms,” Am. J. Distance Educ., vol. 27, no. 4, pp. 253–264, 2013.

[17] M. Hastie, I. Hung, N. Chen, and Kinshuk, “A blended synchronous learning model for educational international collaboration,” Innov. Educ. Teach. Int., vol. 47, no. 1, pp. 9–24, 2010.

[18] H. Karal, A. Cebi, and Y. E. Turgut, “Perceptions of students who take synchronous courses through video conferencing about distance education.,” Turkish Online J. Educ. Technol., vol. 10, no. 4, pp. 276–293, 2011.

[19] T. Plomp, Educational design research: An introduction. Educational Design Research,. 2013.

[20] A. Pérez-Escoda, R. García-Ruiz, and I. Aguaded, "Dimensiones de la alfabetización digital a partir de cinco modelos de desarrollo," Cult. Educ. Cult. y Educ., vol. 31, no. 2, pp. 248–266, 2019.
[21] B. Omonayajo, F. Al-Turjman, and N. Cavus, "Interactive and innovative technologies for smart education," Comput. Sci. Inf. Syst., vol. 19, no. 3, pp. 1549–1564, 2022.
[22] B. S. K. Chan, D. Churchill, and K. F. Chiu, "Digital literacy learning in higher education through digital storytelling approach," J. Int. Educ. Res., 2017.
[23] E. Abiltarova, L. Lisina, Y. Zhuravel, L. Neizhpapa, and Y. Mengyi, "Interactive student learning technologies in higher education," J. Curric. Teach., vol. 11, no. 9, p. 107, 2022.
[24] A. Ussarn, P. Pimdee, and T. Kantathanawat, "Needs assessment to promote the digital literacy among students in Thai community colleges," Int. J. Eval. Res. Educ., vol. 11, no. 3, p. 1278, Sep. 2022, doi: 10.11591/ijere.v11i3.23218.
[25] C. Hague and S. Payton, Digital literacy across the curriculum, vol. 4, no. 1. Futurelab Bristol, 2010.
[26] K. B. Dinata, "Analisis kemampuan literasi digital mahasiswa," Edukasi J. Pendidik., vol. 19, no. 1, pp. 105–119, 2021.
[27] N. K. Martini, L. E. Tripalupi, and I. A. Haris, "Pengaruh Model Pembelajaran Auditory Intellectually Repetition (Air) Terhadap Hasil Belajar Siswa Pada Mata Pelajaran Ekonomi Kelas X Ips Di Sma Negeri 3 Singaraja Tahun Pelajaran 2017/2018," J. Pendidik. Ekon. Undiksha, vol. 10, no. 1, p. 295, Sep. 2019, doi: 10.23887/jjpe.v10i1.20148.
[28] S. H. Lytvynova and N. V Soroko, "Interaction in an educational environment with virtual and augmented reality," Inf. Technol. Learn. Tools, vol. 98, no. 6, p. 13, 2023.
[29] H. R. Akhiruddin, A. Ahmadi, and R. P. Raharjo, "Pemanfaatan Cerita Interaktif Digital sebagai Media Pembelajaran Bahasa yang Inovatif," Judika (Jurnal Pendidik. Unsika), vol. 12, no. 2, pp. 193–208, 2024.
[30] S. Bibi, T. Suryanto, L. Siswanto, and T. B. Atmojo, "Pelatihan Pembuatan Media Pembelajaran Interaktif Pada Fakultas Keguruan dan Ilmu Pendidikan Universitas Nahdatul Ulama Kalimantan Barat," GERVASI J. Pengabdi. Kpd. Masy., vol. 7, no. 1, pp. 416–425, 2023.
[31] A. H. Ramadani, H. Arizal, and I. A. T. Rahayu, "Penerapan Modul Pembelajaran Interaktif Berbasis Web Menggunakan Canva Pada Matakuliah Teknologi Mekanik," J. Vocat. Tech. Educ., vol. 5, no. 1, pp. 1–8, 2023.
[32] H. Hasnawiyah and M. Maslena, "Dampak Penggunaan Media Pembelajaran Interaktif Terhadap Prestasi Belajar Sains Siswa," J. Rev. Pendidik. Dasar J. Kaji. Pendidik. dan Has. Penelit., vol. 10, no. 2, pp. 167–172, May 2024, doi: 10.26740/jrpd.v10n2.p167-172.
[33] F. Farman, C. Chairuddin, and I. Djabbar, "Pelatihan Penggunaan Wondershare Quiz Creator sebagai Alat Evaluasi Interaktif Bagi Guru SMP," J. Pengabdi. Masy. Tjut Nyak Dhien, vol. 2, no. 2, pp. 20–27, 2023.
[34] J. E. Morrison, G. R., Ross, S. M., Kalman, H. K., & Kemp, Designing Effective Instruction (Seventh). United States of America: Jonh Wiley &. Sons. Morrison, G. R., Ross, S. M., Kalman, H. K., & Kemp, J. E. (2013). Designing Effective Instruction (Seventh). United States of America: Jonh Wiley &. Sons., 2013.
[35] G. R. Morrison, S. M. Ross, H. K. Kalman, and J. E. Kemp, Designing Effective Instruction, Seventh. United States of America: Jonh Wiley &. Sons, 2013.
[36] Rusdi, Educational Design and Development Research: New Knowledge Concepts, Procedures and Synthesis. Jakarta: Rajawali Pers, 2019.
[37] M. Rusdi, penelitian perlakuan kependidikan . Depok: Rajawali pres, 2020.
[38] N. C. Agustin and I. Krismayani, "Kemampuan Literasi Digital Mahasiswa S-1 Angkatan 2018 Fakultas Ilmu Budaya Universitas Diponegoro," J. Ilmu Perpust., vol. 8, no. 3, pp. 94–107, 2019.
[39] H. Wynda, "The Transformasi Pendidikan Tinggi: Mengasah Soft skills untuk Menjawab Tantangan Kerja di Era Society 5.0," J. Sains Sosio Hum., vol. 9, no. 1, pp. 91–102, 2025.
[40] A. M. Lubis, A. A. Aprelidea, M. Najib, M. Nabil, E. Iryani, and H. Helty, "Strategi Peningkatan Keterampilan Mahasiswa Di Era Transformasi Digital," Innov. J. Soc. Sci. Res., vol. 5, no. 2, pp. 3581–3590, 2025.

SERVING MORE THAN COFFEE: PROFESSIONALISM, REPRESENTATION, AND PUBLIC PERCEPTIONS OF FEMALE BARISTAS' ATTRACTIVENESS

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Abstract. The coffee shop industry in Indonesia, especially in major cities like Yogyakarta, is experiencing rapid growth influenced not only by the quality of coffee products but also by the experience offered to customers. To stand out from the competition, many coffee shops hire female baristas as part of their marketing strategy, both as a symbol of gender equality and as a visual element to attract customers. This study examined the role of female baristas in coffee shops as marketing strategies in Yogyakarta. The present study focused on the influence of female barista visuals and customer experiences regarding the topic. This study employed the qualitative phenomenological approach. Data were collected through in-depth interviews with female baristas working in several coffee shops in Yogyakarta. The findings indicate that female baristas play a role not only in providing friendly service but also as a crucial element in creating customer experiences through visual-based marketing. Their presence on social media and direct interactions with customers enhance the image of coffee shops. However, the findings reveal ambivalent results, where female baristas are often used as a visual marketing tool that can override their professionalism. This study also found that product and service quality are the key factors in developing customer loyalty. This study emphasizes the importance of balancing the use of female baristas as a visual in marketing strategy and being valued for their professionalism in enhancing the overall customer experience.

Keywords: Female barista, professionalism, marketing strategy, public perception

INTRODUCTION

The coffee shop industry in Indonesia, particularly in major cities like Yogyakarta, has experienced rapid growth in recent years. The increase in the number of coffee shops has been accompanied by increasingly fierce competition, with coffee shops competing not only to serve quality coffee but also to create unique customer experiences. In this regard, customer experience is a key factor in increasing loyalty and fostering long-term relationships between brands and consumers (Rohman & Azizah, 2023). One of the strategies that coffee shops use to differentiate themselves is through brand image development, one of which involves the role of female baristas as a visual element in marketing.

The phenomenon of female baristas in the coffee shop industry reflects a shift in the workforce, previously dominated by men, and further strengthens the experiential marketing dimension. Female baristas serve not only technically skilled coffee servers but also play a crucial role in creating the coffee shop atmosphere and customer experience (Schmitt et al., 2015). As a matter of fact, female baristas are often involved in visual marketing strategies, such as through social media, leveraging their visual appeal to capture audience attention (Amorti, 2023). In this context, female baristas play a key role in creating emotional and social experiences for customers. Furthermore, they influence customer perceptions of service quality and the coffee shop atmosphere, ultimately impacting their decision to return (Chinomona & Dubihlela, 2020). However, despite their significant contribution to the customer experience, there is an ambivalent result regarding the role of female baristas, who are often positioned as visual elements in marketing strategy that focus on their physical attractiveness (Warhurst & Nickson, 2009). This study focuses on the role of female baristas in coffee shop marketing strategies, particularly in Yogyakarta. Using a qualitative phenomenological approach, it aims to explore female baristas' role in marketing, both as part of visual promotion and direct engagement.

LITERATURE REVIEW

Experiential Marketing

Experiential Marketing Theory emphasizes the importance of immersive customer experiences in marketing. Suggests that experiences that engage customers' senses, emotions, and interpersonal relationships can increase their engagement and loyalty to a brand. In the coffee shop industry, this theory can be applied to understand how female baristas, as a service element, can play a role in creating immersive experiences and influencing customer perceptions. Customer experiences in coffee shops are not limited to the taste of the coffee itself, but also include a "customer experience" that involves social interactions, atmosphere, and visual impressions created by elements in the shops, including the baristas. Female baristas, with their communication skills and friendly personalities, play a key role in creating emotional and social experiences for customers, which in turn influence their decisions to return to the shop (Schmitt, 1999).

Experiential marketing refers to a company's ability to deliver emotional experiences to customers in a way that touches their hearts and minds. In other words, experiential marketing is a type of marketing strategy focusing on customers' emotional experiences with a goal of providing pleasant experiences and fulfilling customer value in return. While coffee shops strive to serve the best coffee, they also consider how they can sell their customers' experiences. A good physical environment can be used as an experiential marketing tool to encourage positive emotions, encouragement, satisfaction, and customer loyalty to a restaurant (Ardianto et al., 2021). Other research has found that consumer satisfaction and perceived value are strongly influenced by the experience "sold" in a coffee shop. Baristas are responsible for delivering sensory and brand experiences to customers and selling these experiences (Aritonang, 2024). In recent years, the presence of female baristas in coffee shops has increased. This phenomenon reflects a shift in the workforce structure in the coffee industry, which was previously dominated by men. Furthermore, other research highlights the importance of barista competence in conveying experiential marketing values in coffee shops. They found that baristas who have good communication skills and are able to create a comfortable atmosphere can improve customer experience and contribute to the success of a coffee shop business (Ahmad Alvarizy & Yosini Deliana, 2021).

Traditional Gender Stereotype

Traditional gender stereotypes place women in the "private" space and men in the "public" space. Women are often put into customer service roles due to traditional gender stereotypes in the workplace. For example, men are stereotyped as physically stronger and results-focused, while women are often portrayed as concentrating on emotional interactions with customers. Women are not only better able to navigate role ambiguity, navigate conflict, and experience higher levels of mental stress than men, but they are also better able to manage their emotions when dealing with clients (Amorti, 2023).

RESEARCH METHOD

This study employed a qualitative phenomenological approach, which aimed to investigate the subjective meaning of individual experiences (female baristas) within the context of their work in coffee shops. This approach allows researchers to delve deeper into how female baristas perceive their roles and how their interactions with customers influence their coffee shop experiences. Participants in this study were female baristas working in several coffee shops in Yogyakarta. Purposive sampling was used to select female baristas with at least six months of experience working in coffee shops. Data were collected through in-depth, semi-structured interviews. Interview questions focused on several key topics, including work experiences as female baristas, their perceptions of gender equality in the workplace, and how their roles are utilized in coffee shop marketing activities (e.g., through social media or direct promotions).

Experiential Marketing theory was used to support the analysis in understanding how female baristas create customer experiences that involve sensory, emotional, and relational aspects. Experiential Marketing focuses on creating immersive customer experiences, which involve not only the product but also social interactions, atmosphere, and the image built around the brand (Schmitt, 1999). In the context of a coffee shop, female baristas are not only coffee servers but also part of the overall experience that customers get when visiting the coffee shop. The collected data were then analyzed using a thematic analysis approach, which aims to identify key patterns and themes in the experiences shared by participants. The results of this analysis provided insight into how female baristas play a role in shaping customer experiences and whether this role is more inclined towards empowerment or utilized as a visual marketing tool.

RESULT AND DISCUSSION

The coffee shop industry in Indonesia is growing rapidly. The barista's role extends beyond technical expertise in brewing coffee to encompass aspects of social representation and marketing. Coffee shops have become new spaces that offer more than just caffeinated beverages, but also provide a social experience, aesthetics, and a distinct identity for their customers. Along with this transformation, the barista's role has undergone a fundamental shift. Baristas are no longer simply positioned as coffee brewers working behind the bar, but also as representatives of the coffee shop's image. In many cases, baristas serve as the "face" of the shop, interacting directly with customers, providing recommendations, and creating an atmosphere that shapes consumer perceptions. This dual role makes baristas not just technical workers but also crucial actors in experience-based marketing strategies.

Amidst this dynamic, gender issues emerge as an interesting dimension to examine. The presence of female baristas is often associated with visual appeal, which is believed to enhance the coffee shop image in the eyes of customers. Social media, one of the primary marketing channels, frequently features female baristas as representative figures in promotional content. Female baristas' involvement extends beyond the visual aspects of promotions to include direct interactions with customers. Customers often associate female baristas' service with friendliness, warmth, and pleasant communication. This perception indicates that gender plays a significant role in shaping the customer experience. In other words, coffee shop owners leverage not only the baristas' technical expertise but also social and gender capital in building relationships with consumers. The following are research findings related to the phenomenon of female baristas in coffee shop marketing strategies in Yogyakarta.

Female Barista as a Visual Attraction

One of the interesting findings of this study is the frequent use of female baristas as visual attractions in the marketing strategies of several coffee shops in Yogyakarta. Several informants shared their personal experiences when asked to appear in promotions, either through photos or videos that were then uploaded to social media. This involvement was not always based on professional competence as coffee brewers, but rather on gender identity, which was considered capable of attracting audience attention. This phenomenon reflects the tendency for the commercialization of women's bodies and identities in the coffee industry, which relies heavily on visual imagery. Social media, as the primary promotional medium, further reinforces this pattern by highlighting certain visuals deemed "sellable." However, the female baristas themselves expressed ambivalence. While they understood the importance of visual aspects in promotions, they also felt uncomfortable when this role undermined their professionalism. Nevertheless, most female baristas also emphasized that visual imagery was not the primary factor determining customer loyalty. Coffee quality and consistent service were still considered key determinants of a coffee shop's sustainability. In other words, gender-based visual strategies may be effective in attracting initial attention, but they will not be sufficient to retain customers without guaranteed product quality.

The researchers' analysis shows that this phenomenon can be understood through an experiential marketing framework, which emphasizes that consumer experience is determined not only by the product but also by the atmosphere, interactions, and visual symbols staged by the service provider (Saadi & Sulistiadi, 2025). Therefore, the involvement of female baristas in promotions can be seen as part of a strategy to create an aesthetic experience that supports the coffee shop's image. However, as previous research has shown, the experiential value that drives customer loyalty is more determined by product quality and the quality of the service encounter. Zeithaml, Bitner, and Gremler (Sofyan et al., 2025) emphasized that consumer perceptions of service quality are strongly influenced by direct interactions with employees, including friendliness and warmth of communication. This aligns with the finding that even though female baristas are used as visual appeal, customers continue to return because of the quality of the coffee and the consistency of service.

Furthermore, findings regarding female baristas' ambivalence were divided into the need for promotion and the feelings of discomfort due to their professionalism being marginalized. This is in line with previous research highlighting the commodification of female identity. A study by Warhurst and Nickson showed that female workers are often positioned as "an aesthetic labor" whose appearance is exploited to bolster the company's image (Mears, 2014). In the present study, the risk of objectification arises if baristas' involvement is viewed solely from a visual perspective.

Female Barista's Involvement in Promotion

In addition to providing visual appeal in coffee shops, female baristas are also frequently involved in promotional content for social media. The forms of female baristas' involvement in this promotional content vary considerably. In some places, female baristas are asked to appear explicitly as the main figures in promotional materials. While in others, they are only involved in more technical content, such as the brewing process, latte art, or beverage presentation. This difference in patterns demonstrates that coffee shops have flexibility in constructing the image and narrative they wish to convey to their audience. However, in practice,

the involvement of female baristas is still often influenced by gender factors. This is evident in the tendency of business owners to choose female baristas as promotional figures, arguing that they are considered more visually appealing. At this point, promotional content is not merely a means of product communication but also part of the construction of the coffee shop's identity. Through social media, coffee shops not only showcase the drinks they sell but also create a narrative about the atmosphere, lifestyle, and social representation they offer. Female baristas are then positioned as part of this narrative, both through aesthetic visualization and demonstration of skills.

The above findings indicate that female baristas are frequently involved in coffee shop social media promotional content. Pine and Gilmore stated that marketing success in the experience economy era is determined not only by the quality of the product offered, but also by the holistic experience felt by consumers (Mastarida, 2023). This experience is built through the atmosphere, interactions with baristas, and visual narratives constructed through social media. Therefore, the involvement of female baristas in promotional content, both as central figures and as representatives of their skills, is part of a strategy to create a more memorable customer experience (Zahara et al., 2025).

Promotional content on social media ultimately functions not only as a product communication medium but also as an instrument for shaping the coffee shop's identity. This means that social media has become a hybrid element of the promotional mix, enabling brands to build more personal relationships with consumers (Mangold & Faulds, 2009). In this case, female baristas serve as a symbolic representation that reinforces the narrative about the lifestyle and emotional closeness offered by coffee shops. However, this involvement cannot be separated from gender factors. The concept of aesthetic labor indicates that service workers' physical appearance is often utilized as a visual differentiation strategy (Warhurst & Nickson, 2009). This aligns with the tendency of coffee shop owners to choose female baristas as promotional figures for visual appeal, although this is not always related to professional competence. Other research findings indicate that the aesthetic aspects of the workforce have a significant influence on customer perceptions of service quality (Tsaur & Tang, 2013). Therefore, the involvement of female baristas in promotional content reflects two aspects. First, this strategy aligns with the experiential marketing framework because it creates a visual and emotional experience for customers. On the other hand, it demonstrates the commodification of gender identity, which could potentially create an ethical dilemma if the baristas' professional skills are not highlighted appropriately.

Gender in Coffee Shop Marketing Strategies

Another equally important finding is the role of gender in direct interactions with customers. Several baristas revealed that customers often feel more comfortable when served by female baristas. This relates to the general perception that women tend to be friendlier, more communicative, and capable of providing warm service. Smiles, casual greetings, and interpersonal communication fostered by female baristas are factors considered to enrich the customer experience. From a marketing perspective, this aspect can be understood through the concept of service encounter. The moment of interaction between service providers and consumers is a significant determinant of the perception of service quality. In the context of this research, interactions with female baristas are crucial in shaping customer impressions. When these interactions are warm and personal, customers not only evaluate the coffee they consume but also appreciate the social experience they gain. However, this finding also triggers a discussion about gender stereotypes. The assumption that female baristas are friendlier or better suited to interacting with customers has the potential to perpetuate gender-based role divisions. Meanwhile, male baristas may be given less space to express their communicative side. Thus, this phenomenon demonstrates that coffee shops, as both public and commercial spaces, contribute to the reproduction of gender-related social norms in service interactions.

Based on these findings, the role of gender in interactions between customers and female baristas can be examined using experiential marketing theory, which emphasizes the importance of emotional and sensory experiences in building relationships between brands and consumers. Experiential marketing focuses on creating experiences that actively engage customers, both emotionally, physically, and intellectually, with the aim of increasing customer loyalty and differentiating brands from competitors. Direct interactions with female baristas who are warm, friendly, and communicative can be seen as a form of immersive sensorial experience for customers, which increases their satisfaction. Service encounter is one of the key concepts in experiential marketing theory, describing the moment of interaction between consumers and service providers as a crucial point in building perceptions of service quality. In this study, the interaction of female baristas who are more friendly and communicative is considered to enrich the customer experience. Therefore, customers are not only merely consumers of the product (coffee), but also part of a pleasant social experience. Customers feel valued and treated with warmth, which in turn strengthens positive impressions of the coffee shop brand.

Another study points out the importance of more personal and warm service interactions that are often associated with women. It was found that good service plays a significant role in increasing customer satisfaction and loyalty (Sofyan et al., 2024). The study found that customers were more likely to feel valued and satisfied when they received warm and attentive service. This reinforces the notion that female baristas, who

tend to have better interpersonal communication skills, are more likely to contribute to a more positive customer experience. However, this finding also points to broader issues related to gender stereotypes in the workplace, which tend to reinforce gender roles in society. Moreover, other research found that although women are more often perceived as friendlier and more communicative service providers, this indirectly limits men's roles in jobs that involve emotional interactions with customers (Nurdin, 2022). This can create inequality in job opportunities, as men may not be given the same opportunities to demonstrate their skills in interacting with customers.

Thus, this phenomenon not only demonstrates how customers' interactions with female baristas influence their perceptions of service quality but also how gender stereotypes remain relevant in the context of customer experiences in coffee shops. Interactions with female baristas in coffee shops can enrich customer experiences through the emotional values they offer. However, it is important to consider the social implications of gender stereotypes in the service context. The assumption that women are more friendly and communicative can limit men's roles in service interactions, potentially reinforcing traditional gender roles. Therefore, it is crucial for coffee shops to create an inclusive culture that allows all employees, regardless of gender, to express themselves authentically in interactions with customers.

Customer Attraction Strategy

In addition to visual aspects and interpersonal interactions, female baristas also employ more measured strategies to attract customers, one of which is through upselling. Several informants explained that they recommend specific menu items or suggest additional products to customers in a persuasive, yet unobtrusive manner. This strategy not only increases transaction value but also creates the impression that customers are receiving special attention. This personalized approach has proven effective in building loyalty. Customers who feel valued and receive a unique service experience are more likely to return, even making that coffee shop their first choice. Thus, baristas act not only as coffee servers but also as marketing agents, actively influencing consumption behaviour. Interestingly, such a marketing strategy is even more effective when supported by warm interactions and friendly communication. In other words, product quality, personalized service, and the barista's interpersonal skills complement each other in shaping a comprehensive customer experience. This suggests that customer loyalty in the coffee shop industry is built not only through the taste of the coffee served, but also through the emotional connections created in everyday interactions.

A study by Wardani & Molekandella Boer (2025) found that service personalization and barista interpersonal skills complement each other in shaping a comprehensive customer experience. This suggests that in the coffee shop industry, customer loyalty is built not only by product quality but also by relationship marketing, which emphasizes the importance of emotional connections, thus creating direct interactions. Other research highlights the importance of personalized communication in marketing strategies, including upselling as part of creating a richer customer experience and fostering greater loyalty. Customers who feel a connection with employees or the brand are more likely to accept upselling offers, which positively impact customer satisfaction and loyalty.

The upselling strategy implemented by female baristas, with a personal approach and warm interactions, has proven effective in increasing customer loyalty, not only through product quality but also through the emotional experience customers gain during the interaction. This reinforces the concept in experiential marketing that loyalty is not only built through experiences that go beyond transactions but also through the emotional connection created in every moment of interaction with employees. Thus, it not only increases transaction value but also enriches customer relationships with the brand, positively impacting business sustainability.

CONCLUSIONS AND SUGGESTIONS

This study successfully captures that female baristas play a crucial role in the marketing strategies of coffee shops in Yogyakarta. The baristas not only show attentive and friendly service but also contribute to the customer experience through visual-based marketing. Their presence is often leveraged to attract customers, both through visuals on social media and in-person interactions that foster emotional and social experiences. However, portraying women primarily as a form of visual appeal carries an element of ambiguity, as it may lead to discomfort among baristas who feel that their professionalism is being overlooked. On the other hand, female baristas in fact play a role in other marketing strategies, such as upselling, which can increase customer loyalty. The warm and personal interactions they show during their work contribute to the formation of an emotional connection between customers and the coffee shops, which is crucial for the sustainability of the business.

Recommendation:

Coffee shop owners should balance the marketing strategy with recognition of baristas' professional competence. While visual appeal may attract customers initially, product and service quality are essential for

retention. It is also recommended that coffee shops foster an inclusive workplace culture where all employees, regardless of gender, can express themselves freely. This can help avoid gender stereotypes and increase equity in employment opportunities.

REFERENCES

1. Ahmad Alvarizy, & Yosini Deliana. (2021). KOMPETENSI BARISTA DALAM MENYAMPAIKAN EXPERIENTIAL MARKETING DI COFFEE SHOP DI KOTA BANDUNG . Jurnal Pemikiran Masyarakat Ilmiah Berwawasan Agribisnis.
2. Amorti, V. (2023). Modal Erotis Pada Barista Perempuandi Specialty Coffee Shop: Studi Pada Barista Perempuan Di Jakarta Selatan. Https://Repository.Uinjkt.Ac.Id/Dspace/Handle/123456789/74672.
3. Anzu Elvia Zahara, Loso Judijanto, Apriyanto, Muzayyanah Yuliasih, & Anton Susilo. (2025). Manajemen Pemasaran Modern. Sonpedia Publishing Indonesia.
4. Ardianto, Y., Supriadi Thalib, & Dian Riskarini. (2021). Analisis Repurchase Intention Melalui Customer Satisfaction Dilihat Dari Experiental Marketing dan Servicescape. JRB-Jurnal Riset Bisnis, 4, 155–172. https://doi.org/10.35814/jrb.v4i2.1724
5. Aritonang, K. L. (2024). PENGARUH DIGITAL MARKETING, PERSEPSI HARGA DAN KUALITAS PRODUK TERHADAP KEPUASAN KONSUMEN PADA PRODUK COFFEE SHOP GOODFELLA DI TANJUNG MORAWA. Https://Repository.Uhn.Ac.Id/Handle/123456789/10057.
6. H Nurdin. (2022). Komunikasi Interpersonal Barista Perempuan Dalam Melawan Framing Negatif Khalayak. At-Tanzir: Jurnal Ilmiah Prodi Komunikasi.
7. Mangold, W. G., & Faulds, D. J. (2009). Social media: The new hybrid element of the promotion mix. Business Horizons, 52, 357–365. https://doi.org/10.1016/j.bushor.2009.03.002
8. Mastarida, F. (2023). PENGALAMAN LAYANAN TERHADAP KEUNGGULAN DAYA SAING: KAJIAN LITERATUR. Jurnal Ilmiah Ekonomi Bisnis, 28, 349–360. https://doi.org/10.35760/eb.2023.v28i3.7116
9. Mears, A. (2014). Aesthetic labor for the sociologies of work, gender, and beauty. Sociology Compass, 8, 1330–1343. https://doi.org/10.1111/soc4.12211
10. Rohman, F., & Azizah, A. (2023). ANALISIS PERAN EMOTIONAL BRANDING STRATEGY DALAM MENINGKATKAN LOYALITAS PENGUNJUNG PUSAT PERBELANJAAN. Jurnal Manajemen Pemasaran, 17, 90–100. https://doi.org/10.9744/pemasaran.17.2.90-100
11. Saadi, M. T., & Sulistiadi, W. (2025). Experiential Marketing di Rumah Sakit Indonesia: Scoping Review. Jurnal Bisnis Mahasiswa, 5, 120–128. https://doi.org/10.60036/jbm.v5i1.307
12. Schmitt, B. (1999). Experiential Marketing: How to Get Customers to Sense, Feel, Think, Act, and Relate to Your Company and Brands. The Free Press.
13. Schmitt, B., Joško Brakus, J., & Zarantonello, L. (2015). From experiential psychology to consumer experience. Journal of Consumer Psychology, 25, 166–171. https://doi.org/10.1016/j.jcps.2014.09.001
14. Sofyan, M., Djuraidj Rumik, Irfan Ahmad Musadat, & Ninin Nurhidayati. (2024). View of MODERASI GENDER DALAM HUBUNGAN KUALITAS LAYANAN DAN KEPUASAN NASABAH: STUDI KASUS CUSTOMER SERVICE BANK BRI DI INDONESIA. Https://Ejournal.Unisi.Ac.Id/Index.Php/Jak/Article/View/3970/1819.
15. SOFYAN, M., RUMIKI, D., MUSADAT, I. A., & NURHIDAYATI, N. (2025). MODERASI GENDER DALAM HUBUNGAN KUALITAS LAYANAN DAN KEPUASAN NASABAH: STUDI KASUS CUSTOMER SERVICE BANK BRI DI INDONESIA. JURNAL AKUNTANSI DAN KEUANGAN, 13, 82–91. https://doi.org/10.32520/jak.v13i2.3970
16. Tsaur, S. H., & Tang, W. H. (2013). The burden of esthetic labor on front-line employees in hospitality industry. International Journal of Hospitality Management, 35, 19–27. https://doi.org/10.1016/j.ijhm.2013.04.010
17. Wardani, A., & Molekandella Boer, K. (2025). Strategi Komunikasi Pemasaran Dalam Meningkatkan Brand Awareness Pada Forthis House. https://doi.org/10.37676/professional.v12i1.8594
    a. Warhurst, C., & Nickson, D. (2009). “Who’s got the look?” emotional, aesthetic and sexualized labour in interactive services. Gender, Work and Organization, 16, 385–404. https://doi.org/10.1111/j.1468-0432.2009.00450.x

A Measurement Model for the Rise and Risk of Smartphone Addiction Among Students in Indonesia

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Abstract. Intense social media engagement may lead to psychological withdrawal symptoms when users attempt to reduce or discontinue use. Smartphone addiction has become a significant concern in the field of education, primarily due to its potential to influence students' academic performance both directly and indirectly. This study aims at developing a measurement model for the rise and risk of smartphone addiction among students in Indonesia. The sample of this study consists 346 undergraduate students from various higher education institutions across Indonesia. They evaluated their smartphone engagement and its risk by using an online survey with a 4-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). Model validation was evaluated by employing Smart PLS and it was conducted in two primary phases: evaluation of the measurement model and structural model. Based on the measurement model evaluation it can be concluded if all latent constructs in this study demonstrate strong internal reliability, with both Composite Reliability (CR) and Cronbach's Alpha values exceeding the minimum threshold. Further, the measurement model in this study has demonstrated that most of the constructs meet the requirements for discriminant validity and convergent validity.

Keywords: Measurement model, smartphone addiction, students.

INTRODUCTION

Since the emergence of social media, online interactions have significantly increased 1. By 2024, approximately 5.4 billion people—or 67% of the global population—were smartphone users. This growth is primarily driven by improved connectivity, particularly in densely populated countries such as China, India, and Bangladesh 2,3. An online survey conducted between July 2021 and February 2022 among 440 adolescents in Bangladesh revealed that 61.4% of participants met the criteria for Smartphone Addiction 4

Social media platforms are frequently utilized by adolescents as an escape from emotional stress. Those exhibiting traits of neuroticism and social anxiety are more likely to engage in excessive social media use as a coping mechanism, which often exacerbates their Smartphone dependence 5–7. Digital platforms offer increased anonymity and reduced risk of rejection, providing users with greater control over social interactions compared to face-to-face encounters 8. However, what initially functions as a coping tool often evolves into compulsive behavior with detrimental effects on psychological well-being 9. Compulsive use has been linked to heightened feelings of loneliness, emotional dependence, and digital pressure, which together diminish satisfaction in real-life social interactions 10–12.

A survey in 2023 conducted by Populix involving 1,190 Indonesian Generation Z respondents found that the most frequently reported symptoms of burnout included exhaustion (27%), feelings of worthlessness (21%), sleep difficulties (15%), depression (11%), and irritability (10%). These findings are consistent with research suggesting that excessive smartphone exposure increases academic stress and mental fatigue among students, contributing to academic burnout 13. Additionally, smartphone addiction has been associated with increased

loneliness and a growing aversion toward academic activities, further exacerbating adolescents' mental health issues 11,14.

A study by the Alvara Research Center (2021) reported that 28.3% of Indonesian adolescents experienced high levels of anxiety, which may be aggravated by excessive social media usage. Intense social media engagement may lead to psychological withdrawal symptoms when users attempt to reduce or discontinue use, thereby intensifying stress, anxiety, and depressive symptoms 15,16.

While smartphone use offers various benefits, its excessive usage—commonly referred to as Smartphone Addiction (IA)—negatively affects both physical and mental health, particularly among adolescents and working adults 1,17. The Fear of Missing Out (FOMO) frequently drives excessive engagement with social media, leading to heightened levels of stress, anxiety, depression, and neurotic tendencies 18–20. Moreover, unregulated social media use may impair academic performance by diverting attention from studies and delaying task completion 14,21,22. Media multitasking outside of academic contexts has been shown to disrupt student focus and hinder cognitive learning in classroom settings 23,24. Media multitasking impairs sustained attention, further reducing learning efficiency24. Furthermore, social media platforms—designed to maximize user engagement—may diminish creativity by promoting extrinsic motivation and distracting users from innovative thinking 25.

Research also indicates that technoference—technology-related interference—contributes to conflicts within romantic and family relationships 26–28. Excessive use of social media has been associated with decreased self-esteem, increased anxiety, and sleep disturbances, all of which adversely impact psychological well-being, social interactions, and cognitive development in adolescents 29–34. Additionally, social media addiction may heighten feelings of loneliness, increase the risk of cyberbullying, lead to academic neglect, and reduce self-control. Individuals with social media addiction are more prone to attention deficits, behavioral dysregulation, and may even exhibit withdrawal symptoms when access to platforms is restricted 15,29,35–39.

Empirical evidence indicates that excessive exposure to social media and digital entertainment can lead to technoference—technological interference that disrupts academic focus and productivity 40. This interference renders students more susceptible to academic decline and heightened anxiety due to their inability to regulate digital media usage effectively. Such disruptions may hinder the completion of structured academic tasks. Nevertheless, moderate levels of distraction can potentially enhance creativity by allowing cognitive downtime that facilitates the generation of novel ideas.

In the context of Smartphone Addiction, there is ongoing debate over whether digital technology use supports or impedes creativity by diverting attention away from deep, reflective thought 41. Research has identified a positive association between moderate distractions and increased cognitive flexibility in creative thinking 42. However, when such distractions stem from compulsive or addictive digital media use, creativity may in fact be impaired due to insufficient time for reflective and focused thinking.

Furthermore, creativity can flourish in challenging environments, but stress induced by social media addiction and Smartphone dependency may suppress innovation and reduce students' productivity 43. Therefore, it is essential to understand how digital media disruptions can exert a dual effect on creativity—acting both as a stimulus for ideation and as an impediment to sustained attention and effective problem-solving.

The theoretical model presented in the following figure illustrating the relationships among variables in this study using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach. The model comprises several key constructs, including Creativity Perseverance (CP), Procrastination (P), Laziness (L), Sustained Attention (SA), Fear of Missing Out (FOMO), Smartphone Addiction (IA), and Academic Performance (AP). Each construct is represented by specific measurement indicators which are designed to assess participants' consistency in maintaining creativity throughout the learning process.

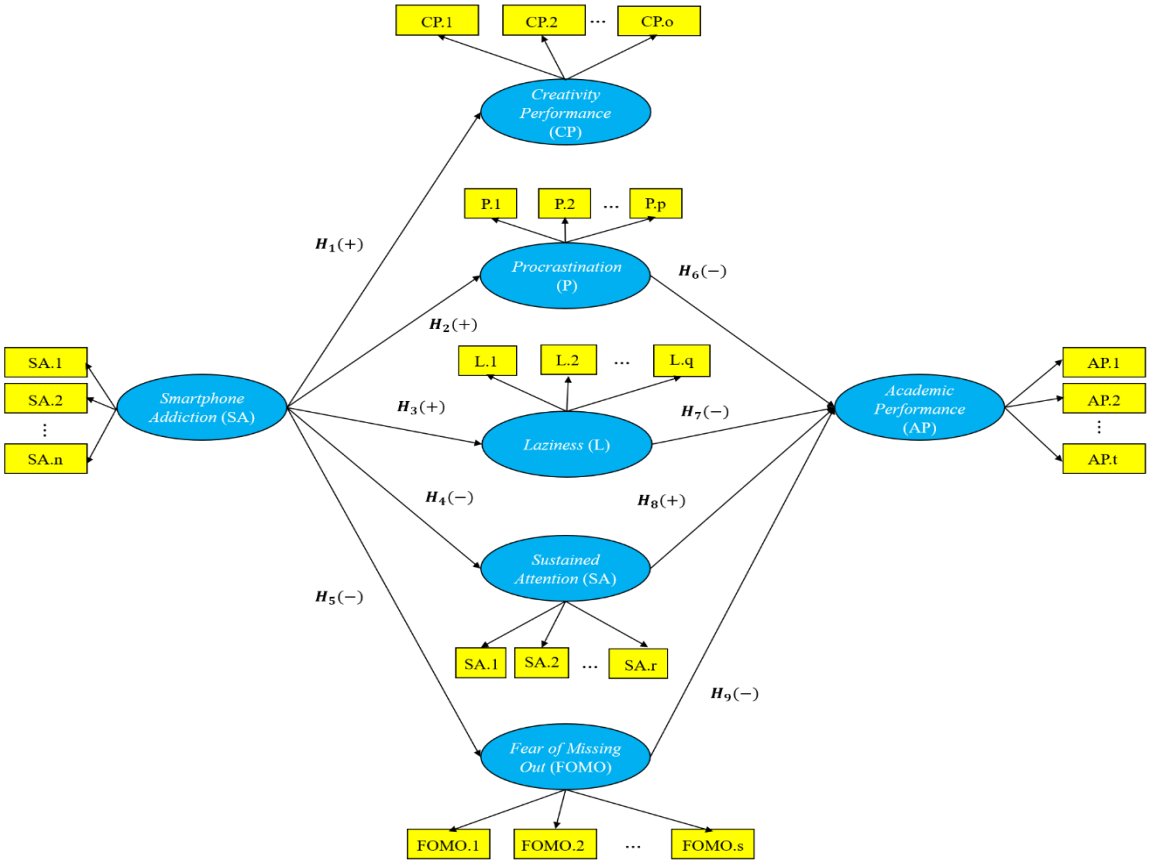

FIGURE 1. To format a figure caption, use the Microsoft Word template style: Figure Caption or Times New Roman Font: 9 pt, Centered.

Smartphone addiction has become a significant concern in the field of education, primarily due to its potential to influence students' academic performance both directly and indirectly. This study investigates how smartphone addiction affects behaviors such as procrastination, laziness, and attention retention (the ability to sustain attention), as well as its impact on academic performance.

RESEARCH METHOD

The population of this study consists of undergraduate students from various higher education institutions across Indonesia. A total of 346 students were selected as the sample using a convenience sampling technique. This method was chosen due to its exploratory nature and practicality in facilitating early data collection, which is valuable for future, more rigorous research. Although this approach has limitations in terms of generalizability, it is considered effective for preliminary studies aimed at identifying trends or initial relationships among variables.

A self-administered survey using convenience sampling was conducted with 346 Indonesian university students. The exploratory design of this study justifies the use of convenience sampling, as it provides a foundational dataset for deeper future investigations in this field. Data were collected through an online survey platform via the link https://unyku.id/KetergantunganHP2025, and participants completed the questionnaire after providing informed consent.

All variables in this study were measured using previously validated and reliable instruments. A 4-point Likert scale was employed for all items, ranging from 1 (strongly disagree) to 4 (strongly agree). Prior to administration, the instruments were translated and culturally adapted to ensure measurement accuracy and relevance within the respondents' sociolinguistic context.

Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 3 software. PLS-SEM was selected due to its robustness in handling non-normally distributed data, its suitability for complex models incorporating both formative and reflective constructs, and its ability to produce stable estimations even with small sample sizes 44. This method is also recommended for exploratory studies aimed at predicting relationships between constructs 45. Model validation was conducted in two primary phases: evaluation of the measurement model and structural model.

In the measurement model phase, reliability was assessed through Composite Reliability (CR) and Cronbach's Alpha (α), with a minimum threshold of 0.70 46. Convergent validity was confirmed through the Average Variance Extracted (AVE ≥ 0.50) 44. while discriminant validity was evaluated using both the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio, with values below 0.85 to ensure construct distinctiveness47. Common Method Variance (CMV) was minimized through both procedural (e.g., respondent anonymity) and statistical remedies, including Harman's Single Factor test (Podsakoff et al., 2012) and Full Collinearity VIF (with VIF < 3.3)48.

In the structural model phase, hypothesis testing was performed using bootstrapping with 5,000 subsamples ($p < 0.05$) 44. Predictive power was evaluated via R^2 values (e.g., $R^2 = 0.50$ for Academic Performance indicates a moderate effect) and Q^2 (predictive relevance) 49. Mediation effects of variables such as Procrastination, Laziness, Sustained Attention, and Fear of Missing Out were analyzed using the specific indirect effect approach50. Analytical results were reported with corresponding beta coefficients, t-statistics, and p-values to ensure transparency and replicability51.

RESULT

Based on the gender data analysis, as it is illustrated in Table 1, a dominant proportion of female respondents (76%) compared to males (24%). This imbalance may carry important implications for multi-group analysis, particularly concerning the stability of cross-gender comparisons. Although gender-based analysis remains feasible, the relatively small sample of male participants (n = 83) necessitates caution regarding potential variance inequality and statistical bias within the model.

TABLE 1. Respondents' Demographic Characteristics

Description	F	Percentage
Female	263	76.01%
Male	83	23.99%
Total	346	100%

Overall, the gender-based differences in this table are modest but consistent with broader psychological trends. Academic performance parity indicates that self-perception might be converging between genders, even as underlying stressors or learning strategies differ. The slightly higher smartphone addiction and FoMO in females, as well as slightly higher procrastination and sustained attention in males, reflect the changing nature of digital engagement, emotional coping, and academic workload.

Modern research emphasizes the need for gender-sensitive interventions. For example, digital literacy and attention regulation strategies might be more beneficial to female students dealing with FoMO and smartphone overuse, while goal-setting and anti-procrastination coaching may help male students improve time management. The small differences in creativity perseverance and laziness also suggest that learning environments should be structured to enhance intrinsic motivation and personalized support, rather than assuming uniform learning preferences across genders.

Table 2 presents the distribution of formal education levels. Most respondents were enrolled in Bachelor's programs (n = 236, ~68%), followed by Applied Bachelor (Diploma 4) students (n = 84). Other categories—Associate Degree (Diploma 3), Master's (S2), and Doctoral (S3)—each comprised less than 5% of the sample, indicating that the majority of participants are in a critical phase of academic and personal development. This is highly relevant to the study's focus on smartphone addiction, FOMO, and academic performance. For cross-educational-level comparisons, only the Bachelor's and D4 groups are deemed sufficiently representative; the remaining groups are statistically underpowered.

TABLE 2. Respondents' Demographic Characteristics

Description	F	Percentage
Diploma 3 (Associate Degree)	10	2,89%
Diploma 4 (Applied Degree)	84	24,28%
Bachelor's Degree (S1)	236	68,21%
Master's Degree (S2)	13	3,76%
Doctoral's Degree (S3)	3	0,87%
Total	346	100%

Table 3 shows that respondents are almost equally distributed between economics/business (n = 172) and non-economics/business majors (n = 174). This balanced distribution is advantageous for the study design, allowing for valid cross-disciplinary comparisons. Such comparisons are particularly important given the

potential variation in academic workload, digital behavior, and performance pressures across different fields, such as social sciences, engineering, or health sciences.

TABLE 3. Respondents' School Background Characteristics

Description	F	Percentage
Faculty of Economics and Business	172	49,71%
Non- Economics and Business Majors	174	50,29%
Total	346	100%

Table 4 indicates that a majority of students (n = 185) spend less than IDR 1 million per month on smartphone usage. This suggests either relatively affordable smartphone access or efficient data usage among respondents. Notably, few individuals fall into higher expense categories (> IDR 3 million), creating a skewed distribution that should be accounted for in subsequent statistical modeling to avoid underrepresenting minority classes.

TABLE 4. Average Monthly Smartphone Expense (IDR)

Description	F	Percentage
< 1,000,000	185	53.47%
1,000,000 – 2,000,000	107	30.92%
2,000,001 – 3,000,000	35	10.12%
3,000,001 – 4,000,000	8	2.31%
4,000,001 – 5,000,000	3	0.87%
> 5,000,000	8	2.31%
< 1,000,000	185	53.47%
1,000,000 – 2,000,000	107	30.92%
2,000,001 – 3,000,000	35	10.12%
3,000,001 – 4,000,000	8	2.31%
4,000,001 – 5,000,000	3	0.87%
> 5,000,000	8	2.31%
Total	346	100%

Table 5 highlights that nearly all respondents use the smartphone for more than 4 hours per day, with a majority (n = 194) exceeding 6 hours daily. This suggests intense digital engagement, potentially related to academic, social, or entertainment needs. Only a small number (n = 5) reported less than 2 hours of daily use, again indicating a highly imbalanced class distribution. These disparities must be carefully considered in advanced modeling, especially when using sensitive algorithms such as statistical or machine learning techniques.

TABLE 5. Daily Smartphone Usage Duration

Description	F	Percentage
< 2 hours	5	1.45%
2 – 4 hours	29	8.38%
4 – 6 hours	104	30.06%
> 6 hours	194	56.07%
Total	346	100%

The evaluation of the measurement model is a critical step in structural equation modeling (SEM), particularly in variance-based approaches such as Partial Least Squares Structural Equation Modeling (PLS-SEM). The primary objective of this evaluation is to ensure that the latent constructs are measured reliably and validly. Internal reliability is assessed using Cronbach's Alpha and Composite Reliability (CR), where values exceeding 0.70 indicate acceptable consistency among indicators measuring the same construct44. Convergent validity is evaluated using the Average Variance Extracted (AVE), with a minimum threshold of 0.50, suggesting that more than 50% of the variance in the indicators is captured by the associated latent construct 46. The results of the reliability and convergent validity tests for each construct are presented in Table 6.

TABLE 6. Internal Consistency and Reliability and Connvergent Validity

Latent Construct	Items	Loadings	AVE*	CR*	Cronbsch's Alpha
Smartphone Addiction (SAD	SAD1	0.538	0,375	0,853	0,810
	SAD2	0.655			
	SAD3	0.495			
	SAD4	0.441			

	SAD5	0.448			
	SAD6	0.686			
	SAD7	0.729			
	SAD8	0.720			
	SAD9	0.622			
	SAD10	0.655			
Creativity Performance (CP)	CP1	0.662	0.438	0.921	0.914
	CP2	0.687			
	CP3	0.562			
	CP4	0.655			
	CP5	0.585			
	CP6	0.674			
	CP7	0.664			
	CP8	0.712			
	CP9	0.641			
	CP10	0.687			
	CP11	0.562			
	CP12	0.655			
	CP13	0.585			
	CP14	0.674			
	CP15	0.664			
Procrastination (PR)	PR1	0.724	0.415	0.901	0.880
	PR2	0.541			
	PR3	0.603			
	PR4	0.653			
	PR5	0.630			
	PR6	0.768			
	PR7	0.778			
	PR8	0.767			
	PR9	0.613			
	PR10	0.541			
	PR11	0.603			
	PR12	0.653			
	PR13	0.653			
Laziness (LZ)	LZ1	0.745	0.501	0.938	0.931
	LZ2	0.727			
	LZ3	0.667			
	LZ4	0.755			
	LZ5	0.679			
	LZ6	0.760			
	LZ7	0.676			
	LZ8	0.616			
	LZ9	0.674			
	LZ10	0.727			
	LZ11	0.667			
	LZ12	0.755			
	LZ13	0.679			
	LZ14	0.760			
	LZ15	0.676			
Sutained Attention (SAT)	SAT1	0.611	0.555	0.881	0.839
	SAT2	0.713			
	SAT3	0.827			
	SAT4	0.781			
	SAT5	0.753			

	SAT6	0.767			
FOMO	FOMO1	0.731	0.470	0.897	0.873
	FOMO2	0.624			
	FOMO3	0.769			
	FOMO4	0.782			
	FOMO5	0.787			
	FOMO6	0.647			
	FOMO7	0.644			
	FOMO8	0.726			
	FOMO9	0.585			
	FOMO10	0.624			
Academic Performance (AP)	AP1	0.743	0.493	0.926	0.913
	AP2	0.752			
	AP3	0.671			
	AP4	0.675			
	AP5	0.726			
	AP6	0.724			
	AP7	0.762			
	AP8	0.761			
	AP9	0.591			
	AP10	0.752			
	AP11	0.671			
	AP12	0.675			
	AP13	0.726			

Note: AVE: Average Values Extracted; CR; Composite Reliability

Based on the results of the measurement model evaluation presented in Table 6, all latent constructs in this study demonstrate strong internal reliability, with both Composite Reliability (CR) and Cronbach's Alpha values exceeding the minimum threshold of 0.70. This indicates that the indicators within each construct exhibit high internal consistency44.

TABLE 7. Discriminant Vailidity with Fornell-Larker Criterion Analysis

Latent Construct	AP	CP	FOMO	LZ	PR	SAD	SAT
Academic Performance (AP)	0.702						
Creativity Performance (CP)	0.637	0.662					
FOMO	-0.067	0.031	0.686				
Laziness (LZ)	0.282	0.232	-0.055	0.708			
Procrastination (PR)	0.240	0.187	0.014	0.665	0.645		
Smartphone Addiction (SAD)	-0.159	-0.159	0.415	-0.202	-0.165	0.613	
Sustained Attention (SAT)	0.473	0.405	-0.035	0.367	0.346	-0.217	0.745

Based on the results of the discriminant validity analysis using the Fornell-Larcker criterion, as presented in Table 7, it can be concluded that most of the constructs meet the requirements for discriminant validity. This is proven by the square root of the AVE values (displayed along the diagonal of the table), which are consistently higher than the correlations between the respective constructs and all other constructs in the same row and column. For instance, the construct Sustained Attention (SAT) has a AVE value of 0.745, which exceeds its correlations with other constructs such as Smartphone Addiction (–0.217), Laziness (0.367), and Academic Performance (0.473). A similar pattern is observed for Creativity Performance (CP), which shows a √AVE of 0.662, higher than its correlations with other constructs. These findings suggest that each construct possesses a sufficient degree of uniqueness and can be empirically distinguished from one another, in accordance with the guidelines proposed by 46. Therefore, it can be concluded that the measurement model in this study has demonstrated adequate discriminant validity.

Following the Fornell-Larcker discriminant validity assessment in Table 8, a cross-loading analysis was also conducted to further strengthen the evidence that each indicator predominantly reflects its intended construct more than any other. This approach serves as an additional method commonly used in Partial Least Squares (PLS) analysis to assess discriminant validity, where each indicator is expected to have a higher loading on its associated construct than on others44. The full results of the cross-loading analysis are presented in Table 8, providing a more detailed view of the strength of each item's relationship with all constructs tested in the model.

TABLE 7. Cross-loading analysis and discriminant validity evaluation

	AP	CP	FOMO	LZ	PR	SAD	SAT
AP1	0.743	0.458	-0.054	0.244	0.192	-0.152	0.342
AP10	0.752	0.473	-0.054	0.207	0.152	-0.168	0.415
AP11	0.671	0.536	-0.100	0.122	0.085	-0.132	0.256
AP12	0.675	0.528	-0.082	0.113	0.165	-0.134	0.356
AP13	0.726	0.529	-0.039	0.139	0.132	-0.019	0.305
AP2	0.724	0.424	-0.083	0.181	0.171	-0.142	0.291
AP3	0.762	0.465	-0.046	0.184	0.126	-0.087	0.394
AP4	0.761	0.530	-0.030	0.245	0.242	-0.145	0.346
AP5	0.591	0.355	-0.075	0.237	0.176	-0.106	0.266
AP6	0.663	0.308	-0.056	0.175	0.131	-0.026	0.272
AP7	0.717	0.426	-0.038	0.240	0.159	-0.078	0.343
AP8	0.698	0.406	0.014	0.250	0.218	-0.136	0.353
AP9	0.617	0.365	0.009	0.213	0.220	-0.099	0.310
CP1	0.481	0.662	0.001	0.250	0.114	-0.089	0.253
CP10	0.509	0.687	0.058	0.107	0.088	-0.074	0.262
CP11	0.363	0.562	0.011	0.109	0.057	-0.041	0.110
CP12	0.459	0.655	0.010	0.162	0.064	-0.056	0.243
CP13	0.462	0.585	0.101	0.196	0.107	0.001	0.283
CP14	0.405	0.674	0.003	0.188	0.140	-0.120	0.307
CP15	0.426	0.664	0.040	0.124	0.107	-0.117	0.251
CP2	0.480	0.712	0.041	0.159	0.053	-0.084	0.315
CP3	0.461	0.641	0.014	0.213	0.202	-0.060	0.254
CP4	0.388	0.678	-0.024	0.187	0.131	-0.126	0.342
CP5	0.400	0.737	0.010	0.123	0.106	-0.132	0.280
CP6	0.427	0.751	0.019	0.133	0.185	-0.185	0.269
CP7	0.410	0.622	0.050	0.163	0.121	-0.071	0.280
CP8	0.489	0.631	0.093	0.166	0.224	-0.054	0.269
CP9	0.528	0.639	0.068	0.142	0.157	-0.019	0.364
FOMO1	-0.084	-0.018	0.731	-0.089	-0.059	0.308	-0.089
FOMO10	0.019	0.083	0.624	0.018	0.073	0.238	0.005
FOMO2	-0.078	-0.031	0.769	-0.088	-0.021	0.317	-0.114
FOMO3	-0.115	-0.050	0.782	-0.113	-0.032	0.318	-0.039
FOMO4	-0.154	-0.070	0.787	-0.091	-0.004	0.293	-0.029
FOMO5	0.009	0.078	0.647	0.015	0.029	0.254	0.023
FOMO6	-0.063	0.046	0.644	0.008	0.004	0.300	0.038
FOMO7	-0.007	0.060	0.726	-0.028	0.039	0.293	-0.027
FOMO8	0.039	0.078	0.585	0.011	0.074	0.314	0.011
FOMO9	0.105	0.184	0.505	0.099	0.051	0.134	0.052
LZ1	0.230	0.185	0.006	0.745	0.526	-0.206	0.264
LZ10	0.241	0.191	-0.071	0.727	0.539	-0.194	0.366
LZ11	0.154	0.154	-0.034	0.667	0.313	-0.038	0.147
LZ12	0.232	0.242	-0.036	0.755	0.391	-0.083	0.243
LZ13	0.098	0.077	-0.057	0.679	0.415	-0.132	0.225
LZ14	0.167	0.133	-0.044	0.760	0.390	-0.096	0.172
LZ15	0.139	0.130	0.011	0.676	0.391	-0.081	0.200
LZ2	0.266	0.224	0.012	0.616	0.537	-0.184	0.365
LZ3	0.140	0.170	-0.068	0.674	0.452	-0.174	0.216
LZ4	0.186	0.116	-0.040	0.753	0.601	-0.189	0.302
LZ5	0.247	0.203	-0.029	0.714	0.597	-0.200	0.335
LZ6	0.206	0.124	-0.065	0.709	0.424	-0.118	0.243
LZ7	0.086	0.064	-0.071	0.663	0.311	-0.038	0.145
LZ8	0.251	0.168	-0.078	0.800	0.499	-0.109	0.247
LZ9	0.122	0.126	-0.055	0.656	0.305	-0.084	0.133
PR1	0.182	0.142	-0.039	0.484	0.724	-0.135	0.282
PR10	0.042	0.072	0.054	0.248	0.541	-0.096	0.231
PR11	0.101	0.145	0.040	0.337	0.603	-0.149	0.198
PR12	0.245	0.175	-0.027	0.428	0.653	-0.071	0.233

PR13	0.066	0.019	0.006	0.427	0.630	-0.156	0.230
PR2	0.217	0.150	0.067	0.474	0.768	-0.121	0.256
PR3	0.247	0.161	0.055	0.513	0.778	-0.064	0.275
PR4	0.170	0.129	-0.017	0.497	0.767	-0.102	0.306
PR5	0.130	0.083	-0.010	0.491	0.613	-0.101	0.247
PR6	0.114	0.110	0.011	0.520	0.519	-0.037	0.164
PR7	0.082	0.054	0.000	0.529	0.596	-0.116	0.188
PR8	0.098	0.114	0.062	0.178	0.503	-0.164	0.149
PR9	0.145	0.132	-0.070	0.449	0.603	-0.095	0.110
SAD1	-0.113	-0.116	0.195	-0.177	-0.135	0.538	-0.164
SAD10	-0.172	-0.161	0.218	-0.158	-0.117	0.655	-0.125
SAD2	-0.061	-0.071	0.246	-0.151	-0.148	0.495	-0.077
SAD3	-0.085	-0.114	0.176	-0.101	-0.057	0.441	-0.034
SAD4	0.031	-0.021	0.122	-0.038	0.021	0.448	-0.068
SAD5	-0.088	-0.060	0.204	-0.127	-0.102	0.686	-0.183
SAD6	-0.129	-0.105	0.378	-0.128	-0.088	0.729	-0.094
SAD7	-0.139	-0.166	0.330	-0.155	-0.088	0.720	-0.193
SAD8	-0.023	-0.037	0.340	-0.067	-0.034	0.622	-0.098
SAD9	-0.106	-0.073	0.227	-0.087	-0.192	0.696	-0.231
SAT1	0.234	0.194	-0.023	0.310	0.331	-0.154	0.611
SAT2	0.281	0.216	-0.048	0.306	0.350	-0.205	0.713
SAT3	0.403	0.351	0.021	0.305	0.301	-0.198	0.827
SAT4	0.366	0.309	-0.003	0.267	0.215	-0.149	0.781
SAT5	0.391	0.381	-0.001	0.265	0.185	-0.124	0.753
SAT6	0.400	0.320	-0.106	0.216	0.213	-0.149	0.767

In this context, Figure 1 provides a comprehensive illustration of the measurement model results, visualizing the relationships among latent variables and their respective indicators. It is evident that smartphone addiction has a negative direct path to procrastination (–0.159), laziness (–0.202), and sustained attention (–0.217), but a positive relationship with FOMO (0.415). The factor loadings for each indicator also demonstrate that the constructs meet the criteria for convergent validity, with most loading values exceeding 0.6. Additionally, the relationships between these variables and academic performance are clearly depicted. Laziness is negatively associated with academic performance (–0.111), whereas sustained attention shows a strong positive effect (0.423). This suggests that the ability to maintain attention plays a crucial role in supporting academic performance, even in the presence of negative influences such as smartphone addiction.

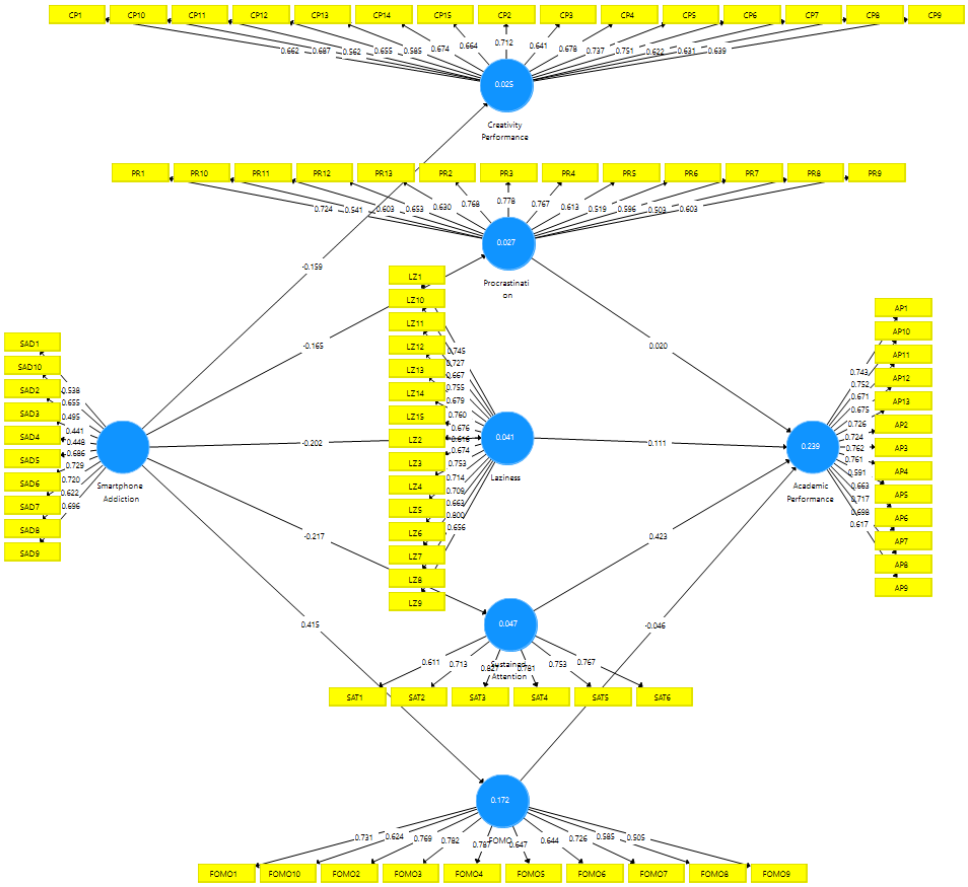

FIGURE 2. Measurement Model for Smartphone Addiction

The data indicates that academic and psychological maturity tend to increase with educational level, as evidenced by improvements in academic performance, creativity perseverance, and reduced laziness, FoMO, and smartphone addiction. However, the rise in procrastination at S2 and S3 levels suggests that even highly educated students are not immune to motivational delays, possibly due to more complex and less structured academic tasks, such as thesis work and independent research.

This highlights the importance of targeted interventions not just for lower-level students but also for postgraduate learners. For instance, graduate students may benefit from coaching in time management and emotional regulation, while undergraduate students may need more support in reducing smartphone dependence and increasing engagement. Educational institutions should promote self-regulated learning strategies and digital well-being education across all academic levels, adapting the approach based on developmental and cognitive readiness.

The data suggests that FEB students generally show stronger academic self-perceptions, better focus, and higher perseverance, possibly due to structured learning, employability orientation, and performance culture. However, they also report higher perceived laziness, which may indicate academic pressure or self-critical thinking. In contrast, Non-FEB students appear more vulnerable to FoMO and smartphone addiction, possibly due to greater social reliance or unstructured academic demands. These findings suggest differentiated strategies for improvement:

a. FEB students may benefit from stress management, workload balance, and intrinsic motivation enhancement.
b. Non-FEB students may need support in digital literacy, distraction control, and FoMO-reduction interventions, such as mindfulness training or tech-break planning. Both groups would benefit from structured time management workshops and anti-procrastination coaching, as procrastination remains a common barrier.

TABLE 7. Discriminant Vailidity with Fornell-Larker Criterion Analysis

Latent Construct		AP	CP	FOMO	LZ	PR	SAD	SAT
		Mean	Mean	Mean	Mean	Mean	Mean	Mean
Duration Accessing smartphone	< 2 Hours	42	49	29	33	16	26	25
	2 - < 4 Hours	41	46	36	44	17	21	22
	4 - < 6 Hours	41	48	36	45	17	23	24
	=> 6 Hours	41	47	35	45	16	23	25
First Year Accessing Smartphone	< 10 Years	42	48	34	44	16	23	26
	10 - 15 Years	41	47	35	45	17	23	24
	16 - 20 Years	41	47	37	45	17	22	23
	> 20 Years	35	41	36	39	16	21	27
Application Accessed	Socmed	41	47	35	44	16	23	25
	Game	39	45	35	43	18	27	26
	Chatting	42	49	36	44	18	22	24
	Browsing	44	52	41	50	19	21	21
	Other	41	48	35	43	16	22	24

The table presents how the duration since first accessing the smartphone (categorized as <10 years, 10–15 years, 16–20 years, and >20 years) correlates with mean scores on seven key variables: Academic Performance, Creativity Perseverance, Procrastination, Laziness, Sustained Attention, Fear of Missing Out (FoMO), and Smartphone Addiction. Students who first accessed the smartphone less than 10 years ago demonstrate the highest academic performance (42) and creativity perseverance (48), along with relatively low procrastination (34) and moderate levels of laziness (44). These students also report higher smartphone addiction (26) and FoMO (23). This group likely represents younger digital natives, who use the smartphone effectively for learning and creativity but may also be highly dependent on their smartphones. These results support 52,53, who found that younger students benefit academically from digital tools but are also vulnerable to distraction and overuse.

The 10–15 years group has slightly lower academic performance (41) and creativity (47), with a slight increase in procrastination and laziness. This middle group reflects a transitional cohort—possibly early millennials—who show a balance between digital fluency and some emerging problematic behaviors. Interestingly, FoMO and smartphone addiction are slightly lower (23 and 24), possibly due to more matured digital coping mechanisms. In the 16–20 years group, procrastination peaks at 37, and laziness remains elevated (45), even as academic performance remains flat (41). This suggests that earlier and longer exposure to the smartphone might increase task avoidance tendencies. Research by54 and 55 supports this, indicating that individuals with prolonged exposure to digital media often develop habits of instant gratification that undermine sustained academic effort.

For those who accessed the smartphone more than 20 years ago, scores significantly drop across academic performance (35) and creativity (41), while procrastination (36) and smartphone addiction (27) remain high. Laziness is also lower (39), perhaps due to age-related factors or more structured daily routines. This group likely includes older or non-traditional students, whose early smartphone exposure was less academically integrated and possibly more recreational or passive. The high smartphone addiction score here suggests long-term habitual use patterns. Studies like56,57show that smartphone overuse can persist across age groups and is influenced by long-term digital habits.

The data shows a clear pattern where minimal daily smartphone usage (<2 hours) is associated with the lowest procrastination and laziness, and highest academic performance and creativity. However, paradoxically, this group also reports higher FoMO and smartphone addiction, possibly due to feeling "left out" of social or academic digital spaces. On the other hand, students with moderate usage (2–<6 hours) show balanced outcomes—slightly worse in performance and discipline, but lower FoMO, suggesting better social connectivity. Excessive users (≥6 hours) maintain stable academic scores but show elevated procrastination, laziness, and smartphone dependency, highlighting risks of digital overexposure.

Overall, the data reveals a U-shaped relationship: both very recent and very early smartphone users display higher smartphone addiction and FoMO, though for different reasons. Recent users might be more socially dependent and immersed in constant connectivity, while long-term users may have developed entrenched digital behaviors. Interestingly, academic performance and creativity decline in the longest-exposed group, indicating that digital saturation over time may erode some cognitive and performance-related behaviors, particularly if not coupled with digital literacy education or intentional academic use.

These findings suggest the importance of targeted digital literacy programs. Younger students may need support to manage screen time and emotional dependency (e.g., FoMO), while older students might benefit from restructuring digital habits and increasing awareness of productive smartphone use. Educators and counsellors

should consider the timeline of digital exposure when designing interventions for focus, academic motivation, and technology wellness.

CONCLUSION

Based on the measurement model evaluation, it can be concluded that all latent constructs in this study exhibit strong internal reliability, as indicated by Composite Reliability (CR) and Cronbach's Alpha values exceeding the minimum threshold of 0.70. Furthermore, most constructs satisfy the requirements for discriminant validity, demonstrated by the square root of the Average Variance Extracted (AVE) values—presented along the diagonal of the correlation matrix—which consistently surpass the correlations between each construct and all other constructs in the corresponding rows and columns. Convergent validity is also established, as evidenced by satisfactory factor loadings for each indicator. Overall, these results confirm that the relationships between the constructs and academic performance are well-defined and empirically supported.

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REFERENCES

1 R.N. Ammunje, M. Prabhu H, and G. Barkur, "Smartphones and academic performance: evidence from India," Interact. Technol. Smart Educ. 20(2), 161–176 (2023).
2 DemandSage, "DemandSage," (2024).
3 G.S. internet usage Estimates., "No Title.," (2023).
4 M.R. Islam, A.A. Mondol, R. Kundu, J.A. Baroi, S. Akter, T.J. Urmi, A.S.M. Roknuzzaman, M.A. Hossain, M.M. Parves, and H.B.M. Omer, "Prevalence, associated factors and consequence of problematic smartphone use among adolescents and young adults in Bangladesh: A cross-sectional study," PLoS One 19(8), e0308621 (2024).
5 H. Wu, H. Wu, I. Chen, and H. Chen, "Exploring the critical influential factors of creativity for college students : A multiple criteria decision-making approach," 11, 1–21 (2014).
6 F.F. Wei, Y.K. Wang, and W. Fass, "Computers in Human Behavior An experimental study of online chatting and notetaking techniques on college students ' cognitive learning from a lecture," 34, 148–156 (2014).
7 D. Blackwell, C. Leaman, R. Tramposch, C. Osborne, and M. Liss, "Extraversion, neuroticism, attachment style and fear of missing out as predictors of social media use and addiction," Pers. Individ. Dif. 116, 69–72 (2017).
8 N. Dabbagh, and A. Kitsantas, "Personal Learning Environments, Social Media, and Self-Regulated Learning: A Natural Formula for Connecting Formal and Informal Learning," Internet High. Educ. 15, 3–8 (2012).
9 É. Duke, and C. Montag, "Smartphone Addiction and Beyond: Initial Insights on an Emerging Research Topic and Its Relationship to Internet Addiction," 359–372 (2017).
10 R.J. Dwyer, K. Kushlev, and E.W. Dunn, "Smartphone use undermines enjoyment of face-to-face social interactions," J. Exp. Soc. Psychol. 78, 233–239 (2018).
11 İ. Yalçın, B. Özkurt, M. Özmaden, and R. Yağmur, "Effect of smartphone addiction on loneliness levels and academic achievement of z generation," Int. J. Psychol. Educ. Stud. 7(1), 208–214 (2020).
12 R. Ruzoli, L. Magistrati, C. Viganò, S. Conte, L.A. Osborne, and P. Reed, "Social media users potentially experience different withdrawal symptoms to non-social media users," Int. J. Ment. Health Addict. 21, 411–417 (2023).
13 R. Hartati, M. Muthoifin, and M. Jinan, "Smartphones and the Effect of Its Use in Early Children on Students' Learning Interest," Profetika J. Stud. Islam 24(01), 149–158 (2023).
14 E. Kutluay, and F. Karaca, "A model proposal explaining the influence of smartphone addiction related factors on high school students' academic success," Educ. Inf. Technol. 30(3), 4061–4098 (2025).
15 R. Truzoli, L. Magistrati, C. Viganò, S. Conte, L.A. Osborne, and P. Reed, "Social media users potentially experience different withdrawal symptoms to non-social media users," Int. J. Ment. Health Addict. 21, 411–417 (2023).
16 S. Guz, H.K. Hecht, S.K. Kattari, and E.B.G. Emily, "A Scoping Review of Empirical Asexuality Research in Social Science Literature," Arch. Sex. Behav. 51(4), 2135–2145 (2022).

17 R.A. Mosharrafa, T. Akther, and F.K. Siddique, "Impact of social media usage on academic performance of university students: Mediating role of mental health under a cross-sectional study in Bangladesh," Heal. Sci. Reports 7(1), (2024).
18 C.F. Yen, T.C. Tang, J.Y. Yen, H.C. Lin, C.F. Huang, S.C. Liu, and C.H. Ko, "Symptoms of problematic cellular phone use, functional impairment and its association with depression among adolescents in Southern Taiwan," J. Adolesc. 32(4), 863–873 (2009).
19 A. V Rodrigues, N.W. Moriarty, R. Kakumanu, A. DeGiovanni, J.H. Pereira, J.W. Gin, Y. Chen, E.E.K. Baidoo, C.J. Petzold, and P.D. Adams, "Characterization of lignin-degrading enzyme PmdC, which catalyzes a key step in the synthesis of polymer precursor 2-pyrone-4, 6-dicarboxylic acid," J. Biol. Chem. 300(10), (2024).
20 X. Lu, J. Watanabe, Q. Liu, M. Uji, M. Shono, and T. Kitamura, "Internet and mobile phone text-messaging dependency: Factor structure and correlation with dysphoric mood among Japanese adults," Comput. Human Behav. 27(5), 1702–1709 (2011).
21 R.W. Kubey, M.J. Lavin, and J.R. Barrows, "Internet use and collegiate academic performance decrements: Early findings," J. Commun. 51(2), 366–382 (2001).
22 M. Owusu-Acheaw, and A.G. Larson, "Use of social media and its impact on academic performance of tertiary institution students: A study of students of Koforidua Polytechnic, Ghana," J. Educ. Pract. 6, 94–101 (2015).
23 F.-Y.F. Wei, Y.K. Wang, and M. Klausner, "Rethinking college students' self-regulation and sustained attention: Does text messaging during class influence cognitive learning?," Commun. Educ. 61(3), 185–204 (2012).
24 M. İmren, and H.G. Tekman, "The relationship between media multitasking, working memory and sustained attention," Uludağ Üniversitesi Fen-Edebiyat Fakültesi Sos. Bilim. Derg. 20, 1075–1100 (2019).
25 M. Runco, "The real creativity crisis," Creat. Hum. Dev., (2015).
26 L.M. Padilla-Walker, S.M. Coyne, and A.M. Fraser, "Getting a High-Speed Family Connection: Associations Between Family Media Use and Family Connection," Fam. Relat. 61(3), 426–440 (2012).
27 B.T. McDaniel, A.M. Galovan, J.D. Cravens, and M. Drouin, "'Technoference' and implications for mothers' and fathers' couple and coparenting relationship quality," Comput. Human Behav. 80, 303–313 (2018).
28 L.A. Stockdale, S.M. Coyne, and L.M. Padilla-Walker, "Parent and Child Technoference and socioemotional behavioral outcomes: A nationally representative study of 10- to 20-year-Old adolescents," Comput. Human Behav. 88, 219–226 (2018).
29 C.N.L. Tan, M.A. Fauzi, and A.O. Ojo, "Predictors of the dependence on smartphones: the neglect of studies among Muslim students," Glob. Knowledge, Mem. Commun. 72, 920–935 (2023).
30 H.C. Woods, and H. Scott, "#Sleepyteens: Social media use in adolescence is associated with poor sleep quality, anxiety, depression and low self-esteem," J. Adolesc. 51, 41–49 (2016).
31 N.J. Sabik, J. Falat, and J. Magagnos, "When Self-Worth Depends on Social Media Feedback: Associations with Psychological Well-Being," Sex Roles 82(7–8), 411–421 (2020).
32 E.A. Vogel, J.P. Rose, L.R. Roberts, and K. Eckles, "Social comparison, social media, and self-esteem," Psychol. Pop. Media Cult. 3, 206–222 (n.d.).
33 T.P. Alloway, J. Horton, and R.G. Alloway, "Social networking sites and cognitive abilities: Do they make you smarter?," Comput. Educ. 63, 10–16 (2013).
34 B. Keles, N. McCrae, and A. Grealish, "A systematic review: the influence of social media on depression, anxiety and psychological distress in adolescents," Int. J. Adolesc. Youth 25(1), 79–93 (2020).
35 A.T. Stephen, "The role of digital and social media marketing in consumer behavior," Curr. Opin. Psychol. 10, 17–21 (2016).
36 E. Marttila, A. Koivula, and P. Räsänen, "Does excessive social media use decrease subjective well-being? A longitudinal analysis of the relationship between problematic use, loneliness and life satisfaction," Telemat. Informatics 59(December 2020), 1–11 (2021).
37 E. Whittaker, and R.M. Kowalski, "Cyberbullying Via Social Media," J. Sch. Violence 14(1), 11–29 (2015).
38 H. Zhang, M. Dong, and X. Zhang, "Unraveling the mechanism of social media application addiction among college students: the moderating role of self-regulation," Asia Pacific J. Mark. Logist., (2024).
39 M.-H. Chiang, and L.-L. Liu, "Need factors and preoccupation among mobile social media users," Int. J. Mob. Commun. 23(1), 1–23 (2024).
40 N.S. Bauer, "Technoference over time and parenting," (April), 1–2 (2018).
41 M. Csikszentmihalyi, "Flow and the psychology of discovery and invention," HarperPerennial, New York 39, 1–16 (1997).
42 S. Da Costa, D. Páez, F. Sánchez, M. Garaigordobil, and S. Gondim, "Personal factors of creativity: A second order meta-analysis," Rev. Psicol. Del Trab. y Las Organ. 31(3), 165–173 (2015).

43 A. Inam, J.A. Ho, H. Zafar, U. Khan, A.A. Sheikh, and U. Najam, "Fostering Creativity and Work Engagement Through Perceived Organizational Support: The Interactive Role of Stressors," SAGE Open 11(3), (2021).
44 J.F. Hair, J.J. Risher, M. Sarstedt, and C.M. Ringle, "When to use and how to report the results of PLS-SEM," Eur. Bus. Rev. 31(1), 2–24 (2019).
45 M. Sarstedt, C.M. Ringle, and J.F. Hair, "Partial least squares structural equation modeling," in Handb. Mark. Res., (Springer, 2021), pp. 587–632.
46 C. Fornell, and D.F. Larcker, "Evaluating structural equation models with unobservable variables and measurement error," J. Mark. Res. 18(1), 39–50 (1981).
47 J. Henseler, C.M. Ringle, and M. Sarstedt, "A new criterion for assessing discriminant validity in variance-based structural equation modeling," J. Acad. Mark. Sci. 43(1), 115–135 (2015).
48 N. Kock, "Common method bias in PLS-SEM: A full collinearity assessment approach," Int. J. e-Collaboration 11(4), 1–10 (2015).
49 G. Shmueli, M. Sarstedt, J.F. Hair, J.-H. Cheah, H. Ting, S. Vaithilingam, and C.M. Ringle, "Predictive model assessment in PLS-SEM: guidelines for using PLSpredict," Eur. J. Mark. 53(11), 2322–2347 (2019).
50 C. Nitzl, J.L. Roldan, and G. Cepeda, "Mediation analysis in partial least squares path modeling: Helping researchers discuss more sophisticated models," Ind. Manag. Data Syst. 116(9), 1849–1864 (2016).
51 G.C. Carrión, C. Nitzl, and J.L. Roldán, "Mediation analyses in partial least squares structural equation modeling: Guidelines and empirical examples," in Partial Least Squares Path Model. Basic Concepts, Methodol. Issues Appl., (Springer, 2017), pp. 173–195.
52 R. Junco, "The relationship between frequency of Facebook use, participation in Facebook activities, and student engagement," Comput. Educ. 58(1), 162–171 (2012).
53 A. Lepp, J.E. Barkley, and A.C. Karpinski, "The relationship between cell phone use, academic performance, anxiety, and satisfaction with life in college students," Comput. Human Behav. 31, 343–350 (2014).
54 K.B. Steel, P., & Klingsieck, "Procrastination and self-regulation failure: An overview of recent insights," Soc. Personal. Psychol. Compass 10(5), 298–312. (2016).
55 D. Rozgonjuk, K. Saal, and K. Täht, "Problematic smartphone use, deep and surface approaches to learning, and social media use in lectures," Int. J. Environ. Res. Public Health 15(1), 92 (2018).
56 C. Montag, and H.-J. Rumpf, "The potential of digital phenotyping and mobile sensing for psycho-diagnostics of internet use disorders," Curr. Addict. Reports 8(3), 422–430 (2021).
57 J.D. Elhai, H. Yang, D. McKay, and G.J.G. Asmundson, "COVID-19 anxiety symptoms associated with problematic smartphone use severity in Chinese adults," J. Affect. Disord. 274, 576–582 (2020).

Women Farmers' Groups as Contextual Learning Resources: Strengthening Experiential Learning in the Community Economy Course

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Abstract. This study aims to analyze the utilization of Women Farmers' Groups (KWT) as contextual learning resources to support the implementation of experiential learning in the community Economy course. The research employed a descriptive quantitative approach supported by qualitative data, involving 178 students of the Faculty of Economics and Business, Yogyakarta State University as respondents. Data were collected through questionnaires, observations, interviews, and documentation. The research instrument was proven highly reliable (Cronbach's Alpha = 0.978) with 83 out of 84 items valid. The findings reveal that student participation in KWT activities strengthened the connection between theory and practice, with high achievement in the stages of concrete experience (4.35) and reflective observation (4.12). The stage of abstract conceptualization (4.05) indicated students' ability to link experiences with theoretical frameworks, while active experimentation (3.87) was relatively lower, suggesting the need for further guidance to foster innovation. Challenges identified include limited access to KWT financial data (42%) and students' lack of confidence in field communication (28%). Overall, KWT-based learning not only enhanced students' understanding of community economy practices but also fostered greater interest in the agricultural sector (+19.1%) and orientation toward agribusiness (+16.5%). This study affirms that community-based contextual learning is an effective strategy to improve the quality of economics education in higher education while simultaneously supporting the empowerment of local farming communities.

Keywords: experiential learning, contextual learning, Women Farmers' Groups, community economy, higher education

INTRODUCTION

The agricultural sector holds a fundamental role in Indonesia's economy, not only as a provider of food but also as a major source of employment and a foundation of rural livelihoods. Despite its strategic role, recent data indicate a 7.5% decline in the number of farmers between 2013 and 2023 (Susilowati, 2016)[1]. This trend is highly concerning as it threatens the sustainability of national food production and increases dependence on food imports.

Several structural and cultural factors contribute to this phenomenon. The conversion of agricultural land into non-agricultural use due to urbanization and infrastructure development has reduced productive land area (Ismail et al., 2018)[2]. In addition, many young people perceive farming as a low-status and economically unpromising occupation, creating a generational gap in agricultural succession (Putrayasa, Sukarsa, & Kencana, 2021)[3]. The reluctance of youth to pursue agriculture poses serious risks to food security and rural development strategies in Indonesia.

Beyond socio-cultural perceptions, structural challenges also hinder agricultural productivity. Limited access to technology, innovation, and financial capital makes it difficult for farmers to compete in the global market. Although modern technologies such as crop-monitoring drones, smart irrigation systems, and digital platforms for farm data management are available, adoption in Indonesia remains low due to high costs and limited training opportunities (Syahyuti, 2020)[4]. Barriers to financing further exacerbate the situation, as smallholder farmers struggle to access affordable credit, slowing agricultural innovation and weakening national food sovereignty (Haryono, 2019)[5].

Addressing these multidimensional challenges requires agricultural regeneration as a key agenda. One fundamental step is to reshape youth perceptions of agriculture through education. Higher education institutions

play a central role in providing learning experiences that link theory with field practice. In this context, the integration of community-based agricultural organizations into curricula becomes an effective strategy to foster student interest while simultaneously empowering them.

One strategic community-based organization is the Women Farmers' Group (Kelompok Wanita Tani/KWT). KWT functions as a platform for rural women's empowerment, actively engaged in agricultural production, product processing, and microenterprises. Its roles include increasing women's contributions in agriculture, strengthening household economies, building social solidarity, and transferring skills and knowledge (Ardiani & Dibyorini, 2021)[6]. In Sleman Regency, Yogyakarta, there were 492 KWTs with around 6,996 members in 2024, reflecting significant potential as community-based learning laboratories (Dinas Pertanian Sleman, 2024)[7].

The involvement of students in KWT activities is highly relevant to the *community Economy* course. Through direct observation, students can understand how community-based groups manage resources, organize production, and implement collective welfare strategies. KWT embodies real-world practices of community economy that emphasize inclusivity, collaboration, and community resilience (Manto, Indriani, & Saleh, 2023)[8]. Furthermore, such experiential learning aligns with Kolb's (1984)[9] theory, which emphasizes a cycle of concrete experience, reflection, conceptualization, and active experimentation.

Thus, the utilization of KWT as a contextual learning resource not only enhances students' understanding of community economy concepts but also enriches the learning process through authentic experiences. This article aims to explore the role of KWT in strengthening experiential learning within the *community Economy* course at the Faculty of Economics and Business, Yogyakarta State University, focusing on: (1) the use of KWT as a contextual learning resource, (2) challenges faced by students, and (3) the relevance of KWT-based learning to the experiential learning cycle.

LITERATURE REVIEW

Contextual Education and Experiential Learning

Contextual learning is an approach that emphasizes the connection between subject matter and real-life situations, thereby making knowledge more meaningful[10]. This principle aligns with Dewey's (1938)[11] idea that direct experience lies at the heart of education. Kolb's (1984)[9] model of experiential learning outlines a four-stage cycle: concrete experience, reflective observation, abstract conceptualization, and active experimentation. Further studies by Kolb and Kolb (2005)[12] demonstrate that this cycle effectively enhances students' understanding and fosters critical thinking skills. Beard and Wilson (2018)[13] even assert that experiential learning simultaneously develops students' analytical, reflective, and social competencies.

A number of international studies reinforce the importance of experience-based learning. Freeman et al. (2014)[14] found that active learning significantly improves student performance in science and mathematics. Prince (2004)[15] also highlighted that active approaches are effective in improving retention and student engagement. Hattie (2009)[16], through his meta-analysis, confirmed that direct learning experiences contribute substantially to learning outcomes. Thus, experiential learning not only deepens conceptual understanding but also develops students' soft skills.

Community Economy and Community-Based Learning

The community economy is defined as an economic system that prioritizes community participation, self-reliance, and distributive justice (Gunawan, 2018)[17]. This concept is consistent with the principles of sustainable development, which emphasize social justice, empowerment, and solidarity (Hidayat, 2020)[18]. Lave and Wenger (1991)[19], through the concept of situated learning, argue that knowledge is constructed through participation in communities of practice. In this context, community-based learning becomes a strategic approach to internalize the values of the community economy.

Bringle and Hatcher (2009)[20] explain that student involvement in community activities not only strengthens academic understanding but also enhances social awareness. Butin (2010)[21] adds that community-based learning prepares students to become active and responsible citizens. Studies in Indonesia also show similar outcomes, where field-based learning improves students' appreciation of the community economy and strengthens social competence (Astuti & Wahyuni, 2019; Dewi & Rahayu, 2022)[22,23].

The Role of Women Farmers' Groups (KWT) in Education and Empowerment

Women Farmers' Groups (Kelompok Wanita Tani/KWT) are community-based organizations that play a crucial role in women's empowerment and household economic strengthening (Ardiani & Dibyorini, 2021)[6]. KWT functions not only as a production unit but also as a space for social solidarity and knowledge transfer. Data from the Sleman Agricultural Office (2024) reported 492 KWTs with 6,996 members, demonstrating their potential as community-based learning laboratories. Manto, Indriani, and Saleh (2023)[8] emphasize KWT's contribution to increasing household income and food security.

The role of KWT is also aligned with global agendas. FAO (2011)[24] states that empowering women in agriculture can enhance productivity and household welfare. UNESCO (2017)[25] highlights the importance of integrating sustainable development education into learning that involves local communities. Wals and Corcoran (2012)[26] also stress the need for innovative, community-based learning to address sustainable development challenges

Beyond economic aspects, student involvement in KWT activities also supports character education. Peterson and Seligman (2004)[27] explain that character strengths such as courage, empathy, and gratitude can be developed through authentic experiences. Mezirow's (1997) [28]theory of transformative learning asserts that field-based experiences can profoundly shift students' perspectives. This is consistent with Ardiani and Dibyorini's (2021)[6] findings that students involved in KWT activities become more sensitive to values of hard work, solidarity, and women's social resilience in rural communities.

Integrating Experiential Learning, KWT, and Higher Education

The integration of experiential learning with KWT activities serves as an effective strategy to strengthen the teaching of the community economy in higher education. Through direct engagement, students follow Kolb's (1984)[9] learning cycle: immersing themselves in fieldwork, reflecting on their experiences, connecting them with theory, and experimenting with innovative solutions. This resonates with project-based learning (Thomas, 2000)[29], which emphasizes solving real problems through collaborative work.

In Indonesia, the issue of farmer regeneration is becoming increasingly urgent due to the declining number of young farmers (Susilowati, 2016; BPS, 2023)[1,30]. Putrayasa, Sukarsa, and Kencana (2021)[3] found that the lack of youth interest in agriculture is influenced by social stigma and weak institutional support. In this context, student involvement in experiential learning through KWT not only improves literacy in the community economy but also serves as a strategy for farmer regeneration.

Furthermore, the United Nations (2015)[24] underscores the importance of education in supporting the Sustainable Development Goals (SDGs). Student involvement in community-based learning such as KWT directly contributes to SDG 2 (Zero Hunger), SDG 4 (Quality Education), and SDG 5 (Gender Equality). Thus, integrating KWT into the teaching of the people's economy not only enhances students' academic achievement but also supports the broader agenda of global sustainable development.

RESEARCH METHOD

Research Design

This study employed a descriptive quantitative approach supported by qualitative data (*mixed descriptive approach*). This approach was chosen because the purpose of the research was to analyze the utilization of Women Farmers' Groups (KWT) as contextual learning resources within the framework of experiential learning, while also identifying the challenges faced by students.

Research Subjects and Location

The research subjects were 178 students of the Faculty of Economics and Business, Yogyakarta State University, who took the *community Economy* course in the 2025 academic year. Field observations were conducted in several KWTs in Sleman Regency, Yogyakarta Special Region. This area was selected because it has a relatively large number of KWTs, namely 492 groups with 6,996 members in 2024 (Dinas Pertanian Sleman, 2024)[7].

Data Collection Techniques

The research data were collected using four main techniques:

1. Questionnaires: using a 5-point Likert scale to measure students' perceptions of KWT-based learning, their learning experiences according to Kolb's experiential learning cycle, and the challenges they encountered.
2. Observation: conducted during students' field activities in KWTs, covering their involvement in production, group management, and discussions with KWT members.
3. Interviews: with KWT administrators and selected students to obtain deeper insights into the benefits and challenges of contextual learning.
4. Documentation: including student activity reports, reflection notes, and photos/videos of field activities.

Research Instrument

The research instrument was designed to capture students' learning experiences comprehensively, consisting of 84 items divided into three main aspects:

1. Utilization of KWT as a contextual learning resource, measuring the extent to which students can connect community economy theory with real-life practices.
2. Experiential learning stages as proposed by Kolb (1984)[9], covering *concrete experience*, *reflective observation*, *abstract conceptualization*, and *active experimentation*.
3. Technical and psychological barriers experienced by students during field learning, such as limited access to data, communication difficulties, or lack of self-confidence when interacting with community members.

This structure allowed the instrument to provide a comprehensive overview of the effectiveness of community-based agricultural learning.

Validity and Reliability Tests

The instrument underwent validity and reliability testing. Content validity was analyzed using the *Corrected Item-Total Correlation (CITC)*, which showed that 83 out of 84 items were valid and thus suitable for research purposes. Reliability was measured using *Cronbach's Alpha*, which yielded a score of 0.978, indicating a very high level of internal consistency and confirming that the instrument could reliably measure the research variables.

Data Analysis Techniques

Quantitative data were analyzed using descriptive statistics, including mean, percentage, and frequency distribution, to describe students' response tendencies. Qualitative data from observations, interviews, and documentation were analyzed using thematic analysis (Miles & Huberman, 1994)[31], which included data reduction, data display, and conclusion drawing.

Research Procedures

1. Preparation: coordination with KWT administrators and preparation of research instruments.
2. Implementation: students conducted field observations according to the course schedule, interacted with KWT members, and completed the questionnaires.
3. Reflection: students prepared reflection reports connected to experiential learning theory.
4. Analysis & Conclusion: quantitative and qualitative data were processed to answer the research questions.

RESULTS AND DISCUSSION

RESULT

1. Utilization of KWT as a Contextual Learning Resource

The questionnaire analysis showed that students had a positive perception of the integration of Women Farmers' Groups (KWT) as a learning resource. The average score obtained was 4.21 out of 5, with 76% of respondents agreeing or strongly agreeing that KWT helped them understand the connection between people's economy theory and real-world practices. This data not only confirms students' acceptance of community-based learning methods but also indicates that KWT functions as an alternative learning space outside formal classrooms. Field observations revealed that students were not merely observers but actively engaged in agricultural production, group management, and economic activities such as product marketing. This demonstrates that KWT can provide authentic and applicable learning experiences that reinforce the objectives of contextual learning.

2. Learning Experiences Based on Kolb's Experiential Learning Cycle

The research data confirmed variations in students' experiences across the stages of Kolb's experiential learning cycle, which consists of concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE).

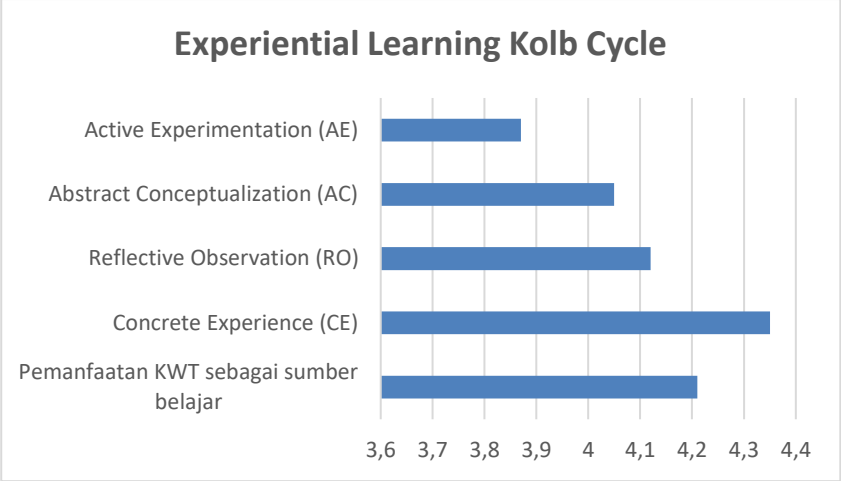

FIGURE 1. Experiental Learning Kolb Cycle

a. At the concrete experience (CE) stage, the average score was 4.35, indicating that students found direct experiences in KWT highly enriching. Activities such as planting, managing organic fertilizer, and interacting with KWT members provided real learning opportunities that could not be obtained through theory alone.
b. At the reflective observation (RO) stage, the average score was 4.12, showing that students were able to engage in critical reflection through reports, daily journals, and group discussions. This reflection helped them evaluate the strengths and weaknesses of their experiences while internalizing values of cooperation and independence.
c. At the abstract conceptualization (AC) stage, students scored an average of 4.05, reflecting their ability to connect field experiences with the theory of people's economy. They were able to analyze concepts such as community empowerment, people-based economics, and sustainability principles in real practice. However, some students still struggled to construct strong conceptual frameworks from their experiences, indicating the need for additional academic guidance.
d. At the active experimentation (AE) stage, the average score was 3.87, which was relatively lower compared to other stages. This shows that although students were able to design new ideas such as digital marketing strategies or product innovations, they still required technical support and intensive mentoring to implement these ideas in practice.

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3. Technical and Psychological Barriers

The study also identified barriers faced by students during field-based learning. From a technical perspective, 42% of students reported limited access to KWT's financial data and restricted observation time, which was only available during certain periods. These barriers limited students' ability to gather more in-depth information on financial management and group development strategies. From a psychological perspective, 28% of students reported lacking confidence in interacting with KWT members. Some expressed concerns about making communication mistakes or being perceived as less competent by the community. These challenges highlight that while community-based learning provides authentic experiences, not all students are mentally prepared to directly face new social contexts. Nevertheless, such obstacles can be mitigated through pre-field training, communication skills workshops, and more intensive faculty mentoring.

4. Instrument Validity and Reliability

The research instrument was proven to be of very high quality. Validity testing using the Corrected Item-Total Correlation (CITC) method showed that 83 out of 84 items were valid, making them appropriate for accurately measuring the research variables. Meanwhile, the reliability test using Cronbach's Alpha produced a score of 0.978, which indicates an exceptionally high level of internal consistency. This confirms that the instrument was not only reliable but also capable of comprehensively capturing students' learning experiences within the framework of experiential learning.

DISCUSSION

1. KWT as a Context for People's Economy Learning

The integration of Women Farmers' Groups (KWT) into the learning process has been proven to bridge the gap between people's economy theory and real-world practice. KWT provides an authentic socio-economic space where students can directly understand how people's economy concepts are implemented in the daily lives of communities. This finding aligns with the concept of contextual teaching and learning, which emphasizes that knowledge becomes more meaningful when learned within relevant contexts (Johnson, 2002)[10]. Furthermore, this study supports Dewi & Rahayu's (2022)[23] findings that community-based field practices can enhance students' motivation, critical thinking skills, and social awareness.

2. The Effectiveness of Experiential Learning

Kolb's experiential learning cycle has proven relevant in KWT-based learning. Students gain real-life experiences (*concrete experience/CE*), engage in critical reflection (*reflective observation/RO*), connect experiences with theory (*abstract conceptualization/AC*), and attempt to develop new ideas (*active experimentation/AE*). However, the relatively lower results at the AE stage indicate the need to strengthen students' innovation and problem-solving abilities. Beard & Wilson (2018)[13] emphasize that the success of experiential learning depends on the quality of facilitation, reflection, and mentoring. Therefore, lecturers play an essential role as facilitators who encourage students to move further in the stage of active experimentation.

3. Technical and Psychological Challenges

The technical and psychological barriers faced by students demonstrate that community-based learning does not always proceed smoothly. Technical barriers, such as limited access to data, are consistent with Haryono's (2019) findings highlighting difficulties in accessing agricultural information in Indonesia. Meanwhile, psychological barriers reflect the need for students to develop soft skills, particularly in interpersonal communication, empathy, and self-confidence. Mezirow (1997)[28] asserts that transformative learning occurs when individuals face challenges that push them out of their comfort zones; thus, psychological barriers may serve as a trigger for new awareness if properly facilitated.

4. Implications for Strengthening People's Economy and Sustainable Education

The findings of this study carry strategic implications. From an educational perspective, KWT functions as a living laboratory that effectively enhances students' 21st-century skills such as critical thinking, collaboration, communication, and creativity (Partnership for 21st Century Skills, 2019)[32]. From an economic perspective, student involvement in KWT strengthens group capacity through new ideas in management and product marketing, particularly the use of digital technology. This aligns with the direction of sustainable development, especially the goals of gender equality, poverty reduction, and strengthening local communities (FAO, 2011; UNESCO, 2017; United Nations, 2015).[33–35] Thus, this research affirms that community-based learning not only impacts students but also makes a tangible contribution to strengthening the people's economy.

CONCLUSION

This study demonstrates that the utilization of Women Farmers' Groups (KWT) as contextual learning resources in the Community Economy course has proven effective in enhancing students' understanding. Students were not only able to connect theory with real-world practice but also gained authentic experiences that enriched their critical thinking, reflection, and collaboration skills. Analysis based on Kolb's experiential learning cycle revealed that the stages of concrete experience and reflective observation contributed significantly to students' comprehension, while abstract conceptualization helped them link experiences with theory. However, the stage of active experimentation showed relatively lower achievement, indicating the need for additional support to encourage students to innovate and implement new ideas. Technical barriers, such as limited access to data and observation time, along with psychological barriers like lack of confidence, highlighted the challenges in implementing field-based learning. Nevertheless, these obstacles can be mitigated through faculty guidance, pre-field training, and the strengthening of students' soft skills.

Overall, this study affirms that KWT serves not only as a socio-economic laboratory but also as a platform for strengthening the people's economy and sustainable education. The integration of such community-based learning aligns with the demands of 21st-century skills and supports the achievement of the Sustainable Development Goals (SDGs), particularly in the areas of community empowerment and capacity building for younger generations in the agricultural sector.

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REFERENCES

1. S.H. Susilowati, "Farmers Aging Phenomenon and Reduction in Young Labor: Its Implication for Agricultural Development," Forum Penelitian Agro Ekonomi 34(1), 35–55 (2016).
2. Ismail, I. Santosa, and S. Wulandari, "Dampak alih fungsi lahan pertanian terhadap ketahanan pangan lokal," Jurnal Ekonomi Pertanian Dan Agribisnis 2(4), 289–300 (2018).
3. Putrayasa, I.K.G. Sukarsa, and E.N. Kencana, "Mengapa Generasi Muda Enggan Bekerja Di Sektor Pertanian? Model Persamaan Struktural Sektor Pertanian Di Kabupaten Jembrana," E-Jurnal Matematika 10(2), 122 (2021).
4. Syahyuti, "Adopsi teknologi pertanian di Indonesia: Kendala dan peluang," Jurnal Agro Ekonomi 38(2), 113–127 (2020).
5. T. Haryono, "Akses pembiayaan pertanian di Indonesia: Tantangan dan solusi," Forum Penelitian Agro Ekonomi 37(2), 145–160 (2019).
6. F.D. Ardiani, and M.C.R. Dibyorini, "Pemberdayaan Perempuan Melalui Kelompok Wanita Tani (KWT) 'ASRI' Kalurahan Bendung Kapanewon Semin Kabupaten Gunung Kidul," Sosio Progresif Media Pemikiran Dan Studi Pembangunan Sosial 1(1), 1–12 (2021).
7. D.P. Sleman, Profil Kelompok Wanita Tani Kabupaten Sleman 2024 (Dinas Pertanian Sleman, Sleman, 2024).
8. R.A. Manto, R. Indriani, and Y. Saleh, "Peran Kelompok Wanita Tani (KWT) Terhadap Peningkatan Pendapatan Keluarga (Studi Kasus KWT Muda Mandiri Desa Dutohe Barat Kecamatan Kabila Kabupaten Bone Bolango)," Agri-Sosioekonomi 19(2), 761–768 (2023).
9. D.A. Kolb, Experiential Learning: Experience as the Source of Learning and Development (Prentice Hall, 1984).
10. E.B. Johnson, Contextual Teaching and Learning: What It Is and Why It's Here to Stay (Corwin Press, 2002).
11. J. Dewey, Experience and Education (Macmillan, 1938).
12. A.Y. Kolb, and D.A. Kolb, "Learning styles and learning spaces: Enhancing experiential learning in higher education," Academy of Management Learning & Education 4(2), 193–212 (2005).

A. Beard, and J.P. Wilson, Experiential Learning: A Handbook for Education, Training and Coaching, 3rd ed. (Kogan Page, 2018).

13. S. Freeman, and et al., "Active learning increases student performance in science, engineering, and mathematics," Proceedings of the National Academy of Sciences 111(23), 8410–8415 (2014).
14. M. Prince, "Does active learning work? A review of the research," Journal of Engineering Education 93(3), 223–231 (2004).
15. J. Hattie, Visible Learning: A Synthesis of over 800 Meta-Analyses Relating to Achievement (Routledge, 2009).
16. Gunawan, "Ekonomi kerakyatan: Konsep, prinsip, dan implementasi dalam pembangunan nasional," Jurnal Ekonomi Dan Pembangunan Indonesia 19(2), 121–136 (2018).
17. Hidayat, "Revitalisasi ekonomi kerakyatan melalui pemberdayaan komunitas," Jurnal Sosial Humaniora 11(3), 210–222 (2020).
18. J. Lave, and E. Wenger, Situated Learning: Legitimate Peripheral Participation (Cambridge University Press, 1991).
19. R.G. Bringle, and J.A. Hatcher, "Innovative practices in service-learning and curricular engagement," New Directions for Higher Education 147, 37–46 (2009).
20. D.W. Butin, Service-Learning in Theory and Practice: The Future of Community Engagement in Higher Education (Palgrave Macmillan, 2010).
21. S. Astuti, and S. Wahyuni, "Community-based learning untuk penguatan kapasitas mahasiswa di bidang sosial ekonomi," Jurnal Pendidikan Ekonomi 12(2), 45–53 (2019).
22. I.R. Dewi, and R. Rahayu, "Inovasi pembelajaran ekonomi kerakyatan berbasis praktik lapangan di sekolah menengah," Jurnal Pendidikan Ekonomi Indonesia 17(1), 55–66 (2022).
23. U. Nations, Transforming Our World: The 2030 Agenda for Sustainable Development (United Nations, 2015).

24. UNESCO, Education for Sustainable Development Goals: Learning Objectives (UNESCO Publishing, 2017).
25. A.E.J. Wals, and P.B. Corcoran, Learning for Sustainability in Times of Accelerating Change (Wageningen Academic, 2012).
B. Peterson, and M.E.P. Seligman, Character Strengths and Virtues: A Handbook and Classification (Oxford University Press, New York, 2004).
26. J. Mezirow, "Transformative learning: Theory to practice," New Directions for Adult and Continuing Education 1997(74), 5–12 (1997).
27. J.W. Thomas, A Review of Research on Project-Based Learning (Autodesk Foundation, 2000).
28. B.P.S. (BPS), Sensus Pertanian 2023: Hasil Sementara (2023).
29. M.B. Miles, and A.M. Huberman, Qualitative Data Analysis: An Expanded Sourcebook, 2nd ed. (Sage Publications, 1994).
30. P. for 21st C. Skills, P21 Framework for 21st Century Learning (Battelle for Kids, Washington, DC, 2019).
E. and A.O. of the U.N. (FAO), The State of Food and Agriculture 2010–11: Women in Agriculture – Closing the Gender Gap for Development (FAO, Rome, 2011).
31. UNESCO, Education for Sustainable Development Goals: Learning Objectives (UNESCO Publishing, 2017).
32. U. Nations, Transforming Our World: The 2030 Agenda for Sustainable Development (United Nations, 2015).

EFFECTIVENESS OF MULTILATERAL FIELD ACTIVITY TRAINING METHODS ON LOCOMOTOR SKILLS AND OBJECT CONTROL SKILLS IN EARLY CHILDHOOD

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Abstract. This study modifies multilateral training methods for children to make them enjoyable so that early childhood children are confident and enthusiastic about participating in the training. The specific objective is to determine the improvement of multilateral field activity training methods on locomotor skills and object control skills in early childhood children. The research methods used were qualitative and quantitative research with an experimental research design. The population in this study were early childhood children aged between 3 and 8 years old. The research sample consisted of 60 boys and girls. The multilateral training methods given consisted of sprinting, horizontal jumping, throwing and catching small balls, cross jumping, turbo throwing, underhand throwing, FMS circuit, shooting at enemies, ninja kids, and soccer penalties. Sampling in this study used probability sampling with random sampling techniques.

Data collection techniques used the Test of Gross Motor Development-Second Edition (TGMD-2). Data analysis techniques using SPSS consisted of normality, homogeneity, and effectiveness tests using the T-test. The research results produced a Sig. value (2-tailed) < 0.05 or a Sig. value of 0.000 < 0.05, leading to the conclusion that there was a significant difference. Therefore, the multilateral training methods provided, consisting of sprinting, horizontal jumping, throwing and catching small balls, cross jumping, turbo throwing, underhand throwing, FMS circuit, shooting at targets, ninja kids, and soccer penalties, can improve locomotor skills and object control in early childhood.

Keywords: Multilateral exercises, Locomotor skills, Object control skills, Early childhood

INTRODUCTION

Basic locomotor skills are fundamental abilities that children should be able to perform in accordance with their age. Basic locomotor movements can be developed if children have good basic locomotor skills, enabling them to coordinate their limbs effectively. Examples include walking, running, bending over, swinging their arms and legs, jumping, and walking sideways to the right and left. A healthy body is essential for humans to be able to perform physical activities well. A healthy body and good physical movement can be developed and achieved through appropriate activities such as exercise, as explained by Clark (2021). In this case, children will be more alert and flexible in interacting with their peers. Additionally, children who have good basic locomotor skills will be able to help themselves display good attitudes and skillfully solve problems they encounter in their daily lives. In the development of children's locomotor skills, there are important elements that can help optimize development, namely coaches or teachers and parents. According to Payne et al. (2022), gross motor skills are movements controlled by large muscle groups. These muscles are an integral part of producing various movements, such as walking, running, and jumping. Fine motor skills are movements controlled by small muscles or muscle groups.

As a coach or teacher, you can provide stimulation in the form of fun multilateral training activities that engage children's gross motor skills by giving them activities that they can do in their daily lives. In addition to the importance of locomotor skills, object control skills are also needed in early childhood, because young children are still very active. Object control skills play a role in shaping the foundations of the body and improving children's physical abilities. According to (FX Sugiyanto., 2020), it is important for early childhood to master these object control skills as preparation for daily life. However, some children still find it difficult to perform basic locomotor skills. These difficulties can hinder children's development, resulting in minimal movement.

However, based on findings from observations of early childhood at Budi Mulia Dua School, Special Region of Yogyakarta, there are still many parents who are neglectful of their children's growth and development. Low supervision, especially regarding excessive use of communication devices, can certainly hinder children's motor development. Therefore, it is important to innovate fun multilateral field activity training methods that aim to attract children's interest in participating, so that the objectives of locomotor skills and object control in children can be achieved and improved. Given these issues, it is necessary to modify multilateral training methods for children to be fun so that early childhood children are confident and enthusiastic about participating in the training. The specific objective is to determine the improvement of multilateral field activity training methods on locomotor skills and object control skills in early childhood.

METHOD

The research method used was qualitative and quantitative research with an experimental research design. The test instrument validation stage consisted of two stages. The first stage was expert validation of the exercise program by expert validators consisting of three academics and four physical education teachers at the school. The second stage, after expert validation and the exercise program was declared feasible, a pretest was conducted on all 60 early childhood children. After the pretest was conducted, the children were divided into two groups, namely the control group and the experimental group. The experimental group, consisting of 30 children, underwent training for 6 weeks with a training duration of 3 times a week to obtain accurate data. The population in this study were early childhood children aged at least 3 years and at most 8 years.

The research sample consisted of 60 boys and girls. The multilateral training methods used included sprinting, horizontal jumping, small ball throwing and catching, cross jumping, turbo throwing, underhand throwing, FMS circuit, shooting at targets, ninja kids, and soccer penalties. Sampling in this study used probability sampling with random sampling techniques. The data collection technique used the Test of Gross Motor Development-Second Edition (TGMD-2). The data analysis technique used SPSS, consisting of normalization tests, homogeneity tests, and effectiveness tests with T-tests.

RESULTH AND DISCUSSION

Result

Before conducting an independent T-test, a data normality test is performed first to determine whether the data produced is normally distributed or not. The normality test can be seen as follows:

TABLE 1. Data Normality Test

Tests of Normality							
Kelompok		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Hasil Data Posttest	Kelompok Kontrol	.137	30	.159	.941	30	.098
	Kelompok Eksperimen	.124	30	.200*	.959	30	.299

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Based on the results in Table 1 above, it can be seen that if the Sig. Value (P Value) > 0.05, it can be concluded that the data is normally distributed. The significance value in the control group is 0.159 > 0.05, so the control group has normal data. Similarly, the experimental group has a value of 0.200, so the experimental group also has normal results. After testing for normality, an Independent T-Test was immediately performed on Table 2.

TABLE 2. Independent T-Test

Independent Samples Test	
Levene's Test for Equality of Variances	**t-test for Equality of Means**

		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Hasil Data Posttest	Equal variances assumed	14.002	.000	-12.134	58	.000	-24.73333	2.03833	-28.81349	-20.65317
	Equal variances not assumed			-12.134	40.943	.000	-24.73333	2.03833	-28.85000	-20.61667

Based on the results in Table 2 above, a Sig. (2-tailed) value < 0.05 or a Sig. value of 0.000 < 0.05 was obtained, leading to the conclusion that there is a significant difference. Therefore, the multilateral training methods provided, consisting of sprinting, horizontal jumping, small ball throwing and catching, cross jumping, turbo throwing, underhand throwing, FMS circuit, shooting at targets, ninja kids, and soccer penalties, can improve locomotor skills and object control in early childhood.

Discussion

Children are the owners of the present and future of the nation, because it is in the hands of children that the history of Indonesian life will continue (Latif, 2022). How can we care for and educate children so that they have good thoughts, words, deeds (social relationships), and movements so that later they will be able to achieve their hopes and dreams in the future? Varied sports activities greatly assist children in the process of learning movement, as stated by Sukadiyanto (2020), one of the principles of training is the principle of variation. With varied learning processes and exercises, children will avoid boredom, reluctance, and anxiety, which are forms of psychological fatigue, thereby attracting them to the learning process of various types of movements in sports, especially locomotor and object control.

Expert assessment of the observation instruments and their effectiveness: the experts agreed that multilateral movement learning through large ball games is effective for training children's basic movements and developing their interest and motivation in sports and movement learning. The subject matter experts assessed that the development of a multilateral movement learning model through large ball games is very effective in transferring the indicators that are the objectives of teaching children multilateral movements and fostering children's interest and motivation in sports and movement learning. The subject matter experts assessed that children are very enthusiastic and excited about participating in multilateral movement learning through large ball games. In addition, the students (children) were very enthusiastic in participating in the development of the multilateral movement learning model through large ball games, as seen from the children's very positive responses to the questions asked.

The need for children to be equipped with a variety of basic motor skills that are appropriate for their age and abilities will have a positive impact on their physical and psychological development. By establishing a proper learning process for movement, children will be better prepared to perform more complex motor activities in the future. Lumintuarso (2023) explains that by providing diverse movement experiences, children will have stronger movement patterns and awareness to be able to perform more efficiently in various situations. Basically, teachers or coaches have the same hopes and desires to shape students or trainees who will be able to achieve in the future. To achieve the desired results, a process must be followed, which must be carried out in stages from the most basic or simple stages to more complex or difficult stages. In line with the teacher's expectations, there are many basic processes that cannot be fulfilled to bring children to more complex stages, such as teaching various basic movements that are expected to become the foundation for children to move on to more complex stages of movement.

CONCLUSION

Locomotor skills in children are skills that involve moving from place to place using the whole body. These skills are important for building muscle and joint strength, as well as improving brain coordination. Examples of locomotor movements include walking, running, jumping, climbing, crawling, and swinging. The benefits of locomotor skills include helping brain coordination in children, building muscle and joint strength, helping to avoid musculoskeletal disorders, helping to develop complex movement skills, and helping to improve fine and controlled motor skills. Locomotor skills can be adapted to the age and abilities of the child.

It is important to start at the appropriate level and increase the intensity gradually. In addition to the need for good locomotor skills in children, object control skills are also needed to improve their agility in play or

performance so that they can be more effective and active in their motor responses. Object control skills are the skills of controlling objects using the hands, feet, sticks, or rackets. These skills are very important to teach to young children in order to aid their physical, mental, and social development. In addition, locomotor and object control skills can increase self-confidence and the ability to focus and concentrate. In order to improve children's locomotor and object control skills, it is necessary to provide exercises that aim to accustom children to moving and being more active in any activity.

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REFERENCES

Renate Van Zandwijk, et al (2015) Joint stress in children with cerebral palsy during a locomotor skill before and after botulinium – toxin – injections. Archives of physical medicine and rehabilition. Volume 96, issue 10, October 2015, page e42. https://doi.org/10.1016/j.apmr.2025.08.139

Dong Zhang, et al (2024) Effect of functional training on fundamental motor skills among children : A systematic review. Journal homepage : www.cell.com/heliyon heliyon 10 (2024) e39531. https://doi.org/10.1016/j.heliyon.2024.e39531

Anssi Vanhala, et al (2024) Developmental associations of fundamental motor skills and executive functions in preschoolers - The role of the physical activity and the effects on early numeracy. Journal homepage : www.elsevier.com/locate/tine. Trends in neurosclence and education 34 (2024) 100220. https://doi.org/10/1016/j.tine.2024.100220.

Zuozheng Shi, et al (2024) An empirical study of the flag rugby game programme to promote gross motor skills and physical fitness in 5–6 year old preschool children. journal homepage: www.cell.com/heliyon. Heliyon 10 (2024) e29200. https://doi.org/10.1016/j.heliyon.2024.e29200 (http://creativecommons.org/licenses/by-nc/4.0/).

Payne, V.G., & Issac, L.D. (2020). Human motor development. New York: McGraw-Hill Companies, Inc.

University Students' Critical Consciousness of Social Injustice in the Era of Digital Transformation

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Abstract. This study explores university students' critical consciousness toward social injustice in the context of digital transformation in higher education. Social inequalities related to class, gender, and access to education persist despite the expansion of digital technologies, raising questions about students' awareness and responsiveness to structural injustice. Employing a qualitative descriptive approach, this research involved in-depth interviews with undergraduate students from various academic backgrounds. Data were analyzed using thematic analysis to identify patterns of understanding, attitudes, and actions related to social injustice. The findings reveal three typologies of students' critical consciousness: pragmatic, idealist, and activist. Pragmatic students tend to prioritize personal achievement and instrumental use of digital technologies, often exhibiting limited sensitivity to structural inequality. Idealist students demonstrate critical understanding at the conceptual level but show minimal engagement in social action. In contrast, activist students integrate critical reflection with collective and transformative practices, positioning digital technologies as both objects of critique and tools for social advocacy. The study highlights that digital transformation in higher education does not inherently foster critical awareness or social justice orientation. Instead, critical consciousness is shaped by pedagogical experiences, socio-cultural contexts, and opportunities for praxis. This research contributes to humanistic educational discourse by emphasizing the importance of critical pedagogy in cultivating socially engaged and reflective learners in the digital era.

Keywords: critical consciousness, social injustice, higher education, digital transformation, critical pedagogy

INTRODUCTION

Social injustice constitutes a fundamental issue in education because it is directly related to the unequal distribution of learning opportunities based on social class, gender, race, religion, and disability. Education, which is normatively understood as an instrument of social mobility and emancipation, in practice often becomes an arena for the reproduction of social inequality. In the Indonesian context, this problem remains structural and systemic, particularly as access to education—especially higher education—is increasingly influenced by market logic and the mechanisms of educational capitalism (Darmaningtyas, 2012).

Although the government has implemented various affirmative policies, such as the provision of scholarships, quotas for students from low-income families, and programs such as Bidikmisi and KIP Kuliah, realities on the ground indicate that these policies have not yet been able to fully overcome structural barriers. The transformation of public university governance toward a corporate model has led to rising education costs, thereby further narrowing access to higher education for lower socioeconomic groups. Data from the Central Statistics Agency (BPS) show that Indonesia's Gross Enrollment Ratio (GER) in higher education in 2024 remains in the range of 31–32%, meaning that only about one-third of the population aged 19–23 can access higher education. This figure reflects the persistent strength of inequality in access to higher education nationally, particularly for poor and marginalized groups.

In addition to class-based inequality, education continues to face serious challenges related to gender injustice. A number of studies indicate that education has not yet become a fully inclusive and gender-friendly space. Juliana et al. (2019) found evidence of gender bias in sociology learning, reflected in the development of lesson plans (RPP), learning processes, and teaching materials that position women in subordinate roles. These findings are reinforced by the study of Murtado et al. (2024), which shows that women, both in education and in the world of work, continue to face various forms of social constraints, including discrimination, exploitation, marginalization, subordination, stereotyping, and negative labeling. Together, these findings indicate that education remains an arena in which patriarchal ideology operates, both structurally and culturally.

Amid these layered issues of social injustice, higher education is also currently situated within a massive wave of digital transformation. The digitalization of learning, the use of online platforms, learning analytics, and

artificial intelligence increasingly dominate academic practices. A number of international studies show that digital transformation in higher education is not neutral, but rather carries significant social and political implications. Petchamé et al. (2023) and Paños-Castro et al. (2024) emphasize that the digitalization of education has the potential to reinforce inequality if it is not accompanied by attention to equitable access, institutional readiness, and humanistic-oriented pedagogical design. Furthermore, Curran (2023) and Stockman and Nottingham (2022) warn that digital education risks being trapped in the logic of surveillance capitalism, in which student data become commodities and technology functions as a mechanism of control that weakens learner autonomy and agency.

Within this context, a public narrative has also developed that portrays young people—particularly millennials and Generation Z—as groups that are less sensitive to social and political issues. The digital-era generation is often labeled as pragmatic, hedonistic, and indifferent to social injustice due to low social literacy and the dominance of digital culture. However, this view is not fully supported by empirical findings. Wahyono et al. (2020) show that millennials in Indonesia display diverse typologies in responding to social and political issues, ranging from pragmatic to critical orientations. International studies also demonstrate that young people in the digital era exhibit varied forms of social engagement, from slacktivism to substantive digital activism, depending on context and levels of critical literacy (Sainz, 2023).

University students, who demographically belong to the millennial and Generation Z cohorts, occupy a strategic position within this landscape. On the one hand, students face the risk of depoliticization and declining social sensitivity due to the dominance of digital technology in academic spaces. On the other hand, they also possess the potential to act as agents of social change through the strengthening of critical intellectualism and engagement in social activism. Thus, students cannot be understood as a homogeneous group, but rather as subjects with diverse typologies of consciousness, ranging from pragmatic to critical activist.

Although numerous studies have discussed social injustice, critical pedagogy, and digital transformation separately, there remains a limitation in research that integrates these three dimensions within a single analytical framework, particularly from the perspective of students' subjective experiences. Empirical research that examines how students understand critical pedagogy, interpret equitable education, and develop critical awareness of social injustice within the context of digitalized higher education remains relatively limited.

Based on this gap, this study aims to examine students' understanding of critical pedagogy and equitable education, as well as to identify the level of students' sensitivity and critical awareness of structural social injustice in the era of digital transformation. Specifically, this study seeks to address the following questions: (1) how do students understand the concepts of critical pedagogy and equitable education in the context of digital higher education; (2) what forms of awareness and sensitivity do students demonstrate toward structural social injustice; and (3) what typologies of critical consciousness emerge among students in the era of digital transformation. The findings of this study are expected to provide a conceptual contribution to the development of higher education that is more humanistic, reflective, and oriented toward social justice.

METHODS

This study employed a qualitative research approach using a field study design grounded in a constructivist paradigm. This paradigm positions social reality as socially constructed and emphasizes the subjective meanings developed through individuals' interactions with their social and educational environments. The qualitative approach was considered appropriate for exploring students' lived experiences, interpretations, and critical awareness of social injustice within the context of digitally mediated higher education.

Research Setting and Participants

The research was conducted at a public university in Indonesia, involving participants from the Faculty of Education and the Faculty of Social Sciences. These faculties were selected due to their strong engagement with courses related to educational theory, social studies, and critical perspectives on education.

Participants consisted of undergraduate, master's, and doctoral students who had completed or were enrolled in courses addressing themes such as pedagogical theory, critical pedagogy, social justice, or education and society. The selection of participants followed a purposive sampling strategy to ensure that informants possessed relevant academic experiences and reflective capacity related to the research focus. In total, the participants represented diverse academic backgrounds, gender identities, and levels of study, allowing for a rich variation of perspectives.

Data Collection Techniques

Data were collected using multiple qualitative techniques to enhance depth and credibility. These techniques included participant observation, in-depth interviews, focus group discussions (FGDs), and document analysis.

Participant observation was conducted during classroom activities, academic discussions, and informal student interactions, focusing on how issues of social justice, inequality, and digital learning practices emerged in academic contexts. In-depth interviews were carried out using semi-structured guidelines, enabling participants to articulate their understandings of pedagogical practices, experiences with digital learning technologies, and perceptions of social injustice. Focus group discussions were employed to capture collective reflections and dialogical processes among students, particularly regarding shared experiences and contrasting viewpoints.

Document analysis complemented the primary data sources and included the examination of course syllabi, learning materials, reflective assignments, and digital artifacts related to students' learning activities. This triangulation of data sources allowed for a more comprehensive understanding of how critical awareness was articulated and negotiated within both formal and informal academic settings.

Data Analysis

Data analysis followed a descriptive-analytic procedure conducted iteratively throughout the research process. The analysis began with data reduction through careful reading and transcription of interview and FGD data, followed by initial coding to identify recurring themes related to social injustice, pedagogical experiences, digital practices, and forms of critical reflection.

Subsequently, thematic categorization was performed to group codes into broader analytical categories. Through interpretive analysis, these categories were then dialogued with theoretical perspectives from critical pedagogy and social justice education. This process led to the abstraction of empirical patterns into conceptual typologies of students' critical consciousness namely, pragmatic, idealist, and activist orientations. Rather than treating these typologies as fixed classifications, they were understood as analytical constructs that illuminate tendencies in students' ways of thinking and acting.

Trustworthiness and Ethical Considerations

To ensure the trustworthiness of the study, several strategies were employed, including data triangulation across methods and sources, prolonged engagement in the research field, and reflective memo writing during data collection and analysis. These strategies enhanced the credibility and dependability of the findings.

Ethical considerations were carefully addressed throughout the research process. Participants were informed about the purpose of the study and provided voluntary consent prior to participation. Anonymity and confidentiality were maintained by using pseudonyms and removing identifiable information from research records. The study was conducted with respect for participants' autonomy and sensitivity to their personal and academic experiences.

RESULT AND DISCUSSION

The identification of pragmatic, idealist, and activist student typologies illustrates that critical consciousness among university students in the digital era is fragmented and unevenly distributed. This finding reinforces the argument that digital transformation in education does not automatically foster emancipatory learning; instead, it may reproduce or even intensify existing forms of social domination when not mediated by critical pedagogy (Giroux, 2011; Selwyn, 2022).

Pragmatic Students and Algorithmic Pedagogy

The dominance of pragmatic students reflects the increasing normalization of instrumental rationality in higher education. Students' orientation toward efficiency, credentialism, and rapid labor-market insertion mirrors what Habermas (1984) conceptualized as the colonization of the lifeworld by system imperatives. In digitally mediated education, this colonization is amplified through algorithmic governance, learning analytics, and AI-based platforms that prioritize performance metrics over critical reflection (Williamson, 2017; Knox, 2020).

The strong reliance on AI among pragmatic students further substantiates concerns raised by Selwyn (2021) and Bayne et al. (2020), who argue that educational technologies often promote passive consumption of knowledge while obscuring underlying power relations. The tendency of students to treat AI as an unquestioned authority resonates with Freire's (1972) notion of banking education, now reconfigured as algorithmic banking pedagogy. In this context, learners risk becoming what Zuboff (2019) describes as objects of behavioral modification within surveillance capitalism.

Moreover, the pragmatic students' immersion in digital consumer culture aligns with Baudrillard's (1998) theory of consumption as a system of signs, where identity is constructed through symbolic ownership rather than social engagement. This helps explain their limited sensitivity to structural injustice, as digital capitalism

redirects attention from material inequalities toward curated virtual experiences (Fuchs, 2019; Couldry & Mejias, 2019).

Idealist Students and the Limits of Intellectual Critique

Idealist students demonstrate that critical awareness can exist without corresponding social action. Their engagement with critical pedagogy at the level of theory reflects what Gramsci (1971) described as traditional intellectualism—critical in discourse yet detached from organic struggles. While they are capable of diagnosing social injustice, their reluctance to engage in praxis suggests a disjunction between knowledge and action.

This condition challenges optimistic assumptions within critical pedagogy that exposure to critical theory alone will generate emancipatory agency. As Brookfield (2017) and Biesta (2015) argue, critical thinking does not necessarily lead to democratic action unless it is embedded within participatory and ethically grounded educational practices. Giroux's (2010) concept of the public intellectual further emphasizes that critical pedagogy must extend beyond classroom discourse to intervene in broader social struggles.

In relation to digital technologies, idealist students' cautious yet ambivalent stance toward AI supports arguments by Knox et al. (2022) that digital literacy without critical political economy awareness may result in superficial critique. Their position reflects what Noble (2018) terms algorithmic opacity, where users recognize bias but lack collective strategies to resist or transform digital systems.

Activist Students and Emancipatory Praxis

The presence of activist students affirms the continued relevance of Freirean praxis in contemporary higher education. By integrating reflection and action, activist students embody Freire's (1972) notion of conscientização, where awareness of oppression leads to transformative engagement. Their involvement in community empowerment, social movements, and advocacy initiatives illustrates what hooks (1994) refers to as engaged pedagogy—education as a practice of freedom.

Activist students' critical engagement with digital capitalism further aligns with contemporary critical media studies. Their skepticism toward AI and platform dominance echoes Fuchs' (2019) critique of big data capitalism and Couldry and Mejias' (2019) concept of data colonialism, wherein digital infrastructures extract value from human life itself. Rather than rejecting technology outright, activist students adopt a reflexive stance that situates technology within broader struggles for social justice.

Importantly, the activist typology disrupts homogenizing narratives about Generation Z as politically apathetic. Studies by Sloam and Henn (2019) and Bennett and Segerberg (2013) demonstrate that contemporary youth activism often operates through hybrid forms, combining online engagement with offline collective action. The findings of this study suggest that digital environments can serve as both sites of domination and spaces of resistance, depending on the critical capacities cultivated through education.

Implications for Higher Education

The coexistence of these three typologies highlights the urgent need for higher education institutions to rethink their pedagogical orientations in the digital era. When education prioritizes efficiency, market responsiveness, and technological optimization, it risks producing pragmatic learners aligned with neoliberal rationalities (Brown, 2015). Conversely, without structured opportunities for praxis, even critically informed students may remain confined to idealist positions.

Therefore, critical pedagogy in higher education must move beyond curricular inclusion toward institutional transformation. This includes redesigning learning environments that foster dialogical engagement, community-based learning, and critical digital literacy. As Mezirow (2009) emphasizes, transformative learning requires disorienting dilemmas that challenge taken-for-granted assumptions and invite learners into reflective and collective action.

REFERENCES

1. Arifin, M. (2024). Tingkat kepercayaan masyarakat Indonesia terhadap AI generatif. Kompas Digital Insight, 12(3), 45–47.
2. Baudrillard, J. (1998). The consumer society: Myths and structures. London: Sage.
3. Bayne, S., Knox, J., & Ross, J. (2020). Artificial intelligence in education: Promise and implications for teaching and learning. Edinburgh: University of Edinburgh Press.
4. Bennett, W. L., & Segerberg, A. (2013). The logic of connective action: Digital media and the personalization of contentious politics. Cambridge: Cambridge University Press.
5. Biesta, G. (2015). Good education in an age of measurement: Ethics, politics, democracy. London: Routledge.
6. Brookfield, S. D. (2017). Becoming a critically reflective teacher (2nd ed.). San Francisco, CA: Jossey-Bass.

7. Brown, W. (2015). Undoing the demos: Neoliberalism's stealth revolution. New York, NY: Zone Books.
8. Couldry, N., & Mejias, U. A. (2019). The costs of connection: How data is colonizing human life and appropriating it for capitalism. Stanford, CA: Stanford University Press.
9. Curran, D. (2023). Surveillance capitalism and systemic digital risk. Big Data & Society, 10(2), 1–13. https://doi.org/10.1177/20539517231123456
10. Darmaningtyas. (2012). Pendidikan yang memiskinkan. Yogyakarta: Intrans Publishing.
11. Fuchs, C. (2019). Digital capitalism: Critical theory of digital society. London: University of Westminster Press.
12. Freire, P. (1972). Pedagogy of the oppressed. New York, NY: Continuum.
13. Giroux, H. A. (2010). Hearts of darkness: Torturing children in the war on terror. Boulder, CO: Paradigm Publishers.
14. Giroux, H. A. (2011). On critical pedagogy. New York, NY: Continuum.
15. Gramsci, A. (1971). Selections from the prison notebooks. New York, NY: International Publishers.
16. Habermas, J. (1984). The theory of communicative action (Vol. 1). Boston, MA: Beacon Press.
17. hooks, b. (1994). Teaching to transgress: Education as the practice of freedom. New York, NY: Routledge.
18. Juliana, S., Pramono, S. E., & Suryadi, A. (2019). Bias gender dalam pembelajaran sosiologi di sekolah menengah. Jurnal Pendidikan Sosiologi, 11(2), 145–158.
19. Kim, J., & Huang, R. (2024). Integrating artificial intelligence in instructional design: Implications for learning analytics. Computers & Education: Artificial Intelligence, 5, 100145. https://doi.org/10.1016/j.caeai.2024.100145
20. Kincheloe, J. L., & McLaren, P. (2010). Rethinking critical theory and qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), The Sage handbook of qualitative research (pp. 279–313). Thousand Oaks, CA: Sage.
21. Knox, J. (2020). Artificial intelligence and education in China. Learning, Media and Technology, 45(3), 298–311.
22. Knox, J., Williamson, B., & Bayne, S. (2022). Machine behaviourism: Learning analytics and the limits of algorithmic education. Learning, Media and Technology, 47(1), 1–15.
23. Markham, A. (2003). Life online: Researching real experience in virtual space. Walnut Creek, CA: AltaMira Press.
24. Mezirow, J. (2009). Transformative learning theory. In J. Mezirow & E. W. Taylor (Eds.), Transformative learning in practice (pp. 18–32). San Francisco, CA: Jossey-Bass.
25. Murtado, A., Rahmawati, D., & Sari, N. (2024). Gender inequality in education and workplace: Structural and cultural barriers. Journal of Gender Studies, 33(1), 45–60. https://doi.org/10.1080/09589236.2023.2298456
26. Noble, S. U. (2018). Algorithms of oppression: How search engines reinforce racism. New York, NY: NYU Press.
27. Nugroho, Y., Putri, D. A., & Laksmi, S. (2019). Digital dispossession and new imperialism in Indonesia. Journal of Indonesian Social Sciences and Humanities, 11(2), 87–105.
28. Paños-Castro, J., Sánchez-Caballé, A., & Esteve-Mon, F. (2024). Digital transformation and teaching innovation in higher education: A critical perspective. Education Sciences, 14(8), 820. https://doi.org/10.3390/educsci14080820
29. Petchamé, J., Iriondo, I., & Valero, D. (2023). Digital transformation in higher education: Students' perceptions and practices. Heliyon, 9(12), e24058. https://doi.org/10.1016/j.heliyon.2023.e24058
30. Sainz, G. M. (2023). Youth digital activism and social justice education. Human Rights Education Review, 6(1), 1–18.
31. Selwyn, N. (2021). Education and technology: Key issues and debates (2nd ed.). London: Bloomsbury.
32. Selwyn, N. (2022). Less work for the teacher? Artificial intelligence, automation, and the future of education. Educational Philosophy and Theory, 54(13), 1–10.
33. Sloam, J., & Henn, M. (2019). Youthquake 2017: The rise of young cosmopolitan voters in Britain. London: Palgrave Macmillan.
34. Stockman, C., & Nottingham, E. (2022). Surveillance capitalism in schools: What's the problem? Digital Culture & Education, 14(2), 123–138.
35. Wahyono, B. (2020). Tipologi generasi milenial dalam merespons isu sosial politik di Indonesia. Jurnal Ilmu Sosial dan Ilmu Politik, 24(1), 1–15.
36. Wahyono, B. (2022). Pendidikan algoritmik dan masa depan subjek belajar. Jurnal Teknologi Pendidikan, 24(3), 201–215.
37. Williamson, B. (2017). Big data in education: The digital future of learning, policy and practice. London: Sage.
38. Zuboff, S. (2019). The age of surveillance capitalism: The fight for a human future at the new frontier of power. New York, NY: PublicAffairs.

ANALYSIS OF THE INFLUENCE OF ERGONOMIC DESIGN ON THE COMFORT OF USERS OF CABRETTA LEATHER CRAFT PRODUCTS WITH ECOPRINT TECHNIQUE

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Abstract. This study aims to analyze the influence of ergonomic design on the comfort of users of Cabretta leather craft products that use ecoprint techniques. The research method was carried out with a survey approach using a questionnaire that included five aspects of assessment, namely ergonomics, aesthetics, color strength, functionality, and general satisfaction. A total of 20 respondents were involved in filling instruments with a Likert scale of 1–5. The results showed that the ergonomics aspect obtained an average score of 4.2, aesthetics 4.6, color strength 4.1, functionality 4.4, and general satisfaction of 4.5. Overall, ecoprint plant-based leather craft products received a positive rating with a high level of satisfaction (mean total 4.4). These findings confirm that the implementation of ergonomic design not only contributes to user comfort, but also improves aesthetic aspects, color fastness, and functionality, thus impacting overall improved consumer satisfaction.

Keywords: ergonomic design, plant-based leather craftsmanship, ecoprint, user comfort, consumer satisfaction

INTRODUCTION

Leather craft products represent an important part of the creative industry that combines functionality, aesthetic value, and cultural expression. In recent years, the development of sustainable design and the use of environmentally friendly materials have become a central concern in the creative craft sector. One of the innovative techniques that reflects this trend is ecoprint—a natural dyeing method that utilizes pigments from plants through direct contact with the substrate surface, such as fabric or leather. The combination of Cabretta leather, which has fine grain and flexibility, with the ecoprint technique, offers new potential for developing eco-friendly and high-value leather crafts.

However, the attractiveness of a product cannot rely solely on visual aesthetics. For a product to be truly accepted by consumers, ergonomic aspects—such as shape conformity, ease of use, and comfort—play an essential role. Ergonomic design ensures that the product not only looks appealing but also provides functional comfort and reduces user fatigue during interaction. In leather crafts, especially those involving accessories or wearable items, the tactile quality and ergonomic form significantly influence user satisfaction. Yet, research linking ergonomic design with comfort perception in Cabretta leather crafts using ecoprint techniques remains limited.

Previous studies have mostly focused on material characteristics, such as the color fastness of natural dyes [1], [2], [3], [4], [5] or the sustainability aspects of ecoprint techniques [6], [7], [8], [9]. Meanwhile, ergonomic evaluation in craft-based design has often been explored from a functional or anthropometric perspective [10], but rarely integrated with aesthetic and material performance. Therefore, this study seeks to fill the research gap by analyzing the influence of ergonomic design on user comfort in Cabretta leather products decorated with ecoprint motifs.

The rationale for choosing Cabretta leather lies in its distinctive physical properties—soft texture, fine pore structure, and high elasticity—which make it suitable for detailed printing and comfortable for skin contact. When combined with ecoprint, Cabretta surfaces can capture natural plant patterns with impressive visual depth, creating products that are not only functional but also artistically expressive. Nonetheless, the ergonomic performance of these products must be empirically assessed to ensure that their design aligns with user expectations of comfort and usability.

This study aims to evaluate how ergonomic design influences user comfort and satisfaction in Cabretta leather crafts produced using ecoprint techniques. By employing a survey method with five assessment

dimensions—ergonomics, aesthetics, color strength, functionality, and general satisfaction—the study provides quantitative insight into how users perceive and experience these products. The findings are expected to contribute to the discourse on sustainable design, particularly in integrating ergonomic principles into eco-friendly leather craftsmanship. Moreover, the results may serve as a reference for artisans, designers, and researchers in developing innovative craft products that balance aesthetics, sustainability, and user well-being.

LITERATURE REVIEW

1. Ergonomic Design and User Comfort

Ergonomics is the science of designing products and systems that fit human capabilities and limitations to ensure safety, efficiency, and comfort [11], [12]. In the context of craft design, ergonomics concerns how form, proportion, and texture influence the ease and comfort of product use. Ergonomic design aims not only to prevent physical discomfort but also to improve the overall user experience, including perceptual and emotional satisfaction [13]. Therefore, ergonomic principles have become essential in the design of wearable or handheld products, such as bags, wallets, gloves, and other leather-based crafts.

2. Cabretta Leather as Craft Material

Cabretta leather is a fine-grained, soft, and strong type of sheepskin derived mainly from hair sheep. It is often used for gloves, footwear, and fashion accessories due to its smooth texture, elasticity, and excellent dye absorption [14]. These properties make it ideal for surface treatments such as ecoprint, allowing natural pigments from leaves or flowers to penetrate the collagen fibers effectively. The natural cream color of Cabretta—resulting from chrome tanning—provides a neutral base that enhances the visibility and clarity of ecoprint patterns.

3. Ecoprint and Sustainable Craft Practices

Ecoprint is a sustainable textile and leather coloring technique that uses natural pigments from plants without synthetic dyes or excessive chemical waste [15]. The process involves contact printing, where plant materials are placed directly on the substrate surface and steamed to transfer pigments and tannins. Compared to synthetic printing, ecoprint minimizes environmental impact while producing unique and non-repetitive patterns. Previous studies [2], [16], [17], [18], [19], [20] indicate that the quality of ecoprint outcomes depends on the type of plant, mordant, and substrate used. In this research, Cabretta leather was selected to explore its visual and tactile interaction with ecoprint pigments.

4. Integration of Ergonomics and Aesthetics in Craft Design

In the creative craft industry, especially leather-based products, ergonomic and aesthetic considerations are closely intertwined. A well-designed product must provide not only physical comfort but also visual and emotional appeal. According to Djelantik [21] and Dewey [22], aesthetic experience in craft objects arises from a balance between form, function, and sensory quality. When ergonomic design principles are applied effectively, they enhance the aesthetic appreciation by improving the user's perception of harmony and usability. Thus, the integration of ergonomics and aesthetics can significantly affect user satisfaction and product acceptance.

5. Conceptual Framework

Based on the reviewed literature, this study assumes that ergonomic design directly influences user comfort, and this comfort correlates positively with overall satisfaction. The study also considers aesthetic value, color strength, and functionality as supporting dimensions that shape user perceptions. Hence, the research integrates ergonomic theory with aesthetic and sustainable craft design principles to analyze Cabretta leather products with ecoprint techniques.

RESEARCH METHOD

1. Research Design

This study employed a quantitative descriptive design using a survey approach to measure user perceptions of ergonomic design and its relationship to comfort and satisfaction. The research focused on *Cabretta leather craft products* developed using the *ecoprint* technique. Data collection was conducted through a structured questionnaire containing five aspects of evaluation: ergonomics, aesthetics, color strength, functionality, and general satisfaction.

2. Population and Sample

The research involved 20 respondents who were potential users or craft product consumers aged 20–45 years. The sampling method used was purposive sampling, emphasizing respondents who had prior experience in evaluating or using handmade leather accessories, such as wallets, bags, or covers. The number of respondents was considered adequate for preliminary analysis of user satisfaction in design evaluation studies [23].

3. Research Instrument

The questionnaire used a **Likert scale** ranging from 1 (strongly disagree) to 5 (strongly agree). Each item was designed to capture user perceptions of product comfort, visual appeal, color durability, and functionality. The ergonomic indicators included aspects of grip comfort, proportion, and ease of use; aesthetic indicators focused on visual harmony and motif clarity; color strength indicators measured the visual durability of *ecoprint* motifs; functionality included practical usability; while general satisfaction reflected overall evaluation.

Before distribution, the questionnaire was reviewed by two design experts to ensure content validity and clarity of the items. Reliability testing from the pilot data produced a Cronbach's alpha coefficient of 0.86, indicating that the instrument was reliable.

4. Data Collection and Analysis

Data were collected through Google Forms and then processed using Microsoft Excel and SPSS. Descriptive statistics (mean, percentage, and standard deviation) were used to describe user responses for each aspect. The relationships among variables—particularly between ergonomic design and user satisfaction—were analyzed using Pearson correlation. The results were interpreted to determine how ergonomic considerations contribute to comfort, perceived color quality, and functional satisfaction.

5. Research Ethics

All participants voluntarily participated and provided informed consent. No personal identifying data were collected, and all responses were treated confidentially for academic purposes only. This study was conducted in accordance with the ethical principles of research involving human participants.

RESULTS AND DISCUSSION

1. Descriptive Results of User Assessment

The assessment of Cabretta leather craft products produced using the ecoprint technique was conducted through a questionnaire distributed to 20 respondents. The evaluation focused on five main aspects: ergonomics, aesthetics, color strength, functionality, and overall satisfaction. Respondents rated each aspect on a 5-point Likert scale ranging from 1 (very poor) to 5 (excellent).

(a) (b) (c)

FIGURE 1. Cabretta leather craft products created using the ecoprint technique with natural plant dyes and ergonomic design considerations: (a) sling bag, (b) pouch, (c) bifold wallet.

TABLE 1. Descriptive Statistics of User Evaluation Scores

Aspect	Mean	SD	Interpretation
Ergonomics	4.2	0.7	Very good – comfortable design
Aesthetics	4.6	0.5	Excellent – visually appealing
Color Strength	4.1	0.6	Good – natural color tone
Functionality	4.4	0.6	Very good – easy to use
Overall Satisfaction	4.5	0.5	High satisfaction

Source: Processed primary data, 2025.

The quantitative results show generally positive perceptions of Cabretta leather products made using the ecoprint technique. The overall mean score of 4.36 indicates that users perceive the products as comfortable, aesthetically pleasing, and functionally effective. Among these aspects, aesthetics achieved the highest score (4.6), highlighting the strong visual appeal of ecoprint motifs on Cabretta leather. Conversely, color strength

obtained the lowest score (4.1), implying that users may perceive slight fading or inconsistency in long-term color durability.

These results confirm that ergonomic design significantly supports comfort and usability [24], [25], [26]. The use of natural dyes fixed with mordants such as alum, lime, and iron sulfate provided adequate color retention under normal use [27], [28], [29], [30]. Functionality (4.4) and overall satisfaction (4.5) scores also demonstrate that the combination of ergonomic form, aesthetic value, and durable coloration enhances user experience holistically [22], [24], [31].

2. Relationship between Ergonomics and User Satisfaction

The findings indicate a clear and positive relationship between ergonomic design and user satisfaction in Cabretta leather craft products made with the ecoprint technique. Respondents who rated the ergonomic aspect highly also tended to express greater overall satisfaction, suggesting that comfort and usability strongly influence the user's perception of product quality.

Products with well-proportioned shapes, smooth finishing, and comfortable grip were particularly appreciated for their user-friendly design. The softness and flexibility of Cabretta leather contributed to a pleasant tactile experience, while its light weight enhanced ease of handling during daily use. These ergonomic qualities reinforced feelings of comfort and practicality, which directly affected users' emotional and aesthetic responses.

This tendency aligns with the ergonomic design principles proposed by Helander [32] and Norman [13], who emphasize that products designed to fit human physical and sensory needs can increase comfort, usability, and emotional attachment. In this context, ergonomic considerations not only support functional aspects but also strengthen the aesthetic and affective value of the product, leading to higher user satisfaction.

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3. Aesthetic and Color Evaluation

The aesthetic aspect received the highest mean score (4.6), indicating that the ecoprint technique on Cabretta leather successfully created products that were visually appealing and artistically distinctive. Respondents described the resulting motifs as natural, organic, and harmonious, with each piece showing a unique pattern that reflected the natural forms of the leaves used. This visual uniqueness is a key factor in the attractiveness of handcrafted products, aligning with Dewey's [22] view that aesthetic experience emerges from the harmony between material, process, and perception.

The color appearance also played an important role in shaping the aesthetic appeal. Variations in mordant type—alum, iron sulfate, and lime produced distinct tonal outcomes. Alum generated bright and clean color tones, iron sulfate deepened the hue with stronger contrast, while lime created softer and muted tones. Such diversity was perceived by users as an element of artistic richness and natural authenticity, emphasizing the handmade character of the ecoprint process.

(a) (b) (c)

FIGURE 2. Ecoprint results on Cabretta leather using three mordants: (a) alum – bright tone, (b) iron sulfate – dark contrast, and (c) lime – soft muted tone.

However, the color strength aspect, with a mean score of 4.1, suggests that although the tones were visually pleasing, their durability could be further improved. Some respondents noted that natural colors tend to fade slightly over time, especially with frequent exposure to light or washing. This observation aligns with Guo et al. [33] and Zhou et al. [34], who reported that natural dye performance on protein-based substrates like leather is influenced by mordant bonding and fiber porosity.

In summary, the ecoprint process on Cabretta leather achieved a strong aesthetic response due to its organic visual character and natural color palette. Yet, improving mordant fixation and UV resistance could further enhance color stability, supporting both the aesthetic and functional longevity of the product.

4. Functional and Emotional Value

From a functional perspective, Cabretta leather craft products made with the ecoprint technique received a high mean score of **4.4**, indicating that users found them easy to use, durable, and adaptable to various contexts of daily life. Respondents emphasized that the products not only fulfilled their functional role as accessories or fashion items but also maintained comfort and usability—key indicators of ergonomic success. The soft and flexible nature of Cabretta leather contributed to ease of handling, while its lightweight character made the products suitable for prolonged use without discomfort.

The ergonomic attributes, such as balanced proportions, smooth surface finishing, and appropriate material thickness, were identified as major contributors to this functionality. These qualities are consistent with Helander's [32] ergonomic design principles, which emphasize harmony between physical comfort, task efficiency, and user interaction. The results therefore demonstrate that ergonomically designed handmade products can achieve both *practical efficiency* and *aesthetic refinement*, bridging art and usability [13].

Beyond practical performance, respondents also expressed a strong **emotional connection** to the products. Many associated the natural colors and organic motifs of ecoprint with a sense of calmness, authenticity, and environmental awareness. This emotional resonance supports Dewey's [22] concept of *art as experience*, wherein aesthetic appreciation extends to personal meaning and sensory satisfaction. Furthermore, the use of natural dyes and manual craftsmanship enhanced the perceived ethical and cultural value of the products, aligning with the principles of sustainable creativity described by Throsby [35] and Howkins [36].

In this context, the functional and emotional dimensions of the Cabretta ecoprint crafts are intertwined—ergonomic comfort amplifies aesthetic enjoyment, while ecological awareness deepens emotional satisfaction. This synthesis of usability, beauty, and sustainability positions ecoprint Cabretta leather as a contemporary example of *green craftsmanship*, reflecting innovation grounded in cultural and ecological consciousness.

5. Summary of Findings

This study analyzed the influence of ergonomic design on the comfort and satisfaction of users of Cabretta leather craft products made using the ecoprint technique. Quantitative data from 20 respondents indicated consistently positive evaluations across five aspects: ergonomics (mean = 4.2), aesthetics (mean = 4.6), color strength (mean = 4.1), functionality (mean = 4.4), and overall satisfaction (mean = 4.5). The results reveal that users perceived these products as visually appealing, comfortable, and highly functional.

The aesthetic dimension emerged as the most dominant factor influencing satisfaction, reflecting the strong appeal of natural patterns and hues produced by plant-based dyes and eco-friendly mordants. The ergonomic design aspects also showed a significant positive relationship with user satisfaction, confirming that comfort, proportion, and material flexibility play essential roles in enhancing user experience. While color strength received slightly lower scores, it still indicated good performance and suggested opportunities for technical improvement in dye fixation and UV resistance.

Overall, the findings confirm that the integration of ergonomic design principles and ecoprint techniques results in sustainable craft products that combine functionality, aesthetic quality, and environmental responsibility. Cabretta leather—when treated through natural dyeing and careful design—demonstrates high potential for development within the creative and sustainable fashion industries. The study thus contributes to the growing discourse on *eco-ergonomic design*, highlighting how user-centered approaches can harmonize artistic value, comfort, and sustainability in modern craftsmanship.

CONCLUSION

This study concludes that the ergonomic design of Cabretta leather craft products using the ecoprint technique has a significant positive influence on user comfort and satisfaction. The quantitative results show that users highly appreciate the product's visual appeal (mean 4.6), ergonomic comfort (mean 4.2), and functional performance (mean 4.4), leading to an overall satisfaction mean of 4.5. The aesthetic aspect was identified as the dominant factor shaping positive perceptions, while the ergonomic form strengthened comfort and usability. Although color strength (mean 4.1) performed slightly lower, it remained within a good category, indicating potential for technical enhancement in mordanting and fixation stages. These findings emphasize that integrating ergonomic principles with sustainable techniques such as ecoprint can produce environmentally friendly leather craft products that are both functional and artistically valuable. Consequently, Cabretta leather ecoprint products hold strong potential as eco-conscious innovations in the creative craft and fashion industries.

REFERENCES

[1] B. Klaykruayat, N. Vuthiganond, and P. Chitichotpanya, "Optimization of ultrasound-assisted anthocyanin extraction from agricultural waste purple corn silk for multifunctional hemp finishes," J. Met. Mater. Miner., vol. 34, no. 4, 2024, doi: 10.55713/JMMM.V34I4.2027.

[2] S. Nurmasitah, S. F. Sangadah, and Musdalifah, "The quality of Jatropha leaf ecoprint products using steaming and pounding techniques," in IOP Conference Series: Earth and Environmental Science, 2023. doi: 10.1088/1755-1315/1203/1/012020.

[3] W. Nuriana, M. Winarni, N. A. Arfan, and A. Fudholi, "Coloring of Mahogany (Swietenia Macrophylla King.) on Textiles with Mordant Process and Fixation Against Fastness," Int. J. Des. Nat. Ecodynamics, vol. 18, no. 5, pp. 1097–1102, 2023, doi: 10.18280/IJDNE.180510.

[4] H. S. Agrawal, M. Praneetha, A. Singh, and A. K. Rajpoot, "A Comprehensive Survey on Production of Fabric from the Organic Extract," in Proceedings - 4th IEEE 2023 International Conference on Computing, Communication, and Intelligent Systems, ICCCIS 2023, 2023, pp. 6–12. doi: 10.1109/ICCCIS60361.2023.10425232.

[5] K. Swetha and S. K. Chinnammal, "A Sustainable Technique to Enhance the Color Intensity of Natural Dyes on Cotton Fabric," J. Environ. Nanotechnol., vol. 13, no. 2, pp. 477–483, 2024, doi: 10.13074/jent.2024.06.242656.

[6] D. P. Sukmawati, I. Nurlatifah, and ..., "ECOPRINT EXPLORATION IN ENVIRONMENT FRIENDLY VISUAL ART WITH NATURAL DYES FROM NATURE," … Annu. Conf. …, 2024, [Online]. Available: https://conference.uin-suka.ac.id/index.php/accept/article/view/1651

[7] A. Faiz and A. H. Afendi, "ECOPRINT INTEGRATION FOR ENVIRONMENTAL CHARACTER EDUCATION IN AN ADIWIYATA SCHOOL: CASE STUDY OF SDN 1 SITIWINANGUN," JPSD (Jurnal Pendidik. Sekol. Dasar), 2025, [Online]. Available: https://jurnal.untirta.ac.id/index.php/jpsd/article/view/35235

[8] I. RISNA, IMPLEMENTASI SUSTAINABILITY PADA ECOPRINT. repository.unj.ac.id, 2023. [Online]. Available: http://repository.unj.ac.id/37470/

[9] S. E. Wahyuningsih, W. Widowati, and ..., "The Role of Fashion Design Education in Developing Ecoprint Technique Clothing to Support Final Projects and Increase Sustainability Awareness," … Conf. (VEIC-5 …, 2024, [Online]. Available: https://www.atlantis-press.com/proceedings/veic-23/125997685

[10] R. Nagpal, S. Sharma, and S. Khanna, Designing with AI: Ethical Challenges and Opportunities in Indian Craft based Fashion. books.google.com, 2025. [Online]. Available: https://books.google.com/books?hl=en&lr=&id=eQ9nEQAAQBAJ&oi=fnd&pg=PR1&dq=ergonomic+evaluation+%22craft+based%22+design&ots=nFtFsnNuMm&sig=Ubi5VQVNu9OUwpJSU1VAzJHcJss

[11] S. Pheasant and C. M. Haslegrave, Bodyspace: Anthropometry, ergonomics and the design of work. CRC press, 2018.

[12] K. E. McCormick and J. H. Sanders, Quality. Butterworth-Heinemann, 2022.

[13] D. A. Norman, "Introduction to this special section on beauty, goodness, and usability," Human–Computer Interact., vol. 19, no. 4, pp. 311–318, 2004.

[14] C. Defonseka, Polymeric coating systems for artificial leather: standard and latest technologies. Walter de Gruyter GmbH & Co KG, 2022.

[15] K. Recker, True colors: world masters of natural dyes and pigments. Schiffer+ ORM, 2024.

[16] I. Risnasari, A. Nuryawan, and A. S. Sinaga, "Utilization of Acacia auriculiformis tannins as a biomordant material for fabrics in the natural dyeing process using the ecoprint technique," in IOP Conference Series: Earth and Environmental Science, 2024. doi: 10.1088/1755-1315/1352/1/012022.

[17] R. Sholikhah, Widowati, S. Nurmasitah, and R. Nafi'Ah, "The impact of the use of different mordantt types on the ecoprint dyeing using tegeran (Cudraina javanensis) dye on primisima fabric," in IOP Conference Series: Earth and Environmental Science, 2022. doi: 10.1088/1755-1315/969/1/012049.

[18] S. Nurmasitah, R. Solikhah, Widowati, and A. S. Milannisa, "The impact of different types of mordant on the eco-print dyeing using tingi (Ceriops tagal)," in IOP Conference Series: Earth and Environmental Science, 2022. doi: 10.1088/1755-1315/969/1/012046.

[19] S. E. Wahyuningsih, A. Kusumastuti, M. Krisnawati, O. Paramita, M. Yuniar, and M. R. Furi, "Quality of motif, colors and fastness of Sekar Ayu ecoprint products in terms of mordant type, natural dyes, and types of leaves on silk fabrics," in IOP Conference Series: Earth and Environmental Science, 2022. doi: 10.1088/1755-1315/969/1/012043.

[20] R. Sholikhah, Widowati, and S. Nurmasitah, "The impact of the use of different mordants types on the ecoprint dyeing using secang wood (Caesalpinia sappan Linn) dye on primisima fabric," in AIP Conference Proceedings, 2023. doi: 10.1063/5.0113010.

[21] A. A. M. Djelantik, Estetika: Sebuah Pengantar. Bandung: Masyarakat Seni Pertunjukan Indonesia, 1999.

[22] J. Dewey, Art as Experience. New York: Minton, Balch & Company, 1934.

[23] Sugiyono, Metode penelitian kualitatif, kuantitatif, dan R&D (Edisi terbaru). Bandung: Alfabeta, 2022.

[24] P. P. Mohanty, S. S. Mahapatra, A. Mohanty, and Sthitapragyan, "A novel multi-attribute decision making approach for selection of appropriate product conforming ergonomic considerations," Oper. Res. Perspect., vol. 5, pp. 82–93, 2018, doi: 10.1016/j.orp.2018.01.004.

[25] Y. Hou, X. Xia, J. Wang, and W. Zhu, "Research on innovative design of intelligent wearable products based on human machine engineering and bionics," MCB Mol. Cell. Biomech., vol. 21, no. 2, 2024, doi: 10.62617/mcb461.
[26] Y. Choi, X. Yang, J. Park, H. Jung, W. Lee, and H. You, "Development of an ergonomic design process for smartphone hard key locations," Appl. Ergon., vol. 97, 2021, doi: 10.1016/j.apergo.2021.103532.
[27] S. Safapour, L. J. Rather, and M. Mazhar, "Coloration and Functional Finishing of Wool via Prangos ferulacea Plant Colorants and Bioactive Agents: Colorimetric, Fastness, Antibacterial, and Antioxidant Studies," Fibers Polym., vol. 24, no. 4, pp. 1379–1388, 2023, doi: 10.1007/s12221-023-00156-1.
[28] N. Vuthiganond, P. Chitichotpanya, M. Nakpathom, and R. Mongkholrattanasit, "Ecological dyeing of acrylic yarn with colorant derived from natural lac dye," J. Met. Mater. Miner., vol. 32, no. 4, pp. 71–78, 2022, doi: 10.55713/JMMM.V32I4.1529.
[29] M. M. Hassan, "Valorisation of sulphonated lignin as a dye for the sustainable colouration of wool fabric using sustainable mordanting agents: enhanced colour yield, colourfastness, and functional properties," RSC Sustain., vol. 2, no. 3, pp. 676–685, 2024, doi: 10.1039/d3su00402c.
[30] S. Failisnur, "Reuse of liquid waste from textile dyeing with natural dyes gambier (Uncaria gambir Roxb.) for cotton yarn dyeing," ARPN J. Eng. Appl. Sci., vol. 12, no. 18, pp. 5313–5318, 2017.
[31] K. Weatherly et al., "Case study of user experience-driven design in a new local anaesthetic dentistry jet injection device," J. R. Soc. New Zeal., vol. 54, no. 2, pp. 177–189, 2024, doi: 10.1080/03036758.2022.2113809.
[32] M. Helander, A guide to human factors and ergonomics. CRC press, 2005.
[33] H. Jiang et al., "Eco-friendly dyeing and finishing of organic cotton fabric using natural dye (gardenia yellow) reduced-stabilized nanosilver: full factorial design," Cellulose, 2022, doi: 10.1007/s10570-021-04401-9.
[34] Y. Zhou, C. Yuan, Q. Zhang, X. Zhang, Y. Li, and H. Wen, "Preparation of quaternary ammonium lignosulfonate modified UV resistant polyurethane and its application in leather dyeing," Int. J. Biol. Macromol., vol. 292, 2025, doi: 10.1016/j.ijbiomac.2024.139259.
[35] D. Throsby, Economics and culture. Cambridge University Press., 2001. [Online]. Available: https://researchers.mq.edu.au/en/publications/economics-and-culture?utm_source=chatgpt.com
[36] J. Howkins, The Creative Economy: How People Make Money from Ideas. London: Penguin, 2001.

Utilization of Cultural Resources from Prambanan Temple Reliefs as a Source of Inspiration in Creating Yogyakarta Batik with Natural and Synthetic Colors

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Abstract. The purpose of this study is to explore, describe, and create new batik designs based on the cultural resources of the Prambanan temple as a basis for the creation of Yogyakarta batik. The approach used in this study is the Gustami craft creation method, which is one of the appropriate approaches in the study of the development of the batik industry. The success of this research is based on the exploration and processing of cultural resources from the Prambanan Temple to be used as a source of ideas in the creation of batik decorative art with a combination of natural and synthetic colors. The Kala Manut motif is the motif that best represents the Prambanan Temple Ornament Motif, with a score of 78, followed by Kala Ksatria with a score of 62, Lung Garuda with a score of 61, Numpang Rejeki with a score of 60, Lung Geometri with a score of 54, and Purna Kalasa with a score of 53. Meanwhile, based on the suitability of colors in depicting the atmosphere and aesthetics of the Prambanan Temple environment from the Prambanan Temple ornamental motif works, Lung Geometri received a score of 83, Lung Garuda received a score of 74, Numpang Rejeki received a score of 70, Kala Ksatria received a score of 66, Purna Kalasa received a score of 61, and Kala Manut received a score of 60. In terms of color, Lung Geometri received the highest score of 83, with dark brown meaning comfort, simplicity, and classicism, a color that is widely chosen by consumers. It is also quite important in the efforts to preserve, develop, and create new batik motifs in the Yogyakarta style. The outcome of this research is the creation of a new motif (Prambanan Motif) and the enrichment of the archipelago's batik art heritage.

INTRODUCTION

Yogyakarta batik is very diverse, but until now, batik with distinctive characteristics that show and depict the Prambanan Temple as a tourist attraction has not been widely produced by batik entrepreneurs. Therefore, this study aims to address this issue by focusing on the Prambanan Temple tourist attraction, which is also known as the *adhiluhung* culture.

Adhiluhung is a term used to describe works of the past that are noble and important. These extraordinary works, with their beauty and philosophical value, are mostly buried deep in the ground and represent a cultural wealth that the nation's children have forgotten. In the midst of extraordinary technological developments, *adhiluhung* works today seem to be deliberately pushed into obscurity to fulfill the ambitions of individuals or groups in pursuit of something that does not originate from their own culture.[1] This is evident in all kinds of (*cemplang*) strange appearances, but ignorance gives rise to pride and confidence in what they have. Perhaps we also need to consider the opinion of Mack[2], who states that Western art forms can be used as teaching materials and sources of reference (in schools and outside of schools) as long as a strong foundation of mental representation in local art is developed first. Mack[2] believes that local art is a crystallization of the nature, strength, and soul of the nation, so it is important to explore and revive it as the foundation of life in society. We as a community have a responsibility to appreciate and preserve the nation's cultural values, beliefs, and customs.[3]

In anticipation of this, the government has made every effort to revive Indonesia's *adhiluhung* culture, including the arts and crafts. In this context, creativity is essential, as competition to dominate market share will be won by creative products. Specifically, regarding batik craftsmanship, Wacik[4] emphasizes that our batik (*adhiluhung* batik) and the presence of natural-colored batik must continue to be developed so that the real beauty of batik can be sought. The Indonesian people need to maximize the utilization of human resources, natural resources, and cultural resources so that this nation can participate in the world of trade to support its own people. Research on Indonesian batik motifs and colors is one of the most important elements in making

batik beautiful and meaningful. This concerns social and cultural factors, namely the values of a society. By understanding the cultural values of a society, we can understand what is liked and disliked, what is considered taboo, and what is considered good. In the world of batik, certain colors have very specific meanings and are considered to bring good luck or to be taboo for the wearer. The uniqueness of batik must continue to be explored, as this will undoubtedly foster a sense of affection and interest among the wider community to own (purchase) it.

Therefore, research on the creation of Prambanan motifs supported by color processing to obtain distinctive characteristics as an icon of the Prambanan region (tourist attraction) is quite important. In a socio-cultural context, batik wearers will feel proud because what they wear is their own culture, they understand the essence reflected in the decorations, and they feel connected to their homeland. The ultimate goal is that products like this will give rise to a generation that is patriotic and loves their homeland, feels a sense of ownership, and is responsible for its preservation.

LITERATURE REVIEW

The History of Prambanan Temple

The original name of this Hindu temple complex is derived from Sanskrit, Siwagrha (House of Shiva) or Siwalaya (Realm of Shiva), based on the Siwagrha Inscription dated 778 Saka (856 AD). The Trimurti is revered in this temple complex with three main temples dedicated to Brahma, Shiva, and Vishnu. However, Shiva Mahadeva, who occupies the main chamber of the Shiva temple, is the most revered deity in this temple complex. Gronemen[5] argues that the name Prambanan comes from the word *ramban*: to gather leaves (for household or medicinal purposes), [pra-ramban-an] is still a place, usually in the forest, where the leaves are gathered. This explanation of the name of the ruins, which were undoubtedly found in such a forest at one time, is also contained in the dictionary compiled by Roorda; [an explanation] so simple and natural that we need not look for another explanation.

Prambanan is the largest and most magnificent Hindu temple ever built in ancient Java. The construction of this royal Hindu temple was initiated by Rakai Pikatan as a counterpart to the Buddhist temple of Borobudur and the Sewu temple, located not far from Prambanan. Some historians believe that the construction of this grand Hindu temple marked the return of the Sanjaya family to power in Java, which is related to the theory of two rival dynasties with different beliefs: the Sanjaya dynasty, which was Hindu, and the Sailendra dynasty, which was Buddhist. Certainly, the construction of this temple signaled that Saivite Hinduism had regained the support of the royal family, after the Sailendra dynasty had previously tended to support Mahayana Buddhism. This marked the shift in the Medang kingdom's religious focus from Mahayana Buddhism to the worship of Shiva.

This building was first constructed around 850 AD by Rakai Pikatan and was continuously refined and expanded by King Lokapala and King Balitung Maha Sambu. Based on the Siwagrha inscription dated 856 AD, this sacred building was built to honor the god Shiva, and the original name of this building in Sanskrit is Siwagrha (Sanskrit: Shiva-grha, meaning: House of Shiva) or Siwalaya (Sanskrit: Shiva-laya, meaning: Realm of Shiva or World of Shiva). This inscription mentions that during the construction of the Siwagrha temple, public works were also carried out to change the water system to divert the flow of the river near this temple. The river in question is the Opak River, which flows from north to south along the western side of the Prambanan temple complex. Historians suspect that originally, the river flowed in a curve to the east and was considered too close to the temple, as erosion from the river could endanger the temple's construction. This water management project was carried out by creating a new river diversion that cuts across the curve of the river with a north-south axis along the western wall outside the temple complex. The original river flow was then filled in to provide more land for the construction of a row of perwara temples (guard temples or companion temples).

This complex of buildings was periodically refined by subsequent Medang Mataram kings, such as Daksa and Tulodong, and expanded with the construction of hundreds of additional temples around the main temple. Due to its grandeur, Prambanan Temple served as the grand temple of the Mataram Kingdom, where various important royal ceremonies were held. At the height of its glory, historians believe that hundreds of Brahmin priests and their students gathered and lived in the outer courtyard of this temple to study the Vedas and perform various Hindu rituals and ceremonies. Meanwhile, the center of the kingdom or royal palace of Mataram is believed to have been located somewhere near Prambanan on the Kewu Plain. This temple consists of three courtyards with a central pattern of three wahana temples, two apit temples, four kelir temples, four patok temples, and 224 perwara temples.

Around the 930s, the capital of the kingdom was moved to East Java by Mpu Sendok, who founded the Isyana Dynasty. The reason for this relocation of power is not known for certain. However, it is very likely that it was caused by the violent eruption of Mount Merapi, which towers about 20 kilometers north of Prambanan

Temple. Other possible causes include war and power struggles. After the capital was moved, Prambanan Temple began to be neglected and left unattended, so that slowly the temple began to deteriorate and collapse.

The temple is believed to have completely collapsed due to a powerful earthquake in the 16th century. Although it is no longer a center of Hinduism and worship, the temple is still recognized and known by the Javanese people who live in the surrounding villages. The temples and Durga statues in the main building of this temple inspired a Javanese folk tale, the legend of Rara Jonggrang. After the division of the Mataram Sultanate in 1755, the temple ruins and the nearby Opak River became the boundary between the Yogyakarta Sultanate and the Surakarta (Solo) Kingdom.

The local Javanese residents around the temple already know about its existence. However, they do not know the true historical background, who the king was, or which kingdom built this monument. As a result of their imagination, the local people created local fairy tales to explain the origins of these temples, colored with fantastic stories about giant kings, thousands of temples built by supernatural beings and demons in just one night, and beautiful princesses who were cursed to become statues. The legend of Prambanan Temple is known as the story of Rara Jonggrang.

In 1733, these temples were discovered by CA. Lons, a Dutch national. They attracted worldwide attention during the British occupation of Java. At that time, Colin Mackenzie, a surveyor working under Sir Thomas Stamford Raffles, discovered these temples. Although Sir Thomas later ordered further investigation, the temple ruins remained neglected for decades. Unserious excavations were carried out throughout the 1880s, which unfortunately encouraged the looting of the temple's carvings and stones. Then, in 1855, Jan Willem IJzerman began cleaning and removing some stones and soil from the temple chambers. Shortly thereafter, Isaäc Groneman carried out a large-scale demolition, and the temple stones were piled haphazardly along the Opak River. The statues and reliefs were taken by the Dutch and used as garden decorations, while the indigenous people used the temple stones for building materials and house foundations.

Restoration began in 1918, but serious efforts did not begin until the 1930s. In 1902–1903, Theodoor van Erp maintained the parts that were prone to collapse. In 1918–1926, the Oudheidkundige Dienst (Jawatan Purbakala) under P.J. Perquin continued the work more systematically in accordance with archaeological principles. As is well known, their predecessors had moved and dismantled thousands of stones indiscriminately without any thought of restoration. In 1926, De Haan continued the work until he died in 1930. In 1931, he was replaced by Ir. V.R. van Romondt until 1942, and then the leadership of the renovation was handed over to an Indonesian son, which continued until 1993.

Restoration efforts continue to this day. The restoration of the Siwa temple, the main temple of the complex, was completed in 1953 and inaugurated by the first President of the Republic of Indonesia, Sukarno. Some parts of the temple were restored using new stones, as many of the original stones had been stolen or reused elsewhere. A temple will only be restored if at least 75% of the original stones are still intact. Therefore, many small temples were not rebuilt and only their foundations remain. Today, this temple is listed as a UNESCO World Heritage Site, a status granted by UNESCO in 1991. Currently, several parts of the Prambanan temple are being restored to repair damage caused by the 2006 Yogyakarta earthquake.

The Beauty of Prambanan Temple Ornaments

Prambanan Temple has various types of ornaments/decorative motifs on its walls. These ornaments/decorative motifs include kala motifs, makara motifs, human and animal figures, vines, Prambanan motifs, geometric motifs, textiles, and so on, as well as reliefs depicting stories such as Ramayana and Krisnayana. One of many reliefs carved on the walls of Prambanan Temple, there is one type of relief that is unique and distinctive as an ornamental relief that can only be found at Prambanan Temple. This relief was later referred to by Van Erp [5] as the Prambanan motif. This relief features a Kalpataru relief, which is depicted differently and is not found in any other temple in Indonesia except Prambanan Temple.[6]

The Kalpataru relief at Prambanan Temple, or the Prambanan tree of life ornament, is a decorative panel that stands alone as an ornament and is not part of the story relief. The relief depicts a Kalpataru tree that is round, dense, full of lotus flowers, with various types of animals around it. Overall, this relief is framed by ceplok flower ornaments and oval shapes like chains/the number eight arranged alternately surrounding the Kalpataru relief. At the corners of the frame, there are stylized leaf shapes that taper towards the corners with a symmetrical pattern, namely the right and left sides of the leaves are curled/curved inward. However, not all of the Kalpataru relief carvings on the frame are intact, considering that some panels have not been completed and some have been damaged.

The Kalpataru relief at Prambanan Temple is a type of high relief with high detail and precision, created by Prambanan artists. The relief itself is placed flanking the lion carving, which experts refer to as the "Prambanan Motif." The difference in the depiction is clearly visible when comparing the reliefs in the three Trimurti temples (Brahma, Shiva, and Vishnu temples) and those in the three Wahana temples (A, Nandi, and B temples). The framing of the Kalpataru relief in the three Trimurti temples is rectangular upwards, while in the

Wahana temples, the framing is rectangular to the side. In the upward-elongated frame (in the Trimurti temples), the Kalpataru tree appears tall and rounded with varying shapes and types, while in the Wahana temples, where the panels are elongated sideways, the Kalpataru tree appears short and oval, filling the width of the panel so that it does not look like a tree but rather like a bouquet.

FIGURE 1. Researchers conducting field observations (Personal documentation, 2025)

Kalpataru can be found in written sources in Indonesia, such as in the Yupa inscription, which states that "the legacy of King Mulawarman of Kutai is in the form of Kalpataru writing." It is also mentioned in the Tantu Pagelaran story, "there is a place called Hiranyapura that is filled with Kalpataru."[6]

The reliefs depicting cockatoos are so natural that biologists can identify them down to the genus level. Two birds on the Kalpataru tree are only found in the Trimurti temples and 63% (24/38) of the panels in the Nandi temple. In the three Trimurti temples, there are cockatoos and pigeons. Meanwhile, at the Nandi temple, the birds on the Kalpataru tree are kakak tua birds, type 4 birds, and type 6 birds. Among the types of birds carved on the Kalpataru tree, kakak tua birds appear 25% more often, and pigeons appear 40% more often than other unidentified bird types. Their depictions at Prambanan Temple show them performing various activities on the Kalpataru tree, such as picking beads from the Kalpataru tree with their beaks and feet, picking flowers with their beaks, perching on flowering branches, perching on the Kalpataru tree among the flowers, perching on umbrellas (*cattra*), and flying.

FIGURE 2. Kala Makara

(Documentation by Feny Widya Kurniawati, 2025)

Kala, when interpreted literally, means an evil monster.[7] However, Kala is one of Lord Shiva's loyal followers because he is always assigned as the guardian of the sacred place used by Lord Shiva. Kala is always depicted as a large figure with bulging eyes and long fangs. Basically, Kala is a guardian who always wants to consume the negativity and impurity of everyone who enters Lord Shiva's place.[8] Therefore, Kala is always located at the top of the entrance to Lord Shiva's place of worship.

Makara in Sanskrit is a sea monster that resembles a dolphin, crocodile, and elephant because all of these are symbols of respect for the god Kama.[9] Over time, makara became a mythical animal, so that in Old Javanese it was interpreted as a mythical animal resembling a fish, crocodile, and elephant.[7] However, the task of this mythical animal is to guard Lord Shiva, which is carved into the entrance to Hindu temples. Animals in Hindu temples are always depicted as creatures of the underworld, so makara are placed in the Bhurloka section by

followers of Hindu Shiva. Makara are mythological creatures that symbolize fertility, protection, and the transition from the material world to the spiritual world.

Purnakalasa is a very beautiful decorative pattern, featuring curling vines that extend to the right and left from the vase and curl downward. Purna means complete, whole, restored, healed, finished.[10] The difference between purnakalasa and purnaghata lies in the flowers that emerge from the vase. Purnakalasa produces curling vines that are stylized versions of flowers and leaves, while purnaghata produces padma vines or lotus flowers.

The color of the lotus is not depicted, but can be seen from its illustration. The red lotus (padma) is depicted in full bloom and seen from the side; the blue lotus (utpala) is seen in a half-open state, while the white lotus (kumuda) is depicted with a wide but pointed flower.[11] The purnakalasa ornamentation of Plaosan Lor Temple has symbolic value as a symbol of fertility and prosperity, associated with the god Kuwera, who in Hindu mythology is the god of wealth.[12]

The Beauty of Natural Color Batik

Van Musshenbroek, in his book Katoen Verven of Midden Java, published in Leiden in 1877,[13] expressed his admiration for the skill of the Central Javanese people, especially in utilizing the rich potential of natural dyes from their flora. It is said that there are no fewer than 70 types of plants and color-determining materials that can be manipulated to produce a rainbow of colors, which ultimately become a unique color harmony, especially in textiles (batik) known as Kalengan, Sogan, and Jumputan batik. In fact, in 1877, Van Musshenbroek had already cataloged the color harmony of natural batik crafts according to their symbols. There are no less than 33 color harmonies (aesthetics) in natural-colored batik related to their uses, as described below.

1. Natural color batik Penganten Anyar with green edges, dark red inside, and white in the center. 2. Natural color batik Gunung Sari with green edges, lilac in the center, and yellow in the middle. 3. Natural color batik Onengan with green edges, lilac in the center, and white in the middle. 4. Natural color batik Panji Gandrung (the prince's son who is in love) with purple edges, green in the middle, and red in the center. 5. Natural color batik Panji Wuyung (the prince's shy son) with purple edges, green-berlin in the middle, and dark red in the center. 6. Natural color batik Puspa Kencana has lilac edges, yellow in the middle, and dark red in the center. 7. Natural color batik Puspanyidra features the colors of flowers on the island of Java, with lilac edges, dark red in the middle, and a lighter shade in the center. 8. Panji Pilis, natural color batik (son of the prince with a mole on his forehead) has lilac edges and a green center. 9. Klabang Entup natural color batik has dark red edges and a green center. 10. Siwalan Pocot natural color batik is white with a lilac center. 11. Wajuwa natural color batik, lilac with green edges. 12. Panji Balik natural color batik, lilac edges with green inside. 13. Panji Karungrungan natural color batik, green edges with lilac center. 14. Natural-colored Pepesan Mateng batik with green edges and dark red in the center. 15. Natural-colored Gendera Walanda batik with dark blue on the outside, white in the middle, and dark red on the inside. 16. Natural-colored Pare Anom batik, yellow with dark green. 17. Natural-colored Mayang Mekar batik, dark green with light green. 18. Jambe Plocot or pandan Binetok natural color batik has white edges and a dark green center. 19. Sindur natural color batik has white edges and a dark red center. 20. Banteng Kedaton natural color batik has dark blue edges and a dark red center. 21. Natural color batik Paru-patru with lilac to dark red colors. 22. Natural color batik Kembang waru with lilac edges and a yellow center. 23. Natural color batik Kembang Blimbing with lilac edges and dulang green center. 24. Natural color batik Kembang Benguk with lilac edges and blue center. 25. Natural color batik Gaduing Melati has green edges and a white center. 26. Natural color batik Kumudoningrat, meaning lily flower or lily-colored world, has green edges and a yellow center. 27. Natural color batik Panji Lengleng, meaning a prince deeply in love, has thin blue edges and a dark red center. 28. Slinditan natural color batik has dark red edges and a green center. 29. Gula Kelapa natural color batik has dark red edges and a white center. 30. Podang Nesep Sarine natural color batik, or bird sucking flower nectar, has dark red edges and a yellow center. 31. Natural-colored Gagah Kucung Mas batik, or a bird with a yellow crest, has the outermost layer in dark blue and the inner layer in white. 32. Natural-colored Kembang Kangkung batik has lilac edges and a white inner layer, and 33. Natural-colored Mangun Arja batik, named after a noble family, has dark blue edges and a light blue center.

The above list does not include the harmony of blue, black, and white, which is very important in ancient Javanese life, namely the concept of bangun tulak. Brown also has the meaning of comfort, simplicity, and classicism (Septino, 2021:124) and is used for traditional clothing in ritual ceremonies, especially in safety ceremonies.

RESEARCH METHOD

The method used in this study is Gustami's[14] method of kriya creation. According to Gustami,[14] in creating a work of art, especially kriya, several stages must be gone through methodologically, namely exploration (searching for sources of ideas, concepts, and the basis for creation); design (designing the work); and

realization (creating the work of art). In this study, Gustami's[14] method of kriya creation was employed to develop new products and skills as an empowerment effort to enhance the capabilities of the craft community.

RESULTS AND DISCUSSION

The motif is inspired by one of the ornaments found in Prambanan Temple. The motif is recreated into an eight-pointed star shape or resembles a fully blooming flower, composed of elements similar to leaves or symmetrical wings. Among the main motifs are secondary motifs such as small eight-pointed stars, like the stars in the kawung or ceplok motifs. There is a pattern of small white dots that form the edges or borders of the main motif (known as *isen titik-titik* in batik tulis). This dot pattern gives a classic impression and fine details characteristic of traditional batik. This motif reflects harmony and symmetry, which are two main values in Javanese philosophy and classic batik. Symmetry symbolizes balance in life, between the physical and spiritual. Cosmic order, or a harmonious world order. Universal beauty, because the regular repeating motif creates a sense of calm and stability. The 8-sided flower/star motif is inspired by the lotus flower, which is a symbol of purity and enlightenment. The star is a symbol of direction and hope. In many classic motifs, this shape is associated with the center of life energy or the eight directions (as in Hindu-Buddhist and Javanese philosophy).

Preparation Stage

Cotton is a short fiber that belongs to cellulose or plant fibers, and comes from cotton fibers. In Indonesia, cotton is often used as the base material for batik. Susanto [15] explains that, in general, cotton fibers consist of straight polymers of glucose, with glucose molecules arranged alternately, and the distance between two glucose molecules in the same position. When soaked in water, it expands considerably, allowing the pores to absorb the dye. Cotton has many OH groups where O is strongly electronegative and H is weakly electropositive, so that cotton fibers in water are negatively charged due to the strong dipole moment of OH.

The process of making batik with natural dyes is different from synthetic dyeing in that it is longer and more complicated. The process or flow of making natural-colored batik is as follows:

1. Preparation of the fabric, motifs, and patterns.
2. Mordanting or soaking the fabric.
3. The process of making patterns on the fabric.
4. Batik.
5. Dyeing.
6. Fixing or setting.
7. Removing the batik wax.

FIGURE 3. Boiling and filtering the boiled secang bark

Creation of Motifs

The creation of batik cannot be separated from motif design, and motif design is a key part of the pattern or a key part of the ornament, while the pattern is a combination of motifs. As explained by Sartika et al. [16] batik motif design is a tangible work that can be touched and held, which means that batik is an object.

Meanwhile, the beauty of batik (this work) is inseparable from its form, visual elements, and colors, which make batik a work that can be seen and enjoyed.

FIGURE 4. The kala motif

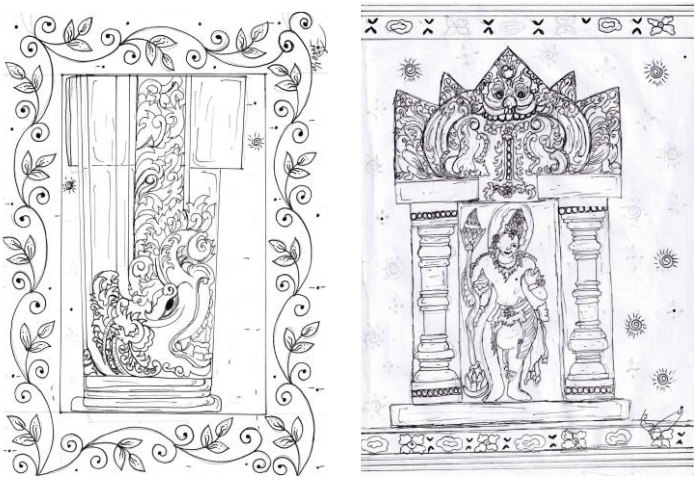

FIGURE 5. The motif kala makara

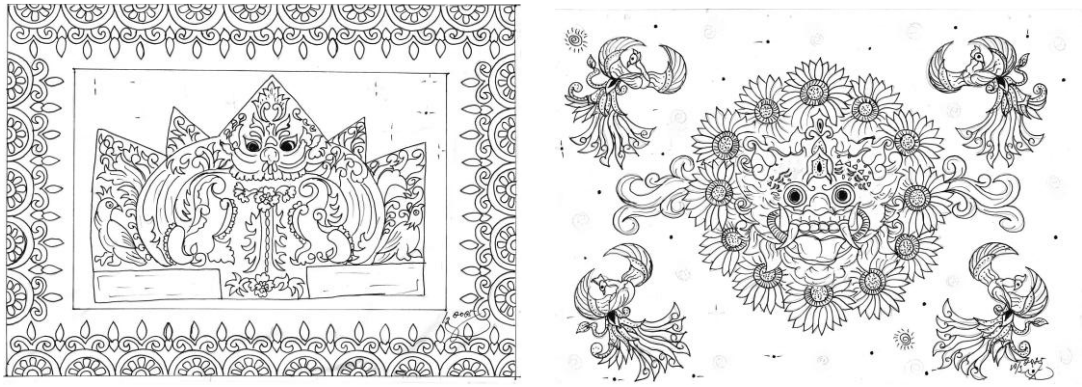

FIGURE 6. The kala makara motif and the kala motif

Creating patterns and Mencanting

Transferring the motif onto fabric by tracing the pattern.

FIGURE 8. Creating patterns and mencanting

Dyeing

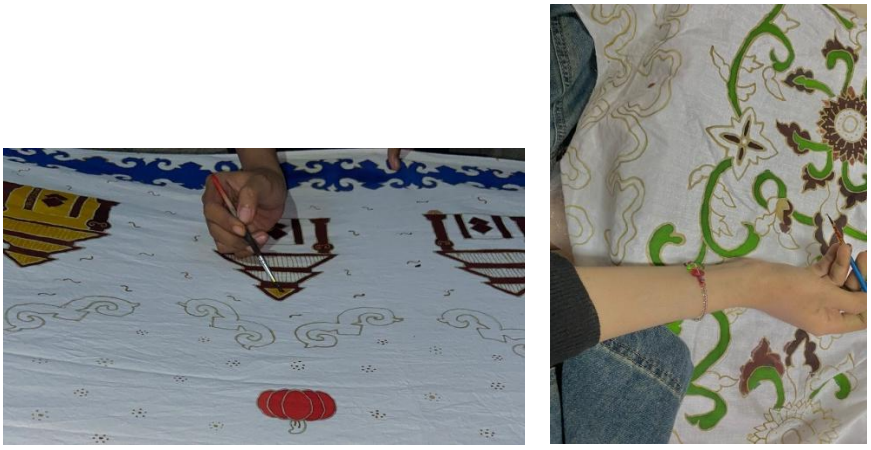

FIGURE 9. Dyeing Process

Completed Works

FIGURE 10. Kala Ksatria and Purna Kalasa

FIGURE 11. Kala Manut and Numpang Rejeki

FIGURE 12. Lung Geometri and Lung Garuda

Testing Consumer Interest in Prambanan Batik Motifs

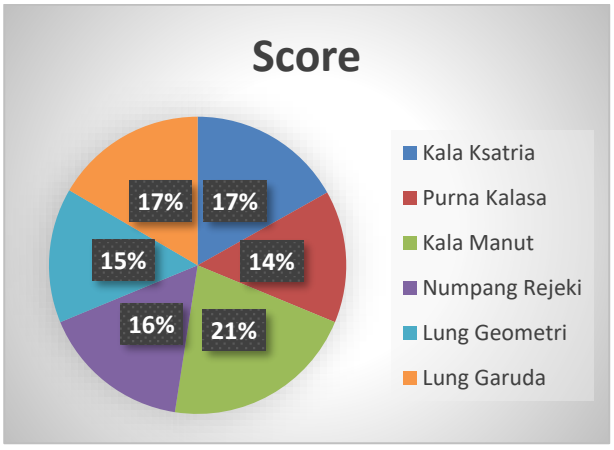

FIGURE 13. Percentage of interest in each Prambanan Batik motif

There were 20 respondents, and each respondent gave a score of one to five for each motif. A score of 1 means that the motif does not accurately describe the ornamentation of Prambanan Temple, a score of 2 means that the motif does not quite accurately describe the ornamentation of Prambanan Temple, a score of 3 means that the motif fairly accurately describes the ornamentation of Prambanan Temple, a score of 4 means that the motif accurately describes the ornamentation of Prambanan Temple, and a score of 5 means that the motif very accurately describes the ornamentation of Prambanan Temple. This indicates that the minimum possible score is 20 and the maximum score is 100. Then, the overall scores of the twenty respondents were added together to obtain the final score. The overall score for the Kala Ksatria motif is 62, the Purna Kalasa motif received a final score of 53, the Kala Manut motif received a final score of 78, Numpang Rejeki received a final score of 60, Lung Geometri received 54, and the Lung Garuda motif received a final score of 61. Therefore, it can be

concluded that the Kala Manut motif is the motif that, according to the respondents, best describes the Prambanan Temple Ornament motif with a percentage of 21%, as shown in Figure 13 above.

Consumer Preference Testing on the Color Harmony of Prambanan Batik

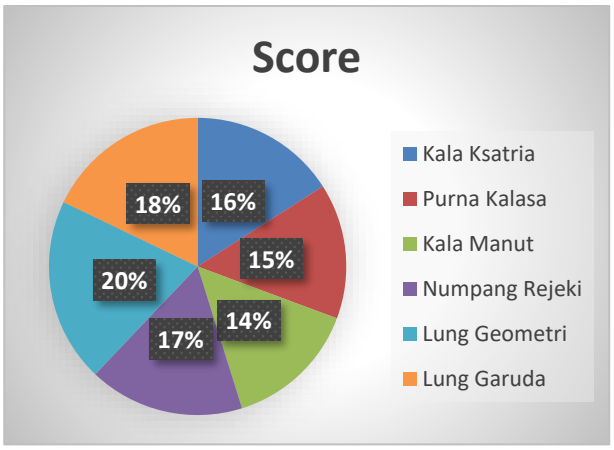

FIGURE 14. Percentage of respondents who prefer the color of Prambanan Batik Motif

The 20 respondents previously filled out a statement regarding the suitability of the colors used in the Prambanan Temple motif batik, with each respondent giving a score of one to five for each piece of Prambanan Temple motif batik fabric. A score of 1 meant that the colors did not match the atmosphere and aesthetics of the Prambanan Temple environment, a score of 2 meant that the colors did not quite match the atmosphere and aesthetics of the Prambanan Temple environment, a score of 3 meant that the colors were fairly consistent with the atmosphere and aesthetics of the Prambanan Temple environment, a score of 4 means that the colors are suitable for depicting the atmosphere and aesthetics of the Prambanan Temple environment, and a score of 5 means that the colors are very suitable for depicting the atmosphere and aesthetics of the Prambanan Temple environment. This shows that the minimum possible score is 20 and the maximum score is 100. Then, the overall scores from the twenty respondents were added up to obtain the final score. The Kala Ksatria motif received a total score of 66, the Purna Kalasa motif received a final score of 61, the Kala Manut motif received a final score of 60, Numpang Rejeki received a final score of 70, Lung Geometri received 83, and the Lung Garuda motif received a final score of 74. Therefore, it can be concluded that the Kala Manut motif is the motif that, according to the respondents, best describes the Prambanan Temple Ornament motif with a percentage of 20%, as shown in Figure 14.

CONCLUSION

In conclusion, the ornaments found at Prambanan Temple are evidence of the beauty and sophistication of sculpture during the Ancient Mataram Kingdom. The reliefs and decorations that adorn this temple not only serve as aesthetic elements, but also have deep philosophical and religious meanings. Various motifs found, such as the Ramayana relief, Kala-Makara, and flora and fauna, reflect the religious values and social life of that period. The existence of these ornaments reflects the glory of Hinduism in the archipelago and demonstrates the extraordinary skill of the past artists.

The Kala Manut motif is the motif that best describes the Prambanan Temple Ornament Motif, with a score of 78, followed by Kala Ksatria with a score of 62, Lung Garuda with a score of 61, Numpang Rejeki with a score of 60, Lung Geometri with a score of 54, and Purna Kalasa with a score of 53. Meanwhile, in terms of color suitability in depicting the atmosphere and aesthetics of the Prambanan Temple environment from the ornamental motifs of Prambanan Temple, Lung Geometri received a score of 83, Lung Garuda received a score of 74, Numpang Rejeki received a score of 70, Kala Ksatria received a score of 66, Purna Kalasa received a score of 61, and Kala Manut received a score of 60. In terms of color, Lung Geometri received the highest score of 83, with the color brown symbolizing comfort, simplicity, and classicism, making it a popular choice among consumers.

REFERENCES

1. I.K. Sunarya, “Zat warna alam alternatif warna batik yang menarik,” Inotek **16**(2), 103–121 (2012).

2. D. Mack, "Pengembangan model pembelajaran kesenian di sekolah," in *Int. Semin. Cult. Arts Educ.*, (Universitas Negeri Surakarta, Surakarta, 2013).
3. I.K. Sunarya, I. Ismadi, W. Wahyono, N.K. Dianita, and I.W. Nain Febri, "Kembar mayang and ronce as motif ideas in natural dye batik of keci beling leaves and honey mango leaves," Open Cult. Stud. **9**(20240044), (2025).
4. J. Wacik, "Strategi promosi batik di dalam dan luar negeri," in *Proceeding Semin. Nas. Kebangkitan Batik Indones. Dengan Tema Batik Di Mata Bangsa Indones. Dan Dunia*, (Yayasan Batik Indonesia dan Paguyuban Pecinta Batik Indonesia Sekar Jagad, Yogyakarta, 2008).
5. R. Jordaan, editor , *Memuji Prambanan* (Yayasan Obor Indonesia, Jakarta, 1996).
6. L.D. Ratnawati, "Variasi Relief Kalpataru pada Candi Prambanan," in *Pros. Pertem. Ilm. Arkeol. V*, (Ikatan Ahli Arkeologi Indonesia, Yogyakarta, 1989), pp. 334–349.
7. P.J. Zoetmulder, and S.O. Robson, *Kamus Jawa Kuna Indonesia* (PT. Gremedia Pustaka Utama, Jakarta, 1995).
8. F. Arifin, "Representasi simbol Candi Hindu dalam kehidupan manusia: Kajian linguistik antropologis," J. Penelit. Hum. **16**(2), 12–20 (2015).
9. S.M. Monier-Williams, *A Sanskrit-English Dictionary: Etymologically and Philologically Arranged with Special Reference to Cognate Indo-European Languages* (Asian Educational Services, New Delhi, 1999).
10. S.S. Utomo, *Kamus Lengkap Jawa-Indonesia* (Kanisius, Yogyakarta, 2009).
11. N. Widya, "Ragam hias non-cerita pada relief candi untuk perkembangan motif batik kontemporer," Balai Arkeol. Banjarmasin **6**(1), 64–78 (2012).
12. R.P. Herwindo, Y. Saliya, D. Mariana, I. Astrina, G. Martinus, Andreas Andika, and N. W., *Eksistensi Candi Sebagai Karya Agung Arsitektur Indonesia Di Asia Tenggara* (Kanisius, Yogyakarta, 2018).
13. L.S. Sulaiman, "Budidaya dan peran masyarakat Indonesia dalam penggunaan zat pewarna alami," in *Makalah*, (Dekranas DIY, Yogyakarta, 1999).
14. S.P. Gustami, *Butir-Butir Mutiara Estetika Timur, Ide Dasar Penciptaan Seni Kriya Indonesia* (Prasista, Yogyakarta, 2007).
15. S. Susanto, *Seni Kerajinan Batik Indonesia* (Balai Penelitian Batik dan Kerajinan, Jakarta, 1974).
16. D. Sartika, E. Eskak, and I.K. Sunarya, "Uma Lengge dalam kreasi batik Bima," Din. Kerajinan Dan Batik Maj. Ilm. **34**(2), 73–82 (2017).

THE EFFECT OF BREATHING EXERCISES COMBINED WITH GUIDED IMAGERY ON MENTAL HEALTH, STRESS LEVELS, AND ANXIETY AMONG ADOLESCENTS IN YOGYAKARTA

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Abstrak. Mental health problems among adolescents have become a significant concern, with approximately 6.2% experiencing depression, anxiety disorders, and stress due to academic pressure, family issues, and social media influence. Objectives: This study aimed to examine the effect of breathing exercise combined with guided imagery on improving mental health and reducing stress and anxiety levels in adolescents in Yogyakarta. Methods: This experimental study used a two-group pretest-posttest design with 30 adolescents aged 16-19 years, divided into treatment (n=15) and control (n=15) groups. The Depression, Anxiety, Stress Scale (DASS) was used to measure mental health outcomes. The treatment group received breathing exercise combined with guided imagery intervention for 12 sessions. Data were analyzed using paired sample t-test and Mann-Whitney U test. Results: The breathing exercises and guided imagery treatment significantly ($p<0.05$) reduced depression, anxiety, and stress levels in the treatment group compared to the control group. All three variables showed significant differences between pre-test and post-test in the treatment group ($p<0.001$). Conclusions: Breathing exercise combined with guided imagery is effective in improving mental health by reducing depression, anxiety, and stress levels in adolescents in Yogyakarta.

Keywords: breathing exercise, guided imagery, mental health, stress, anxiety

INTRODUCTION

Mental health is an aspect of development related to an individual's emotional control in daily physical and social activities. Adolescence is a transitional phase from childhood to adulthood, characterized by changes (Gintari et al., 2023). Adolescence is considered a period of inner conflict, serving as an unstable bridge between the dependent childhood phase and adulthood (Muhtadin et al., 2022). Adolescence results in physical, cognitive, emotional, and psychosocial changes. Mental health issues remain an unresolved topic in global society, especially in Indonesia. Approximately 6.2% of adolescents experience depression, anxiety disorders, and stress due to academic pressure, family problems, and the influence of social media (Riskesdas, 2018).

Another aspect of psychological disorders in adolescents is the inseparable use of gadgets in today's life. Excessive gadget use can lead to addiction, sleep disturbances, eye fatigue, and cognitive decline, which can increase anxiety and depression in individuals (Kamaruddin et al., 2023). The challenges of adolescent health issues are the focus of this research. Adolescents, who are being groomed as the future generation, must maintain their mental health by maintaining their emotional (psychological) well-being. One alternative therapy that can be implemented is breathing exercise and guided imagery.

Breathing exercise and guided imagery are methods used in psychology and health. This theory is supported by research by Dharmariana & Hamidah (2019), which found that providing guided imagery interventions can elicit changes during the intervention process, reducing levels of social appearance anxiety. Furthermore, research (Imam Abidin et al., 2024) found that breathing exercise treatment using the Buteyko breathing technique (level 1) significantly reduced anxiety levels, allowing students to experience a relaxed phase and improving sleep quality.

Breathing exercise is a breathing technique that uses a specific rhythm to stabilize the autonomic nervous system. Breathing exercise is designed to improve the quality of life for seniors by training the body's oxygen intake and carbon dioxide output (Hermansyah et al., 2015). There are many techniques for applying breathing exercises. One method used is rib stretching, which involves holding air in the lungs for 10-25 seconds, or starting with a 7-6 second hold. This is designed to increase physical freshness, reduce stress levels, and help control the respiratory system, combined with guided imagery. Guided imagery is a visualization technique applied as an analogy to

imagine a calming and happy moment, such as a natural landscape or a happy memory. This can stimulate the brain to respond to imagination, thereby increasing the quality of the happy hormone endorphin.

Yogyakarta is a city with a high youth population due to the presence of various educational institutions from secondary to tertiary levels. The high level of academic competition, adolescent social interactions, and the influence of gadgets in Yogyakarta are major factors in the emergence of anxiety and stress. To address adolescent mental health issues, the implementation of breathing exercises and guided imagery is necessary as a way for adolescents to gain psychological control and provide a relaxing effect.

METODE

This research was an experimental study with a two-group pretest and posttest design. The study was conducted at Yogyakarta State University from February to June 2025. Thirty adolescents aged 16 to 19 years old were divided into two groups: a treatment group and a control group, each with 15 participants. This study received ethical approval from the research ethics committee.

The instrument used was a breathing exercise model combined with guided imagery. Mental health, stress, and anxiety were measured using the Depression, Anxiety, and Stress Scale (DASS). The breathing exercise program employed a rib stretch technique, involving holding air in the lungs for 10-25 seconds, designed to increase physical well-being and reduce stress levels. The treatment group received 12 sessions of breathing exercise combined with guided imagery. The treatment program was administered to 80 participants. The control group received no specific intervention.

The data analysis technique used qualitative and quantitative analysis. The Shapiro-Wilk test for normality was used because the sample size was <50 in each group. The Levene's test for homogeneity was used. To analyze the effectiveness test data, the paired sample t-test (dependent sample t-test) was used for normally distributed data and the Wilcoxon test for non-normally distributed data. The intergroup difference test used the Independent t-test for normal data and the Mann-Whitney U test for non-parametric data..

RESULT

Normality Test

Variabel Treatment Group	Sig.	Information
Depresi	0.319	Normal
Anxiety	0.009	Not Normal
Stress Level	0.204	Normal

TABLE 1 Uji Normalitas Kelompok Perlakuan

The results of the normality test for the treatment group showed that the depression variable value was 0.319>0.05 (P>0.05) so that the depression data was normally distributed, the anxiety variable was 0.009<0.05 (P<0.05) indicating that the data was not normally distributed, and the stress level variable value was 0.204>0.05 (P>0.05) so that the data was normally distributed.

Variabel Kontrol Group	Sig.	Information
Depresi	0.052	Normal
Anxiety	0.004	Not normal
Stress Level	0.012	Not normal

TABLE 2 Uji Normalitas Kelompok Kontrol

The results of the normality test for the control group showed that the depression variable value was 0.052>0.05 (P>0.05) so that the depression data was normally distributed, the anxiety variable was 0.004<0.05 (P<0.05) and the stress level was 0.012<0.05 (P<0.05) indicating that the data was not normally distributed.

Homogenity Test

Variabel	F	Sig.	Information
Depresi	0.008	0.930	Homogen (p > 0.05)
Anxiety	0.602	0.444	Homogen (p > 0.05)
Stress Level	1.565	0.221	Homogen (p > 0.05)

TABLE 3 Uji Homogenitas

The homogeneity test results showed that all variables exhibited significance values above the 0.05 threshold, indicating no significant differences in variance between groups. Thus, the assumption of homogeneity of variance was met for all three variables (depression p=0.930, anxiety p=0.444, stress level p=0.221).

Paired Data Test of Treatment Groups

Variabel Kelompok Perlakuan	Sig	Information
Depresi	0,001	Signifikan
Anxiety	0,001	Signifikan
Stress Level	0,001	Signifikan

TABLE 4 Uji Data Berpasangan Kelompok Perlakuan

The test results showed a significant difference between pretest and posttest scores on depression, anxiety, and stress variables, with a very low significance value (<0.001). It can be concluded that the breathing exercises and guided imagery provided had a positive impact on reducing levels of depression, anxiety, and stress in the treatment group.

Paired Data Test Control Group

Variabel Kelompok Perlakuan	Sig	Information
Depresi	0,001	Signifikan
Anxiety	0,001	Signifikan
Stress Level	0,001	Signifikan

TABLE 5 Uji Data Berpasangan Kelompok Perlakuan

The results of paired data testing in the control group showed that the depression (p=0.145) and anxiety (p=0.343) variables did not experience significant changes in the control group. Meanwhile, the stress variable showed significant changes (p=0.004) even without intervention.

Intergroup Difference Test

Variabel	Sig	Information
Depresi	0,001	Signifikan
Anxiety	0,001	Signifikan
Stress level	0,001	Signifikan

TABLE 6 Uji Beda

The results of the difference test showed that the breathing exercise and guided imagery interventions significantly reduced depression (p<0.001), anxiety (p<0.001), and stress (p<0.001) compared to the control group..

DISCUSSION

The results of this study indicate that the breathing exercise and guided imagery intervention significantly reduced depression, anxiety, and stress compared to the control group. The treatment in this study combined two relaxation techniques: breathing exercises (deep, regular breathing) and guided imagery (guided visualization with a relaxing narrative).

This combination is designed to activate the parasympathetic nervous system, reduce physiological tension, and improve emotional regulation. Breathing exercises have physiological effects that regulate pH, electrolyte balance, hemoglobin, blood flow, and kidney function. Breathing also has a significant influence on other behaviors such as motivation, strength, emotions, focus, perception, and anxiety memory.

Guided imagery has benefits for a number of psychological and physical complaints. The principles of guided imagery are based on the concepts of psychophysiology and gate control theory. Psychophysiology explains that imagination creates a mood that connects feelings with thoughts, and each thought creates a reaction and physiological changes in the body.

These results are consistent with previous research findings showing that breathing exercises help stabilize breathing rhythm and heart rate, while guided imagery facilitates mental relaxation through positive and safe imagery.

Research supports the widespread use of this technique in psychological interventions due to its ability to simultaneously reduce symptoms of stress, anxiety, and depression.

Limitations of this study include the relatively small sample size and limited duration of the intervention. Future research could explore the long-term effects of this intervention with a larger sample size and longer follow-up period..

CONCLUSION

The guided breathing and imagery exercises significantly ($p<0.05$) reduced levels of depression, anxiety, and stress in adolescents in Yogyakarta compared to the control group that did not receive the intervention. This study can be used as a reference for further research and can serve as a guideline for conducting guided imagery breathing exercises as a non-pharmacological intervention to improve adolescent mental health.

REFERENCE

1. Andriyani, J. (2019). Strategi Coping Stres Dalam Mengatasi Problema Psikologis. At-Taujih Bimbingan Dan Konseling Islam, 2(2). Chand, S. P., & Marwaha, R. (2024).
2. Anxiety. StatPearls Publishing LLC.
3. Dharmariana, J. R., & Hamidah, H. (2019). Guided Imagery untuk Menurunkan Social Appearance Anxiety pada Wanita Dewasa Awal Obesitas. Persona:Jurnal Psikologi Indonesia, 8(1), 78-96. https://doi.org/10.30996/persona.v8i1.2462
4. Fakhriyani, D. V. (2019). Kesehatan Mental. In Halodoc.Com. Duta Media Publishing.
5. Gintari, K. W., Desak Made Ari Dwi Jayanti, Laksmi, I. G. A. P. S., & Sintari, S. N. N. (2023). Kesehatan Mental Pada Remaja. Journal Nursing Research Publication Media (NURSEPEDIA), 2(3), 167-183. https://doi.org/10.55887/nrpm.v2i3.49
6. Hermansyah, Karel Lina, R., & Aminoto. (2015). Pengaruh Breathing Exercise Terhadap Kualitas Hidup Lanjut Usia Di Panti Werdha Ria Pembangunan. Jurnal Ilmu Dan Teknologi Kesehatan, 2, 57-64.
7. Imam Abidin, L., Nurlianawati, & Puspitasari, S. (2024). The Effect of Buteyko Breathing Intervention on the Sleep Quality of Nursing. 7(2), 428-433. https://doi.org/10.52774/jkfn.v7i2.326
8. Kamaruddin, I., Leuwol, F. S., Putra, R. P., Aina, M., Suwarma, D. M., & Zulfikhar, R. (2023). Dampak Penggunaan Gadget pada Kesehatan Mental dan Motivasi Belajar Siswa di Sekolah. Journal on Education, 6(1), 307-316.
9. Krau, S. D. (2020). The multiple uses of guided imagery. Nursing Clinics of North America, 55, 467-474. https://doi.org/10.1016/j.cnur.2020.06.013
10. Muhtadin, D. A., Nurdiantami, Y., Fadhil, M. S., Ayudiputri, Z. Z., & Afifah, Z. (2022). Hubungan Karakteristik Remaja Dengan Perilaku Berisiko Penyalahgunaan Napza Pada Remaja Awal. PREPOTIF : Jurnal Kesehatan Masyarakat, 6(2), 1722-1729. https://doi.org/10.31004/prepotif.v6i2.4581
11. Örün, D., Karaca, S., & Arıkan, Ş. (2021). The Effect of Breathing Exercise on Stress Hormones. Cyprus Journal of Medical Sciences, 6(1), 22-27. https://doi.org/10.4274/cjms.2021.2020.2390
12. Parizad, N., Goli, R., Faraji, N., Mam-qaderi, M., & Mirzaee, R. (2021). Effect of guided imagery on anxiety, muscle pain, and vital signs in patients with Covid-19: A randomized controlled trial. Complementary Therapies in Clinical Practice, 43, 101335. https://doi.org/10.1016/j.ctcp.2021.101335
13. Riset Kesehatan Dasar (Riskesdas). (2018). Laporan Riskesdas 2018 Nasional. Lembaga Penerbit Balitbangkes.
14. Sheikh, S., Rostami, A., Shahbazi, A., & Nezhad, F. A. (2024). Clinical effectiveness of guided breathing exercises in reducing anxiety, stress, and depression in COVID-19 patients.
15. Skeens, L. M. (2017). Guided imagery: a technique to benefit youth at risk. National Youth at Risk Journal, 2(2). https://doi.org/10.20429/nyarj.2017.020207
16. Toussaint, L., Nguyen, Q. A., Roettger, C., Dixon, K., Offenb, M., Kohls, N., Hirsch, J., & Sirois, F. (2021). Effectiveness of Progressive Muscle Relaxation, Deep Breathing, and Guided Imagery in Promoting Psychological and Physiological States of Relaxation. 2021.

BUSINESS INCUBATOR STRATEGY IN SUPPORTING MICRO, SMALL, AND MEDIUM ENTERPRISES (MSMES): A PRELIMINARY STUDY AT UNIVERSITAS NEGERI YOGYAKARTA

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Abstract. Micro, Small, and Medium Enterprises (MSMEs) contribute significantly to Indonesia's economy, yet they still face persistent challenges in networking, legality, digitalization, and market access. University-based business incubators are designed to systematically address these challenges through mentoring, training, and network facilitation. The Business Incubator of Universitas Negeri Yogyakarta (UNY) has achieved notable outcomes such as tenant certification, grant funding, and even product export. However, more structured and measurable strategies are needed to ensure that incubation programs remain effective and sustainable. This study aims to formulate strategic development priorities for the UNY Business Incubator using the Analytical Network Process (ANP), which offers a more comprehensive framework compared to conventional SWOT–QSPM approaches. ANP is particularly suitable because it captures interdependencies and feedback among factors, which are often overlooked in linear models. Data were collected through focus group discussions (FGD), in-depth interviews, and pairwise comparison questionnaires involving tenants, incubator managers, and external stakeholders. Preliminary findings reveal that three dominant strategies are required by tenants: (1) strengthening external networking and partnerships, (2) enhancing business management, legality, and certification, and (3) implementing digitalization through hybrid incubation models. These findings suggest that collaborative networking and professional business–legal reinforcement form the foundation of incubation success, while digitalization acts as an accelerator for scaling up. Further analysis with ANP will quantitatively determine the priority weights of each strategy, thereby providing more robust recommendations for incubator development.

Keywords: Business Incubator, MSME, ANP, mentoring, strategy

INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) play a significant role in Indonesia's economy, particularly in employment creation, poverty alleviation, and local economic growth. However, MSMEs still face challenges in several key aspects: networking, business legality, digitalization, and market access. University-based business incubators are designed to systematically support MSMEs through mentoring, training, and networking facilitation. The UNY Business Incubator has already achieved notable outcomes, including tenant certifications, grant-based funding, and even product export (see Figure 1). Nevertheless, more structured and measurable strategies are required to ensure that incubation assistance becomes more effective and sustainable.

The main research problem is: what strategies are most effective for a university business incubator in supporting tenants toward sustainable growth? This study aims to formulate development strategies for the UNY Business Incubator using the Analytical Network Process (ANP), which provides a more comprehensive framework compared to the widely used SWOT–QSPM methods.

Previous studies on incubator and MSME development strategies have primarily relied on the Quantitative Strategic Planning Matrix (QSPM), rooted in SWOT analysis, Internal Factor Evaluation (IFE), and External Factor Evaluation (EFE). QSPM is relatively simple, as it requires only weighting internal and external factors, followed by calculating attractiveness scores to generate a Total Attractiveness Score (TAS). Syarifuddin & Halim (2022), and Sitorus et al. (2023), both applied QSPM to develop business incubator strategies, resulting in strategy rankings based on TAS scores.

The main limitation of QSPM, however, lies in its assumption of independence among factors, which prevents it from capturing interdependence and feedback among strategic elements. In practice, incubator development involves factors such as networking, digitalization, legality, and market access that are mutually interrelated and cannot be analyzed in isolation. To address these limitations, this study applies the Analytical Network Process (ANP), developed as an extension of AHP (Saaty, 2006). ANP allows reciprocal relationships among strategic elements and integrates expert judgment with empirical data, making the prioritization results more representative of the complex nature of business incubation systems.

Several related studies have successfully applied ANP in the MSME and incubation context: Widjajanti and Sugiyanto (2024); Titisari et al. (2021): applied ANP to formulate development strategies for culinary MSMEs in Central Java, with networking and product innovation identified as dominant factors. Cenenda and Saurombe (2025): used ANP to evaluate incubator models in South Africa, showing that business networking and regulatory support outweighed physical infrastructure. Several related studies combined SWOT–ANP to strengthen university incubators (Jamil et al., 2016; Rai et al., 2025; Wajdi et al., 2020), finding that networking and legal assistance were the top priorities. Mavi et al. (2019): ranked strategic management factors of university incubators in Rasht, Iran using ANP, identifying talented managers as the most critical success factor. By building upon these studies, this research strengthens previous evidence while offering a more holistic approach than QSPM, as ANP can capture the complexity and interdependence among strategic factors in the incubator ecosystem.

FIGURE 1. The UNY Business Incubator Activities

RESEARCH METHOD

The research was conducted during the period of March – November 2025, ensuring sufficient time for data collection, analysis, and validation through stakeholder engagement. Business incubators can generally be categorized into three types: 1) University-based incubators – driven by research and innovation, 2) Private incubators – focused on investment and global networking, 3) Government incubators – oriented toward regulation and empowerment programs (Fithri et al., 2025; Machado & Freiling, 2023; Sohail et al., 2023). Universities are considered suitable units for managing incubator businesses (Adriansyah & Rimadias, 2023; Shekhar et al., 2023). The UNY Business Incubator belongs to the university-based incubator category (Figure 1.), but increasingly collaborates with private and government stakeholders to strengthen its ecosystem.

This study employed an exploratory design using both qualitative and quantitative approaches.

1. Primary data were collected from FGDs, questionnaires, in-depth interviews with tenants, and incubator managers, and external stakeholders.
2. Secondary data were obtained from internal documents, national regulations, and relevant literature on business incubation.

The preliminary stage involves descriptive analysis to capture early findings. In the next stage, ANP will be applied to determine strategic priorities. ANP was chosen because it accommodates the interdependence among strategy factors, unlike traditional linear models. Data processing will be conducted using Super Decisions software and verified with Microsoft Excel.

PROFILE OF UNY BUSINESS INCUBATOR

The UNY Business Incubator has been active since 2012, established under Rector's Decree No. 139a/2012 and strengthened by Rector's Decree No. 1.15/2017 under the Institute for Research and Community Service (LPPM). The incubator supports both student and non-student tenants across multiple sectors, including food, ICT, manufacturing, education, sports, health, and tourism. The incubator experienced reduced activity in 2023, mainly due to the COVID-19 pandemic and leadership transition. Despite this, it remains a strategic unit for fostering entrepreneurship at Universitas Negeri Yogyakarta.

The organizational structure consists of a Head, a Secretary, and staff supported by professional mentors and business facilitators. Current mentors cover expertise in economics, engineering, certification, creative industries, marketing, and catering services. The incubator is equipped with physical facilities such as an office building, tenant rooms, meeting rooms, showrooms, and supporting office equipment. These services ensure that tenants not only receive technical and managerial training but also legal and market readiness support. Challenges faced by the incubator include: Limited human resources, inadequate technological adoption, infrastructure constraints, regulatory complexity, and limited access to broader market networks.

The incubator provides comprehensive services, including:

1. Access to seed funding and investor networks.
2. Support for market access and partnerships.
3. Assistance in digital marketing and branding.
4. Training in financial management and business planning.
5. Mentoring in business modeling and operations.
6. Guidance in business ethics, legality, and regulatory compliance.

TENANT PROFILES

The UNY Business Incubator supports tenants from diverse industries. Selected tenant profiles are presented in Table 1. These tenants illustrate the diverse portfolio of the incubator, ranging from manufacturing and creative industries to agri-tech, tourism, and cultural products (see Figure 2).

TABLE 1. Profile of UNY Business Incubator Tenants

Tenant Name	Year Established	Business Focus	Achievements / Funding
SPD Speedometer	2015	Custom & restoration of speedometers	Winner of *Superpreneur 2023*; 4 branches (Yogyakarta, Surabaya, Bandung, Jakarta)
Indobot	2016	Technology training & certification	Collaboration with Ministry of Research & Technology
Printer Plotter Pola Batik (P3B)	2017	Batik pattern plotting machine	Funded by *Perusahaan Pemula Berbasis Teknologi (PPBT) Ristekdikti* (2017)
Astrobike	2018	Electric bike manufacturing & services	Expanded to 4 branches across Java
Cutle Machine	2022	Fish processing machinery (catfish slicer)	Proposed for national startup grant
Sineas Kreatif Indonesia	2024	Creative agency (video, social media, 3D)	RIIM Startup funding (2024)
Tripyoo	2024	Tourism services	Received IDR 500 million BECC funding
Triayu Batik Kit	2024	Innovative batik training kits	Received IDR 200 million BECC funding
Opti Feed	2024	Poultry feed enriched with Omega-3	Supported by RIIM Startup 2025

FIGURE 2. Profile of UNY Business Incubator Tenants

PRELIMINARY FINDINGS AND DISCUSSION ACHIEVEMENTS OF TENANTS

The UNY Business Incubator tenants have recorded significant achievements, including:

1. Winning national and international business competitions.
2. Opening branches in major Indonesian cities (Yogyakarta, Jakarta, Bandung, Surabaya).
3. Securing business funding from government and private institutions.
4. Obtaining business legality, intellectual property rights, ISO 9001:2015, and SNI certifications.
5. Achieving increased revenue through more structured management.
6. Expanding to international markets through export activities.
7. Strengthening product branding and widening consumer reach.

These findings demonstrate that incubation programs provide tangible value-added impacts on tenants' business performance.

PROPOSED STRATEGIES FROM FGD

The Focus Group Discussion (FGD) identified several strategies to strengthen the role of the UNY Business Incubator (see Figure 3). These are summarized in Table 2.

TABLE 2. Proposed Strategies from FGD

Strategy Area	Proposed Actions	Expected Impact
Stage-based mentoring	Incubation divided into ideation, validation, execution, and scale-up stages	More targeted support according to tenant's business phase
Mentoring & coaching	Regular sessions by practitioners and successful alumni entrepreneurs	Practical insights and stronger entrepreneurial mindset
Market access & partnerships	Collaboration with SOEs, marketplaces, hotels, and government institutions	Wider business opportunities and institutional credibility
Demo day & investor pitching	Routine sessions to present business ideas to investors and partners	Improved access to capital and potential strategic alliances
Digital incubation programs	Online learning, webinars, consultation platforms	Broader reach, especially for tenants outside Yogyakarta
Tenant curation & alumni ecosystem	Stricter selection of tenants and long-term alumni involvement	Sustainable incubation ecosystem and organic B2B collaboration

The FGD emphasized that incubation strategies should not be uniform, but rather differentiated by tenant business phase, so that interventions are relevant and effective. In addition, the need for regular mentoring from practitioners and alumni was strongly highlighted as a way to bridge academic knowledge with practical experience. Furthermore, tenants see market access and partnerships as a priority, since many MSMEs struggle to scale without institutional support. Activities such as demo days and investor pitching are expected to open new funding opportunities. Lastly, digital incubation and tenant curation are critical for long-term sustainability. Digital platforms allow the incubator to expand its services beyond physical boundaries, while alumni involvement ensures that the incubation ecosystem continues to grow even after formal programs end.

The FGD findings suggest that digitalization must go hand-in-hand with collaboration. A web/app-based incubation platform would serve as the backbone of digital incubation, enabling remote mentoring and monitoring. Meanwhile, e-commerce integration directly connects tenants to digital marketplaces, which is critical for MSMEs to expand beyond local markets.

FIGURE 3. Focus Group Discussion (FGD) by UNY Business Incubator

Digital branding through KOL collaboration and live streaming was highlighted as a low-cost but impactful strategy for strengthening visibility. At the same time, collaborative networks among tenants and alumni are expected to create an organic B2B ecosystem. Finally, academic partnerships such as student internships ensure continuous knowledge transfer and human resource development. These are summarized in Table 3.

TABLE 3. Digitalization and Collaboration Strategies Identified from FGD

Focus Area	Proposed Initiatives	Expected Impact
Digital incubation	Development of web/app-based incubation platform for training, mentoring, and monitoring	More efficient management and wider accessibility for tenants
E-commerce integration	Training and direct integration with platforms (Tokopedia, Shopee, TikTok Shop)	Enhanced online sales channels and market reach
Digital branding	Collaboration with Key Opinion Leaders (KOL), use of live streaming and social media	Stronger brand awareness and direct consumer engagement
Collaboration network	Strengthening cooperation among tenants, alumni, and university stakeholders	Creation of an organic B2B ecosystem and peer-to-peer learning
Academic partnership	Internship and co-incubation programs with universities and vocational schools	Knowledge transfer, talent development, and sustainable incubation ecosystem

TENANT EXPECTATIONS

Tenants expect the incubator to:

1. Provide stronger business models and marketing strategies.
2. Facilitate access to investors and business networks.
3. Support long-term business roadmaps (legality, certification, expansion).
4. Accelerate business growth through business matching, HR training, and branding initiatives.
5. Establish an alumni program to maintain post-incubation collaboration.
6. Nurture university-based startups that generate employment opportunities.

DISCUSSION

The preliminary findings highlight three main strategic needs:

1. External networking as the primary driver of market expansion and funding access.
2. Business legality and management as a foundation for professionalization and credibility.
3. Digitalization as an accelerator for scaling business operations and improving efficiency.

The implication is that the incubator must adopt a more adaptive, collaborative, and stage-based incubation model aligned with tenant development phases.

PRELIMINARY CONCLUSION AND RECOMMENDATIONS

CONCLUSION

This study confirms that the UNY Business Incubator has delivered positive impacts for MSME tenants, reflected in increased revenue, business expansion, certification achievements, and internationalization. Preliminary findings emphasize three dominant strategies: (1) Strengthening strategic networking and partnerships. (2) Enhancing business management, legality, and certification. (3) Utilizing digitalization for hybrid incubation models. (4) Curating tenants according to their business development phase. (5) Facilitating access to markets and investors. Overall, collaborative networking and business–legal reinforcement form the foundation of incubation success, while digitalization serves as a catalyst for accelerated growth.

RECOMMENDATIONS

Based on these preliminary findings, several recommendations can be made for the next stages of research and practice. First, it is essential to apply a quantitative Analytical Network Process (ANP) analysis to provide measurable weights and prioritize strategies objectively. This approach will enable the incubator to determine which interventions yield the highest strategic value. Second, incubation should be tailored to tenant business phases, namely ideation, validation, execution, and scale-up. Differentiated support ensures that tenants receive relevant mentoring and resources at each stage of their development.

Third, the incubator needs to gradually implement digitalization by developing a dedicated web/app platform, integrating e-commerce marketplaces, and adopting digital branding strategies. These initiatives will

help extend services beyond physical boundaries and increase tenant competitiveness in the digital economy. Fourth, multi-stakeholder networking should be expanded through collaborations with state-owned enterprises (SOEs), online marketplaces, research institutions such as BRIN, and national startup communities. This would strengthen the ecosystem and create sustainable business linkages.

Finally, from an academic perspective, this study provides preliminary insights in the form of a proceedings paper, while the comprehensive ANP analysis will be presented in a subsequent journal publication. This dual output strategy not only enriches scientific discourse but also supports practical policymaking in business incubation.

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REFERENCES

1. Adriansyah, A., & Rimadias, S. (2023). Key Factors for University Business Incubator Implementation (UBI): Literature Review. *Journal of Business Management and Economic Development*, *2*(01), 98–110. https://doi.org/10.59653/jbmed.v2i01.335
2. Cenenda, N., & Saurombe, M. (2025). Business incubator coaching for small, medium and micro enterprises in South Africa. *The Southern African Journal of Entrepreneurship and Small Business Management*, *17*(1). https://doi.org/10.4102/sajesbm.v17i1.1065
3. Fithri, P., Hasan, A., Games, D., & Albar, B. B. (2025). Business Incubators and Technology-Based Startups in Emerging Economies: A Bibliometric Analysis. *Jurnal Optimasi Sistem Industri*, *24*(1), 156–173. https://doi.org/10.25077/josi.v24.n1.p156-173.2025
4. Jamil, F., Ismail, K., Siddique, M., Khan, M. M., Kazi, A. G., & Qureshi, I. (2016). International Review of Management and Marketing Business Incubators in Asian Developing Countries. *International Review of Management and Marketing*, *6*(S4), 5–6. http:www.econjournals.com
5. Machado, H. P. V., & Freiling, J. (2023). Expatriation-enhanced competencies: A multiple case study of technology-based entrepreneurs. *Journal of Entrepreneurship, Management and Innovation*, *19*(3), 7–46. https://doi.org/10.7341/20231931
6. Mavi, R. K., Gheibdoust, H., Khanfar, A. A., & Kiani Mavi, N. (2019). Ranking factors influencing strategic management of university business incubators with ANP. *Management Decision*, *57*(12), 3492–3510. https://doi.org/10.1108/MD-06-2018-0688
7. Rai, R. S., Prasad, A., & Murthy, B. K. (2025). Incubation support for academia-based entrepreneurship: an empirical study. *Journal of Asia Business Studies*, *19*(2), 289–314. https://doi.org/10.1108/JABS-02-2024-0102
8. Shekhar, H., Satyanarayana, K., & Chandrashekar, D. (2023). Role and contributions of an incubator in academic intrapreneurship – An examination. *Technovation*, *126*. https://doi.org/10.1016/j.technovation.2023.102821
9. Sitorus, G. F., Machfud, M., & Anggraeni, E. (2023). Strategi Pengembangan Inkubator Bisnis Dalam Pendampingan Bisnis Usaha Mikro, Kecil, dan Menengah (UMKM). *Jurnal Aplikasi Bisnis Dan Manajemen*. https://doi.org/10.17358/jabm.9.3.987
10. Sohail, K., Belitski, M., & Castro Christiansen, L. (2023). Developing business incubation process frameworks: A systematic literature review. *Journal of Business Research*, *162*. https://doi.org/10.1016/j.jbusres.2023.113902
11. Syarifuddin, & Halim, M. R. (2022). Strategi Pengembangan dan Penguatan Inkubator Dalam Usaha Mikro Kecil Menengah (UMKM). *Jurnal Ilmiah Bongaya (JIB)*, *6*(1).
12. Titisari, M. A., Fidita Karya, D., & Hadi, S. (2021). *Swot Analysis and Anp for Organic Tempeh SME Business Development Strategy*.

13. Wajdi, M. F., Mangifera, L., & Isa, M. (2020). *Strategi Penguatan Inkubator Bisnis dalam Pengembangan Usaha Kecil dan Menengah*. *22*(2).
14. Widjajanti, K., & Sugiyanto, E. K. (2024). Competitiveness Improvement Strategies of Msme Blora Batik: Analytic Network Process Approach. *International Journal of Professional Business Review*, *9*(1), e03381. https://doi.org/10.26668/businessreview/2024.v9i1.3381

THE EFFECT OF THE PROBLEM BASED LEARNING MODEL ON FOOTBALL PLAYING SKILLS AND LEARNING ACTIVITIES IN PHYSICAL EDUCATION LEARNING IN SPECIAL SPORTS CLASS

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Abstract The study aims to determine the effect of using problem-based learning model on soccer playing skills and learning activities in physical education in special sports classes. This type of research is a quasi-experimental study with a pretest-posttest design. The subjects used in this study were 36 students in the 11th grade of special sports classes at Seyegan State Senior High School. The instrument used was a soccer playing skills test from David Lee with a validity of 0.76 and a reliability of 0.81. The data collection instrument for learning activities used an observation sheet. The data analysis technique was Paired Samples T Test. The results of the paired sample t test (Paired Samples T Test) for soccer playing skills had a significance of 0.000 which was smaller than 0.05, so the conclusion was that there was a difference in pretest and posttest soccer playing skills. By looking at the average scores of the pretest and posttest, the posttest had a better average. The results of the paired-sample t-test on learning activities showed a significance level of 0.000, which is less than 0.05. Therefore, we conclude that there is a difference between pretest and posttest learning activities. Posttest learning activities are superior to pretest learning activities.

Keywords: Problem-Based Learning Model, Soccer Skills, Learning Activities

INTRODUCTION

Physical education, sports, and health plays a crucial role in the holistic development of students, contributing to their physical, cognitive, and social well-being (Santoso & Santoso, 2024). Learning that focuses solely on mastering basic techniques without incorporating real-world play makes it difficult for students to apply newly acquired skills in the real world (Santoso et al., 2024). Physical education teachers often tend to employ a technical approach to teaching sports (Aditya et al., 2019).

Education is designed for teaching and learning activities carried out by individuals, between individuals and groups, and groups with the aim of broadening students' insights and mindsets regarding the scope of education (Rahmayanti Dewi et al., 2020). The current learning process has been framed with a scientific approach through the application of various scientific learning models, such as: Problem Based Learning (PBL), Project Based Learning (PjBL), Inquiry, and Discover Learning (Priyadi, 2021). In every learning process, the role of teachers is very important in achieving success in the teaching and learning process of physical education. Physical education teachers are not only skilled in educating, but must also be able to be facilitators and motivators in every learning process (Pradipta et al., 2023). Physical Education teachers face the challenge of creating a learning atmosphere that is able to combine critical thinking, creativity, and group collaboration in addition to developing students' skills and physical development (Rokhman et al., 2024).

The success of achieving physical education learning objectives is largely determined by the teacher's ability to choose appropriate methods, strategies, and learning models according to the characteristics of the students they teach (Pangga & Kuntjoro, 2023). The Problem Based Learning (PBL) learning model is a learning model that applies real, unstructured, open-ended problems as a learning context for students to develop problem-solving and critical thinking skills as well as to develop new knowledge (Riskayani, 2022). The PBL learning model is a strategic and flexible type of learning model in developing problem-solving and critical thinking skills.

The Problem-Based Learning model has several key advantages, namely: (Reza Abrillian Firdaus et al., 2025)

1. Fosters critical thinking and high creativity in students.
2. Improves students' skills in solving problems independently or in groups.

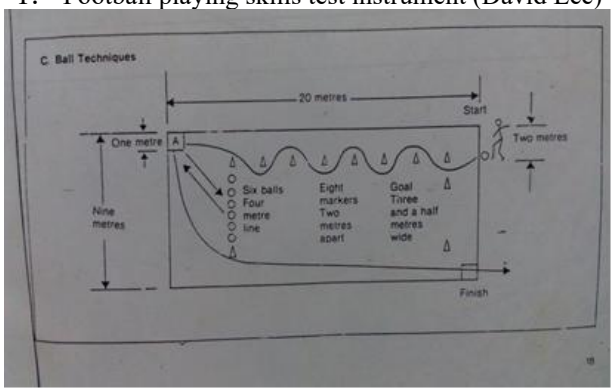
3. Increases students' enthusiasm for learning.
4. Develops students' ability to transfer knowledge to new situations.
5. Can stimulate students' independent learning initiatives.
6. Can encourage students to express their creativity in problem-solving.
7. Makes learning more meaningful.
8. Can integrate knowledge and skills simultaneously, and can be applied to relevant situations.
9. Can improve critical thinking skills, develop initiative, intrinsic motivation in learning, and foster good group work.

Researchers argue that designing learning that implements Problem Based Learning well is believed to have a positive impact on students' cognitive and psychological development, teach independence in learning, and ensure students' active involvement in learning (Arisetiyana et al., 2020).

RESEARCH METHODS

This research is a quasi-experimental study with a pretest-posttest design in a special sports class. The subjects were students in the special sports class in grade XI of Seyegan State Senior High School. Two instruments were used in this study:

1. Football playing skills test instrument (David Lee)



2. Learning activity instruments with observation sheets.

LEMBAR OBSERVASI AKTIVITAS BELAJAR PESERTA DIDIK

Sekolah : SMA N SEYEGAN
Kelas :XI
Materi : Olahraga Permainan (sepakbola)
Pertemuan Ke : I

No.	Nama	Memperhatikan penjelasan guru atau teman pada saat pelajaran atau diskusi	Mengajukan pertanyaan	Mengerjakan tugas	Menanggapi pertanyaan	Senang dan bersemangat dalam belajar	JUMLAH
1	Dewangga Aqsa Pradana	1	1	1	1	1	5
2	Raditya Pututama			1	1	1	3
3	Rezky Satriya Bhamakerti	1		1		1	3
4	Rafael Yodia Fatauta			1			1
5	Dhevinda Enggar Kusuma			1		1	2

The data analysis technique used prerequisite tests (normality and homogeneity tests) and paired samples t-test.

RESULTS AND DISCUSSION

The results of the calculations using descriptive statistics from the pretest and posttest data are as follows:

TABLE 1. Descriptive Statistics of Pretest and Posttest Data

Deskripsi	Model Pembelajaran Problem Based Learning	
	Pretest	Postest
N	36	36
Mean	39,9161	33,4781
Median	40,7100	32,1150
Mode	35,45	27,85
Std. Deviation	9.02865	7.31010
Variance	81,516	53,438
Range	33,41	26,01
Minimum	24,84	22,27
Maximum	58,25	48,28

The results of the data normality test from the pretest and posttest research data of the problem based learning model are as follows:

TABLE 2. Results of the Normality Test of Soccer Playing Skills Data

	Kolmogorov-Smirnova			**Shapiro-Wilk**		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
PBL Pretest	0,064	36	0,200*	0,968	36	0,366
PBL Postest	0,110	36	0,200*	0,940	36	0,050

The results of the Lilliefors data normality test using the Kolmogorov Smirnov and Shapiro-Wilk. For the Kolmogorov Smirnov method, if the significance value is less than 0.05, the conclusion is that the data is not normally distributed. If the significance value is more than 0.05, the data is normally distributed. Thus, the normality test for both the pretest (0.200) and posttest (0.200) data is normally distributed because the significance value is greater than 0.05.

The results of the homogeneity test of the pretest and posttest data for the soccer playing skills test using the Problem Based Learning learning model are as follows:

TABLE 3. Results of the Homogeneity Test of Soccer Playing Skills Data

	df1	**df2**	**Sig.**	**Keterangan**
Prtest-Postest PBL	1	70	0,273	Homogen

The results of the homogeneity test for pretest and posttest data have a significance value of 0.273. Determining whether the data is homogeneous or not is determined. If the significance value is less than 0.05, it is not homogeneous. If the significance value is greater than 0.05, the data is homogeneous. Thus, the pretest and posttest data are homogeneous.

The results of the paired sample t-test were used to compare two paired sample means on soccer playing skills and learning activities. The results of the paired sample t-test are as follows:

TABLE 4. Results of the Paired Samples T Test for Soccer Playing Skills

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Sebelum Perlakukan - Setelah perlakuan	6,43806	5,18000	0,86333	4,68540	8,19072	7,457	35	0.000

The output of the paired sample t-test (Paired Samples T-Test) for soccer playing skills is 0.000. If the significance is less than 0.05, the conclusion is that there is a difference in the value of soccer playing skills in

the pretest and posttest. If the significance is more than 0.05, the conclusion is that there is no difference in the value of soccer playing skills in the pretest and posttest. The conclusion of the paired sample t-test (Paired Samples T-Test) is that there is a difference in the value of soccer playing skills in the pretest and posttest.

TABLE 5. Results of the Paired Samples T Test on Learning Activities

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Aktivitas belejar Sebelum Perlakuan - Aktivitas Belajar Sesudah Perlakuan	-1,22222	1,01731	0,16955	-1,56643	-0,87801	-7,209	35	0,000

The output of the paired sample t-test on learning activities is 0.000. If the significance is less than 0.05, the conclusion is that there is a difference in the value of learning activities in the pretest and posttest. If the significance is more than 0.05, the conclusion is that there is no difference in the value of learning activities in the pretest and posttest. The conclusion of the paired sample t-test results is that there is a difference in the value of learning activities in the pretest and posttest.

Physical education in the formal education curriculum is an integral part of the overall education system at every level of education (Ridwan et al., 2017). Therefore, special sports classes must still be required to provide physical education subjects, even though special sports classes are for students with special sports talents. Special sports classes are formed to accommodate talented students and to receive further guidance in the field of sports in addition to receiving physical education (Worldailmi, et al., 2022) (Santoso et al., 2020). The implementation of special sports classes is essentially the embodiment of the educational objectives stated in Law No. 20 of 2003 concerning Sikdinas in Article 5 paragraph 4 which states "Citizens who have the potential for intelligence and special talents have the right to receive special education" (Santoso, 2020).

The application of the Problem Based Learning model in physical education learning will further improve students' memory and understanding of the learning material, increase focus on relevant knowledge, develop group collaboration, train leadership, social skills, student motivation, and learning skills (Nopandri & Wathoni, 2024). The main goal of implementing an appropriate learning model according to student characteristics is to increase learning effectiveness which is usually measured and observed by student involvement (motivation) and learning outcomes (Arisetiyana et al., 2020). Problem Based Learning as an approach in learning applies real-world problems by applying critical thinking processes and problem-solving skills to acquire essential knowledge and concepts from the learning material.

The problem-based learning model was created based on innovative learning theories (constructivism and contextual learning) by presenting a problem to be solved by students in groups through learning scenarios (Priyadi, 2021). The advantages of implementing problem-based learning, based on research results, can help students become more active in the learning process, provide satisfaction in expressing opinions, and most importantly, students can develop their mindset in terms of knowledge (Rahmayanti Dewi et al., 2020). The problem-based learning model provides opportunities for students to develop explicit ideas, providing practical experiences related to ideas that students already have on the field (Pradipta et al., 2023). The results of this study prove that the problem-based learning model implemented can improve learning outcomes in soccer playing skills and student learning activities such as paying attention to teacher and peer explanations, asking questions, doing assignments, responding to questions, and enjoying and being enthusiastic about learning.

CONCLUSION

The paired samples t-test results for soccer playing skills showed a significance of 0.000, which is less than 0.05. Therefore, we conclude that there is a difference between the pretest and posttest soccer playing skill scores. Looking at the mean scores for the pretest and posttest, the posttest scores were significantly higher. The paired samples t-test results for learning activities showed a significance of 0.000, which is less than 0.05. We conclude that there is a difference between the pretest and posttest learning activity scores. The posttest learning activities were significantly better than the pretest learning activities..

BIBLIOGRAPHY

1. Aditya, R., Nugroho, A., Hasil, P., & Menggiring, B. (2019). Peningkatan Hasil Belajar Menggiring Bola Pada Pada Siswa Sekolah Dasar. Jurnal Ilmiah, 7(2), 75–78.
2. Arisetiyana, F. F., Kartiko, D. C., Indahwati, N., & Prakoso, B. B. (2020). Motivation And Student Learning Outcomes In Problem Based Learning Motivasi Dan Hasil Belajar Siswa Dalam Pembelajaran Berbasis Masalah pelajaran Pendidikan Jasmani , Olahraga , dan Kesehatan (PJOK). Menurut menerapkan kurikulum 2013 yaitu model saintif. Jp.Jok (Jurnal Pendidikan Jasmani, Olahraga Dan Kesehatan), 4(1), 1–10.
3. Nopandri, R. A., & Wathoni, M. (2024). Efektivitas Model Pembelajaran Problem Based Learning terhadap Peningkatan Hasil Belajar Bola Voli Kelas X IPA SMA Muhammadiyah Ponjong. Semnasfip, 2165–2173.
4. Pangga, D., & Kuntjoro, B. F. T. (2023). Meningkatkan Hasil Belajar PJOK Melalui Model Pembelajaran Problem Based Learning (PBL) Pada Siswa Kelas III UPT SDN 223 Gresik. Jurnal Mahasiswa Pendidikan Olahraga, 4(1), 1–13. http://jurnal.goretanpena.com/index.php/JGE/article/view/409
5. Pradipta, I. K. Y. W., Astra, I. K. B., & Semarayasa, I. K. (2023). Implementasi Model Pembelajaran Problem Based Learning untuk Meningkatkan Hasil Teknik Shooting dalam Permainan Sepak Bola. Jurnal Ilmu Keolahragaan Undiksha, 11(3), 252–258. https://doi.org/10.23887/jiku.v11i3.64973
6. Priyadi, B. (2021). Efektivitas Penerapan Model Problem Based Learning Terhadap Peningkatan Hasil Belajar Bola Voli. Physical Activity Journal, 3(1), 41. https://doi.org/10.20884/1.paju.2021.3.1.4774
7. Rahmayanti Dewi, Resti Gustiawati, & Rolly Afrinaldi. (2020). Implementasi Model Pembelajaran Problem Based Learning Dalam Pembelajaran Pendidikan Jasmani Di SMA Negeri 4 Karawang. Journal Coaching Education Sports, 1(2), 83–92. https://doi.org/10.31599/jces.v1i2.327
8. Reza Abrillian Firdaus, Atmojo Prayogo Widodo, & Vega Chandra Dinata. (2025). Model Pembelajaran Problem Based Learning Dalam Upaya Meningkatkan Hasil Belajar Pjok Pada Siswa Kelas Iii Upt Sd Negeri 222 Gresik. JURNAL ILMIAH PENJAS (Penelitian, Pendidikan Dan Pengajaran), 11(1), 196–213. https://doi.org/10.36728/jip.v11i1.4135
9. Ridwan, M., Darmawan, G., & Nanang, I. (2017). UPAYA MENINGKATKAN PENGUASAAN KETERAMPILAN PASSING PADA PERMAINAN SEPAKBOLA MELALUI PENDEKATAN TAKTIS. Bravo‟s Jurnal Program Studi Pendidikan Jasmani Dan Kesehatan STKIP PGRI Jombang, 5(1), 1–10.
10. Riskayani, N. L. (2022). Model Pembelajaran Problem Based Learning (PBL) Meningkatkan Aktivitas Dan Hasil Belajar Teknik Dasar Passing Bola Basket. Jurnal Pendidikan Jasmani, Olahraga Dan Kesehatan Undiksha, 10(1), 1–7. https://doi.org/10.23887/jjp.v10i1.47192
11. Rokhman, M. T., Putra, B. A., & Luthfitasari, D. (2024). Penerapan Metode Pembelajaran Problem-Based Learning (PBL) untuk Meningkatkan Kreativitas dan Kolaborasi Siswa dalam Mata Pelajaran PJOK di SMPN 1 Dagangan, Madiun. Pendas: Jurnal Ilmiah Pendidikan Dasar, 09(02), 5038–5045.
12. Santoso, N. (2020). Evaluasi Program Kelas Khusus Olahraga Tingkat Sekolah Menengah Atas Di Kabupaten Kulonprogo Yogyakarta. MAJORA: Majalah Ilmiah Olahraga, 26(1), 8–19. https://doi.org/10.21831/majora.v26i1.30512
13. Santoso, N., & Santoso, N. P. (2024). Case study : problem-based learning model for soccer basic movement skills and learning activity Estudio de caso : modelo de aprendizaje basado en problemas para las habilidades básicas de movimiento en el fútbol y actividad de aprendizaje Introduction Ph. 2041, 578–582.
14. Santoso, N., Wiyanto, A., & Masri. (2020). Evaluation of football development program: A case study on specific sport class for high school level in Sleman Regency, Yogyakarta. Journal of Contemporary Issues in Business and Government, 26(2), 717+.
15. Worldailmi, E., Azzam, A., & Utami, T. W. (2022). Big Data dan Pemetaan Masalah untuk Keberlanjutan Kelas Khusus Olahraga (KKO) di Kota Yogyakarta. Journal of Approriate Technology for Community Services, 3(2), 12–20. https://doi.org/10.20885/jattec.vol3.iss2.art1

MONETARY CONDITION INDEX AND ITS TRANSMISSION MECHANISM IN INFLUENCING THE INDONESIAN MACRO ECONOMY

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Abstract. The rapid evolution of digital transformation, financial innovation, and monetary policy frameworks in Indonesia has reshaped the dynamics of the national economy and the effectiveness of policy transmission mechanisms. This study investigates the intersection of monetary policy, digital financial development, and economic growth, focusing on how technological advancement and policy innovation jointly influence macroeconomic stability and financial inclusion. Using a mixed-methods approach that combines secondary quantitative data from Bank Indonesia, the Financial Services Authority (OJK), and the Central Statistics Agency (BPS) with qualitative analysis from policy documents and regulatory frameworks, the research examines the period from 2015 to 2024 — a decade characterized by significant financial digitalization, the expansion of fintech, and the central bank's evolving role.

The findings reveal that digital financial services, particularly electronic payment systems, fintech platforms, and digital banking initiatives, significantly contribute to expanding financial access, increasing transaction efficiency, and supporting inclusive economic growth. Moreover, the study shows that monetary policy tools — including interest rate adjustments, macroprudential measures, and payment system innovations — have become increasingly intertwined with digital financial infrastructure. This integration enhances the transmission mechanism's responsiveness, reduces policy lag, and broadens its impact across sectors. However, challenges persist in regulatory adaptation, cybersecurity, and consumer protection, highlighting the need for stronger institutional coordination.

This research contributes to the literature by providing a comprehensive view of how monetary policy operates in a rapidly digitalizing economy. It emphasizes the necessity for central banks to adopt forward-looking frameworks that integrate digital transformation into policy design. The study concludes that the synergy between digital financial innovation and monetary policy is essential for maintaining macroeconomic stability and fostering sustainable, inclusive growth in the era of digital finance.

Keywords

Monetary Policy; Digital Finance; Financial Innovation; Transmission Mechanism; Fintech; Inclusive Growth; Indonesia

INTRODUCTION

1.1 Background

Over the past decade, Indonesia's financial and economic landscape has undergone a profound transformation driven by rapid digital innovation, evolving monetary policy frameworks, and increasing financial inclusion efforts. The global financial system is experiencing a structural shift from conventional, bank-centric models to digital, technology-driven ecosystems. This transformation is characterized by the proliferation of fintech platforms, the adoption of electronic payment systems, the rise of digital banking, and the increasing role of central banks in fostering innovation while safeguarding stability. These changes have significant implications for the effectiveness of monetary policy, the structure of financial intermediation, and the broader trajectory of economic development.

Monetary policy — traditionally centered on controlling money supply, managing interest rates, and influencing aggregate demand — remains one of the most powerful tools for macroeconomic stabilization.

However, the mechanisms through which monetary policy transmits its effects have evolved significantly in the digital era. With the advent of digital payments, mobile banking, peer-to-peer (P2P) lending, and blockchain-based financial services, the velocity of money, the composition of money demand, and the behavior of financial intermediaries have changed in fundamental ways. These dynamics necessitate a reassessment of how monetary policy operates and how its instruments interact with the evolving financial ecosystem.

Indonesia presents a particularly compelling case for examining these dynamics. As one of the largest emerging economies in Asia, Indonesia has witnessed exponential growth in digital financial activities over the past decade. According to Bank Indonesia (2024), the total value of electronic money transactions grew from less than IDR 5 trillion in 2015 to over IDR 450 trillion in 2023, while the number of fintech platforms surpassed 300, spanning payments, lending, investment, and insurance services. The government's commitment to building a digital economy — as outlined in the "Indonesia Digital Vision 2045" — and the central bank's proactive approach through initiatives such as the Blueprint Sistem Pembayaran Indonesia (BSPI) and Quick Response Code Indonesia Standard (QRIS) further underscore the strategic importance of digital transformation in economic policy.

1.2 Problem Statement

Despite the undeniable benefits of digital financial innovation, its implications for monetary policy effectiveness and macroeconomic stability are not fully understood. Traditional monetary theory posits a stable relationship between monetary aggregates, interest rates, and economic activity. However, the rise of digital payment instruments and alternative financial channels may disrupt this relationship by altering money demand, influencing savings and investment behavior, and changing how policy signals are transmitted through the economy. Moreover, as financial intermediation increasingly occurs outside conventional banking channels, central banks face challenges in monitoring liquidity, regulating financial activity, and calibrating policy tools.

The interaction between digital finance and monetary policy is particularly complex in emerging markets like Indonesia, where structural characteristics such as financial inclusion gaps, regulatory capacity, and technological readiness influence the transmission mechanism. This raises critical policy questions: Does digital financial innovation enhance or weaken the effectiveness of monetary policy? How do new financial technologies affect the traditional channels of policy transmission, such as the interest rate, credit, and expectations channels? And how should central banks adapt their policy frameworks to ensure stability and inclusivity in this evolving environment?

1.3 Research Objectives and Questions

This study aims to explore the evolving relationship between monetary policy, digital financial innovation, and macroeconomic performance in Indonesia. Specifically, it seeks to:

1. Analyze the impact of digital financial development on the effectiveness of monetary policy transmission.
2. Examine how financial technologies — including electronic money, fintech lending, and digital banking influence money demand, liquidity dynamics, and financial intermediation.
3. Assess the policy responses and strategic adjustments implemented by Bank Indonesia to enhance monetary effectiveness in the digital era.
4. Provide recommendations for integrating digital transformation into future monetary policy frameworks.

From these objectives, the research seeks to answer the following key questions:

How has digital financial innovation influenced the transmission mechanisms of monetary policy in Indonesia?

What are the main channels through which digital technologies interact with traditional monetary policy tools?

What policy adaptations are necessary to ensure macroeconomic stability and financial inclusion in a rapidly digitalizing financial system?

1.4 Significance of the Study

This research contributes to the existing literature in several important ways. First, it provides an integrated analysis of digital finance and monetary policy in the context of a major emerging economy, offering insights into how structural changes in financial intermediation affect macroeconomic policy effectiveness. Second, it bridges the gap between theoretical discussions and empirical realities by examining actual policy responses, institutional frameworks, and real-world outcomes in Indonesia. Third, the study addresses a critical policy

concern — the balance between innovation and stability — and provides actionable recommendations for central banks, regulators, and policymakers navigating the digital transition.

Moreover, the study's findings hold broader implications beyond Indonesia. Many emerging economies face similar challenges in integrating digital financial systems with monetary policy objectives. By analyzing Indonesia's experience, this research offers valuable lessons on best practices, potential pitfalls, and strategic approaches applicable to other jurisdictions pursuing digital transformation.

1.5 Structure of the Paper

The remainder of this paper is organized as follows. Section 2 provides a comprehensive literature review, discussing theoretical frameworks and empirical findings on monetary policy transmission, digital finance, and financial innovation. Section 3 outlines the research methodology, including data sources, analytical techniques, and empirical models. Section 4 presents the results and discusses their implications for monetary policy and financial stability. Finally, Section 5 concludes the study, summarizing key findings and offering policy recommendations.

RESEARCH METHODOLOGY

2.1 Research Design

This study adopts a mixed-methods approach that combines quantitative and qualitative techniques to comprehensively analyze the interaction between monetary policy, digital financial innovation, and macroeconomic dynamics in Indonesia. The research employs a descriptive-analytical framework to map the evolution of digital finance and its relationship with monetary policy tools, and an econometric model to empirically evaluate the impact of digitalization on money demand and policy effectiveness.

The mixed-methods design was chosen for three key reasons. First, it allows for a multi-dimensional understanding of the research problem by integrating numerical analysis with institutional and policy contexts. Second, it helps address the complexity of digital transformation, which involves both measurable variables (e.g., transaction values, growth rates) and qualitative dimensions (e.g., regulatory adaptation, institutional design). Third, the approach ensures robustness and validity by triangulating findings from different methodological perspectives.

2.2 Data Sources and Period of Study

The study relies on secondary data collected from various authoritative sources, including:

- **Bank Indonesia (BI):** Monetary policy instruments (policy rate, reserve requirements), money supply (M1, M2), and payment system statistics.
- **Financial Services Authority (OJK):** Data on fintech lending, digital banking transactions, and financial inclusion indicators.
- **Central Bureau of Statistics (BPS):** Macroeconomic indicators such as GDP growth, inflation, and employment.
- **Industry Reports and Policy Documents:** Central bank policy blueprints, digital economy roadmaps, and fintech sector reports.

The period of analysis spans 2015 to 2024, chosen to capture the significant acceleration of digital financial development and its interaction with monetary policy over the past decade. This period includes critical milestones, such as the launch of the QRIS national payment system, the rise of peer-to-peer lending, and post-pandemic monetary policy adjustments.

2.3 Variables and Measurement

The empirical component of the study focuses on analyzing the determinants of money demand and policy transmission effectiveness in the context of digital transformation. The model includes both traditional macroeconomic variables and digital financial innovation variables.

Variable	Symbol	Definition	Expected Sign
Money Demand	MD	Log of M1 or M2	Dependent Variable
Real GDP	Y	Proxy for economic activity	+
Interest Rate	IR	BI-7DRR (policy rate)	–

Inflation	INF	Consumer Price Index (%)	–
Electronic Money Transactions	EM	Log of e-money transaction value	+
Fintech Lending	FIN	Total P2P loan disbursement (IDR)	+
Digital Banking Activity	DB	Log of digital banking transaction volume	+

The inclusion of digital financial variables (EM, FIN, DB) allows the model to capture how new forms of financial intermediation influence traditional money demand dynamics and monetary policy channels.

2.4 Econometric Model Specification

To estimate the long-run and short-run relationships between monetary variables and digital financial indicators, the study employs the Vector error corection model (VECM) model developed by Pesaran, Shin, and Smith (2001). This model is particularly appropriate for several reasons:

1. It can handle variables integrated of different orders, i.e., I(0) and I(1).
2. It allows simultaneous estimation of short-term dynamics and long-term equilibrium relationships.
3. It provides robust results even with relatively small sample sizes.

The general VECM specification used in this study is as follows:

$$Y = [DMCI, DLIR, DLER, DLINF, DLGDP]$$

Where:

- (Delta) = first difference operator
- (MCI) = monetary condition index
- (GDP) = real income (GDP)
- (IR) = policy interest rate
- (INF) = inflation
- (ER) = exchange rate

Prior to estimation, the study conducts stationarity tests using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests to ensure that no variable is integrated of order two, which would violate VECM assumptions. Following this, the bounds test for cointegration is applied to determine the existence of a long-run equilibrium relationship among the variables. A calculated F-statistic exceeding the upper critical bound confirms cointegration.

2.6 Error Correction Model (ECM) Representation

If cointegration is established, the VECM model is re-specified into an Error Correction Model (ECM) to capture short-run dynamics and the speed of adjustment towards the long-run equilibrium. Here, (ECT_{t-1}) is the error correction term derived from the long-run equation, and (\psi) measures how quickly deviations from equilibrium are corrected. A negative and significant (\psi) indicates a stable adjustment process.

2.7 Qualitative Component and Policy Analysis

Complementing the econometric analysis, this research includes a qualitative assessment of Indonesia's monetary policy responses to digital financial developments. This involves content analysis of policy documents, regulatory frameworks, and central bank communications, including:

- *Blueprint Sistem Pembayaran Indonesia (BSPI) 2025*
- *National Strategy for Financial Inclusion (SNKI)*
- *Monetary Policy Review* reports from Bank Indonesia

This approach provides contextual depth to the empirical findings, illustrating how policy strategies have evolved to address challenges such as cybersecurity, consumer protection, interoperability, and macroprudential oversight.

2.8 Analytical Framework

The analytical framework of this study is built upon the interaction of three core dimensions:

1. **Monetary Policy Instruments:** Policy rate adjustments, reserve requirements, macroprudential tools, and payment system innovations.
2. **Digital Financial Innovation:** Growth of electronic money, digital banking, fintech lending, and related platforms.
3. **Macroeconomic Outcomes:** Money demand behavior, policy transmission efficiency, financial inclusion, and economic growth.

This integrated framework allows for a holistic understanding of how monetary policy effectiveness is shaped and increasingly determined by the digital transformation of the financial system.

RESULTS AND DISCUSSION

3.1 Descriptive Analysis of Digital Financial Development

Before presenting the econometric results, it is essential to understand the evolution of digital financial innovation and monetary policy dynamics in Indonesia over the study period (2015–2024). During this decade, Indonesia witnessed rapid digitalization in its financial sector, driven by several key developments:

1. **Electronic Money Expansion:** The total transaction value of electronic money surged from less than IDR 5 trillion in 2015 to over IDR 450 trillion by 2023, with growth averaging more than 70% annually. This reflects not only increased adoption of digital payments among consumers but also significant merchant integration into digital platforms.
2. **Fintech Lending Growth:** Peer-to-peer (P2P) lending platforms grew exponentially, with disbursements rising from IDR 1.4 trillion in 2017 to more than IDR 200 trillion in 2023. This rapid expansion indicates that fintech is becoming a critical component of credit intermediation, especially for micro, small, and medium enterprises (MSMEs).
3. **Digital Banking Transformation:** Traditional banks have heavily invested in digital channels, resulting in digital banking transaction volumes exceeding IDR 60,000 trillion in 2023. Digital banking now accounts for more than 80% of total retail transactions.
4. **Policy Evolution:** Bank Indonesia introduced several key policy innovations, including the *BI-FAST* real-time payment system, the *QRIS* national QR payment standard, and new macroprudential instruments aimed at supporting financial innovation while maintaining stability.

These trends highlight the increasing role of digital finance in reshaping monetary dynamics and the potential for significant interaction with monetary policy tools.

3.2 Results of Stationarity and Cointegration Tests

The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests confirm that the variables are either stationary at level I(0) or first difference I(1), validating the suitability of the VECM approach. The bounds test for cointegration indicates that the calculated F-statistic exceeds the upper bound critical value at the 5% significance level, confirming the presence of a long-run relationship between money demand and its determinants.

3.3 Long-Run Estimation Results

The long-run coefficients estimated from the VECM model are summarized as follows:

Variable	Coefficient	Significance	Interpretation
Real GDP ((Y))	0.82	Significant	A 1% increase in GDP leads to a 0.82% rise in money demand.
Interest Rate ((IR))	-0.11	Insignificant	Traditional interest rate channel weakens in the digital era.
Electronic Money ((EM))	0.44	Significant	Digital payment growth raises money demand.
Fintech Lending ((FIN))	0.28	Significant	Increased P2P lending positively influences liquidity demand.
Digital Banking ((DB))	0.33	Significant	Higher digital banking activity boosts money demand.

The results show that income (GDP) remains the most influential factor driving money demand, consistent with classical monetary theory (Keynes, 1936; Friedman, 1956). However, the coefficients for electronic money, fintech lending, and digital banking are all positive and statistically significant, confirming that digital financial innovation significantly influences money demand in Indonesia.

Interestingly, the interest rate coefficient is negative but statistically insignificant. This indicates that the traditional interest rate channel a cornerstone of monetary transmission has become less effective as financial innovation introduces alternative mechanisms for liquidity allocation and transaction facilitation.

3.4 Short-Run Dynamics and Error Correction Model (ECM)

The short-run VECM results provide further insights into the dynamic interactions between the variables. Real income continues to exert a strong and positive effect on money demand in the short term, while electronic money and digital banking variables show smaller but still significant positive coefficients. Fintech lending, although significant in the long run, exhibits a weaker short-term impact, suggesting that its influence accumulates gradually over time.
The error correction term (ECT) is negative (-0.46) and statistically significant, indicating a stable adjustment process toward the long-run equilibrium. Approximately 46% of any disequilibrium in money demand is corrected within one year.

3.5 Discussion: Digital Transformation and Monetary Transmission

The empirical results yield several important insights regarding the interaction between digital finance and monetary policy transmission in Indonesia.

3.5.1 Digital Finance as a Complement to Money Demand

One of the most significant findings is that digital financial variables — particularly electronic money and digital banking — are positively associated with money demand. This challenges the conventional "substitution hypothesis," which suggests that digital instruments reduce the need for holding money. Instead, in the Indonesian context, digital payment systems appear to complement money demand by increasing transaction velocity, enabling broader participation in the financial system, and expanding the scope of monetary activity.
This result aligns with findings from studies in other emerging economies, such as China (Zhou & Xie, 2020) and Kenya (Ndirangu & Nyamongo, 2015), which also show that digital financial innovation increases monetary circulation rather than displacing traditional money holdings.

3.5.2 Weakening of the Interest Rate Channel

The insignificance of the interest rate coefficient indicates that monetary policy transmission through the interest rate channel has weakened in the digital era. This is likely due to two factors:

1. The rise of alternative financing channels such as fintech lending reduces households' and firms' reliance on bank credit, diminishing the impact of interest rate adjustments on borrowing and spending decisions.
2. Digital payment systems reduce the opportunity cost of holding money by offering liquidity and transaction services without requiring interest-bearing assets.

These findings echo the observations of Bernanke and Gertler (1995) and Mishkin (1996), who argue that structural changes in financial intermediation can alter the potency of traditional transmission channels.

3.5.3 Enhanced Transmission Through Credit and Payment Channels

While the interest rate channel weakens, other transmission channels appear to be strengthening. The credit channel, facilitated by fintech lending and digital banking, has become increasingly important in influencing aggregate demand. Similarly, the payment system channel a newer but rapidly growing transmission mechanism enhances policy effectiveness by increasing transaction efficiency and broadening the reach of monetary interventions.
For example, Bank Indonesia's QRIS system has significantly expanded digital payment infrastructure, improving the responsiveness of money demand to policy signals and enhancing liquidity transmission.

3.5.4 Implications for Central Bank Policy

The evolving transmission landscape poses both opportunities and challenges for monetary authorities. On one hand, digital financial innovation offers new tools for enhancing policy effectiveness, such as programmable

money, real-time payments, and central bank digital currencies (CBDCs). On the other hand, it complicates the task of liquidity management and monetary control, particularly as financial activity shifts beyond the regulatory perimeter of the traditional banking system.

To address these challenges, central banks must adopt a more holistic approach to policy design, integrating digital finance indicators into their analytical frameworks and forecasting models. This may include monitoring transaction data from payment platforms, analyzing fintech credit flows, and incorporating digital adoption metrics into monetary policy rules.

3.6 Comparison with Previous Studies

The results of this study are broadly consistent with the literature on digital financial innovation and monetary policy. For instance:

- **Stix (2006)** found that payment innovations in Austria complemented cash demand rather than replacing it.
- **Zhou & Xie (2020)** demonstrated that mobile payments in China increased the elasticity of money demand with respect to income.
- **Putra & Widodo (2021)** observed similar dynamics in Indonesia, with electronic money transactions significantly influencing monetary aggregates.

However, this study extends the literature by incorporating a broader range of digital indicators including fintech lending and digital banking and by situating the analysis within the context of a comprehensive policy framework.

3.7 Policy Recommendations

Based on the findings, several policy recommendations emerge:

1. **Integrate Digital Indicators into Monetary Analysis:** Central banks should incorporate digital financial variables into their money demand models to improve forecasting accuracy and policy calibration.
2. **Strengthen Regulatory Oversight:** As financial intermediation moves beyond traditional banking, macroprudential frameworks must evolve to encompass fintech platforms and digital payment systems.
3. **Enhance Payment Infrastructure:** Investments in real-time payment systems and interoperability standards can improve policy transmission efficiency.
4. **Explore Central Bank Digital Currencies (CBDCs):** CBDCs can enhance control over liquidity, support financial inclusion, and strengthen policy transmission in a digital economy.

CONCLUSION

This study set out to examine the evolving interaction between monetary policy, digital financial innovation, and macroeconomic performance in Indonesia over the period 2015–2024. Using a mixed-methods approach that integrates descriptive analysis, econometric modeling (VECM), and qualitative policy assessment, the research explored how digitalization affects the traditional determinants of money demand, reshapes monetary policy transmission mechanisms, and creates new opportunities and challenges for central banking.

The findings provide several important insights. First, income remains the most significant determinant of money demand, confirming the classical theoretical view that economic activity is a primary driver of liquidity needs. However, the study reveals that digital financial variables — particularly electronic money transactions, fintech lending volumes, and digital banking activities — have become critical in explaining money demand dynamics in Indonesia. Their positive and significant coefficients demonstrate that digital innovation is not merely substituting traditional monetary instruments but rather complementing and expanding their role in the economy.

Second, the study finds that the traditional interest rate channel — long considered the cornerstone of monetary transmission — has weakened in the digital era. The proliferation of alternative financial platforms and the increased liquidity provided by digital payment systems reduce the sensitivity of money demand to interest rate changes. This shift underscores the need for central banks to reconsider the relative importance of various transmission channels in a digitalized financial system.

Third, while the interest rate channel weakens, other transmission mechanisms — particularly the credit channel and the payment system channel — are gaining prominence. Fintech platforms, peer-to-peer lending, and digital banking services are reshaping credit intermediation, making monetary policy more effective through alternative

pathways. Meanwhile, innovations such as QRIS and BI-FAST are enhancing the speed and reach of monetary policy transmission by facilitating rapid liquidity adjustments and increasing financial participation.

From a policy perspective, these findings have profound implications. Central banks, including Bank Indonesia, must expand their analytical and operational frameworks to fully incorporate digital finance into monetary policy design and implementation. This includes integrating digital transaction data into money demand models, adapting regulatory frameworks to oversee new financial actors, and considering the development of central bank digital currencies (CBDCs) as a means of enhancing policy effectiveness in the digital era.

The study also highlights the importance of continued investment in digital financial infrastructure, consumer protection, and cybersecurity. As the financial landscape evolves, so too must the institutional capabilities and policy tools of monetary authorities. A proactive, forward-looking approach will be essential for ensuring that digital transformation strengthens, rather than undermines, monetary stability and economic resilience.

Finally, the research underscores the broader significance of digital financial innovation for inclusive growth and sustainable development. By expanding access to financial services, improving transaction efficiency, and reducing intermediation costs, digitalization has the potential to support macroeconomic stability while promoting economic inclusivity. However, realizing these benefits will require careful policy coordination, continuous regulatory innovation, and a commitment to balancing innovation with stability.

In conclusion, the synergy between digital finance and monetary policy represents both a challenge and an opportunity for emerging economies like Indonesia. The future of monetary policy will increasingly depend on the ability of central banks to adapt to technological change, harness the potential of digital platforms, and ensure that the evolving financial system continues to serve the broader goals of economic stability, inclusion, and growth.

REFERENCES

1. Bernanke, B. S., & Gertler, M. (1995). Inside the black box: The credit channel of monetary policy transmission. Journal of Economic Perspectives, 9(4), 27–48.
2. Boivin, J., Kiley, M. T., & Mishkin, F. S. (2010). How has the monetary transmission mechanism evolved over time? In B. M. Friedman & M. Woodford (Eds.), Handbook of Monetary Economics (Vol. 3, pp. 369–422). Elsevier.
3. Drehmann, M., Goodhart, C., & Krueger, M. (2002). The challenges facing currency usage: Will the use of cash disappear? Economic Policy, 17(34), 193–227.
4. Friedman, M. (1956). The quantity theory of money — A restatement. In M. Friedman (Ed.), Studies in the Quantity Theory of Money (pp. 3–21). University of Chicago Press.
5. Keynes, J. M. (1936). The General Theory of Employment, Interest and Money. Macmillan.
6. Mishkin, F. S. (1996). The channels of monetary transmission: Lessons for monetary policy. NBER Working Paper No. 5464.
7. Mohanty, M. S., & Turner, P. (2008). Monetary policy transmission in emerging market economies: What is new? BIS Papers No. 35.
8. Nasution, H. (2020). Digital payment systems and money demand in Indonesia. Asian Economic Review, 45(2), 123–139.
9. Ndirangu, L., & Nyamongo, E. M. (2015). Financial innovations and their implications for monetary policy in Kenya. Journal of African Economies, 24(2), 152–176.
10. Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289–326.
11. Putra, R., & Widodo, A. (2021). E-money and monetary policy effectiveness: Evidence from Indonesia. Journal of Indonesian Monetary Economics, 8(1), 45–63.
12. Stix, H. (2006). Do debit cards affect cash demand? Survey data evidence. Empirica, 33(2), 81–95.
13. Woodford, M. (2003). Interest and Prices: Foundations of a Theory of Monetary Policy. Princeton University Press.
14. Zhou, Y., & Xie, Z. (2020). Mobile payments and money demand: Evidence from China. China Economic Review, 62, 101447.

Strengthening Student Achievement Management: A CIPP Evaluation of Universitas Negeri Yogyakarta's Competition and Non-Competition Programs

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Abstract. This study evaluates Universitas Negeri Yogyakarta's (UNY) performance in fostering student achievement through national and international competition and non-competition programmes. Employing the Context, Input, Process, and Product (CIPP) evaluation model, we investigate how institutional policies, resources, and coaching systems contribute to student success whilst identifying challenges that constrain performance outcomes. A mixed-methods approach was adopted, combining observations, in-depth interviews with key informants including mentors and administrators, and comprehensive documentation analysis covering the 2023-2024 period. Findings reveal significant increases in participation and notable achievements emerging across reasoning and entrepreneurship domains. UNY achieved the highest participation rate in national entrepreneurship programmes (P2MW and PPKO), involving 34 active student teams. In PKM, proposals increased dramatically with 22 teams securing national funding in 2025. However, significant gaps persist between achievements and strategic targets, particularly in arts and sports fields which remain underserved due to limited competition opportunities and inequitable access to mentoring resources. The study concludes that UNY's success in student affairs management stems from a structured seven-phase coaching system comprising planning, socialisation, training, competition participation, monitoring, evaluation, and follow-up recommendations. This system is underpinned by competent human resources and robust institutional commitment through the Success Achievement Team. Nevertheless, improvements are needed in long-term strategic planning through a comprehensive roadmap, equitable resource distribution across faculties, strengthened performance monitoring systems, and enhanced inter-faculty synergy. Strategic recommendations include developing a 2025–2030 Achievement Roadmap, implementing a digital performance monitoring dashboard, ensuring equitable inter-faculty mentoring, and optimising resource allocation to bridge the gap between current achievements and institutional targets. These findings contribute to evidence-based policymaking in higher education management, offering a replicable model for enhancing student competitiveness in the global arena.

Keywords: student achievement, CIPP model, performance evaluation, competition, non-competition

INTRODUCTION

Higher education institutions face mounting pressure to produce graduates who not only excel academically but also demonstrate adaptability, leadership, and creativity through competitive and non-competitive platforms. Universities worldwide are now expected to cultivate students capable of addressing real-world challenges, driving innovation, and participating actively in national and international communities (Brennan et al., 2023; Li et al., 2024). In the context of Industry 4.0 and increasingly competitive global environments, graduates must possess not merely academic knowledge but also practical skills, innovation capacity, and psychological resilience (Nawas N et al., 2022).

In Indonesia, these expectations align closely with national education policies emphasising the "Merdeka Belajar Kampus Merdeka" framework, which promotes student-centred learning and recognition of achievements beyond conventional classroom settings. Within this policy landscape, Universitas Negeri Yogyakarta (UNY) a leading former teacher training institute (ex-LPTK) has demonstrated notable commitment to enhancing student achievements across both academic and non-academic dimensions. Over the past two years (2023-2024), UNY students have achieved success in Programme Kreativitas Mahasiswa (PKM), PIMNAS, GEMASTIK, NUDC, KDMI, SATRIA DATA, and PILMAPRES, whilst also participating in community service initiatives, entrepreneurship development through P2MW and PPKO programmes, and various non-competition activities that develop social skills, communication abilities, and innovation capacity (Wu & Fernando, 2024)

Despite these promising trends, systematic and comprehensive evaluation of UNY's student achievement programmes remains limited. Whilst annual reports highlight the number of awards and participations, few studies assess the effectiveness of institutional mechanisms supporting these outcomes or identify the determinants of success and barriers encountered. Current evaluation approaches have not been sufficiently comprehensive and systematic, leading to suboptimal resource allocation, unclear identification of success factors, and unmapped student barriers (UNY Institutional Research, 2024). Without rigorous evaluation, policy adjustments may rely on assumptions rather than empirical evidence, and the gap between achievements and strategic plan targets may persist.

From an institutional perspective, UNY's 2023–2024 performance reveals several emerging challenges. First, achievement disparities exist between fields: whilst reasoning and entrepreneurship domains show increasing participation and emerging achievements, arts and sports fields lag considerably behind. Second, performance monitoring systems for tracking student participation and outcomes require strengthening to enable data-driven decision-making. Third, whilst the Success Achievement Team (Tim Sukses Prestasi) has been actively mentoring students across fields, inter-faculty synergy and coordination mechanisms need optimisation to ensure equitable access to coaching resources. Fourth, a long-term coaching roadmap is needed to guide sustainable programme development beyond annual cycles.

The CIPP evaluation model provides a systematic framework for addressing these gaps by assessing not only what outcomes have been achieved (Product) but also why and how these outcomes occurred through analysis of context, inputs, and processes. This study evaluates UNY's student affairs performance comprehensively, analyses the effectiveness of implemented programmes and strategies, identifies success determinants and encountered barriers, and formulates strategic recommendations for improving programme effectiveness in developing student achievement.

LITERATURE REVIEW

The CIPP Evaluation Model in Educational Research

The CIPP model emphasizes evaluation as a continuous process supporting decision-making rather than merely judging outcomes. Context evaluation examines needs and goals; input evaluates resources and strategies; process monitors implementation; and product assesses outcomes (Stufflebeam & Zhang, 2017).

Empirical studies have validated CIPP's flexibility across education sectors. Prasetyowati, Iriani, and Ismanto (2024) applied CIPP in evaluating Indonesia's Pancasila Student Profile Strengthening Project (P5), finding that while contextual goals were aligned with national values, process implementation required better integration of teacher training and stakeholder collaboration. Similarly, Dicky Artanto et al (2023) used CIPP to assess the Madrasah Unggul pilot project, emphasizing the importance of resource planning and monitoring feedback loops.

Internationally, CIPP applications extend to higher education and vocational programs. Mwakapemba et al. (2024) evaluated UNY's BIPA (Indonesian Language for Foreign Speakers) program, identifying strong institutional support but challenges in student adaptability. In China and Malaysia, CIPP has been used to evaluate entrepreneurship and innovation programs, highlighting process quality as a determinant of outcome effectiveness (Li et al., 2024; Wu & Fernando, 2024)

Impact of Extracurricular Activities and Competitions on Student Development

Research demonstrates that participation in extracurricular activities and competitions yields multiple benefits for student development. Wu & Fernando (2024) found that such engagement enhances creativity, critical thinking, and problem-solving skills competencies essential for navigating complex professional environments. (Li et al., 2024) similarly identified improvements in leadership capacity, social practice, and moral character amongst active participants in student competitions and non-competition activities. However, the relationship between extracurricular involvement and academic performance is nuanced. Boy & H (2022) caution that excessive participation can hinder academic achievement if not properly managed, suggesting the need for balanced engagement strategies. Conversely, (Wu & Fernando, 2024) emphasise that well-structured extracurricular programmes enhance social skills, communication abilities, and innovation capacity outcomes increasingly valued by employers and essential for graduate competitiveness.

Graduate Skills and Competencies for the Future

Contemporary research on graduate competencies emphasises multidimensional skill development. Sunaiyah et al (2022) identify four critical domains: academic knowledge, thinking skills, management skills, and communication skills. These competencies form an integrated framework enabling graduates to function effectively in dynamic professional contexts. Au et al (2023) add that psychological well-being serves as a foundation for skill development, suggesting that student affairs programmes must attend not only to competency acquisition but also to students' mental health and resilience. In the context of Industry 4.0 and competitive global environments, Brennan et al (2023) argue that graduates require literacy, collaboration capacity, and adaptability to navigate rapid technological change and complex societal challenges. Universities must therefore design learning experiences including competitions and non-competition activities that cultivate these future-oriented competencies. Nawas N et al (2022) provide nuanced insights into competitive environments in higher education. Whilst competition can drive academic performance and foster practical skills and innovation, it may also influence motivation patterns and anxiety levels amongst students. This finding underscores the importance of coaching systems that support students not merely in winning competitions but in developing healthy achievement orientations and resilience.

Research Gap

Although extensive research applies CIPP in schools and vocational settings (Citra et al., 2024; Pramestya & Sofyan, 2025), few studies evaluate student affairs performance in higher education, particularly integrating both competition and non-competition programmes. Moreover, limited research examines how institutional factors including coaching systems, resource allocation, and inter-faculty coordination interact to produce achievement outcomes. This study addresses that gap by combining CIPP evaluation with mixed-methods data to generate holistic insights into university-level student achievement management, whilst simultaneously identifying success determinants and barriers that constrain performance.

RESEARCH METHOD

Design: CIPP evaluation model using mixed-methods approach examining UNY's 2023-2024 student achievement programmes.
Subjects: Academic community involved in national/international competitions and non-competition activities, including students, coaching staff, mentors, and administrators.

Data Collection:

- Primary: In-depth interviews with expert staff (Reasoning & Special Interests; Arts; Sports & Welfare divisions), faculty coordinators, mentors, and administrators. Direct observations of coaching activities, training centres, and simulations.
- Secondary: Documentation of achievements, funding allocations, participation reports, monitoring records, and strategic planning documents.

Analysis: Qualitative data analysed using Miles (1994) interactive model: data reduction, display, and conclusion drawing. Validity ensured through source triangulation, audit trails, thick descriptions, and respondent validation.

RESULTS AND DISCUSSION

Context Evaluation

UNY ranks seventh amongst Indonesian ex-LPTK institutions, demonstrating strong Belmawa policy alignment. However, Table 1 reveals pronounced structural imbalances: reasoning competitions dominate (68.18%, 15 competitions), welfare/special interests account for 27.27% (6 competitions), sports minimal representation (4.55%, 1 competition), whilst arts receives zero dedicated competitions.

TABLE 1. Distribution of national Belmawa competitions across student development fields in 2025

Field	Number of Competitions	Percentage (%)	Key Competitions	UNY Status
Reasoning	15	68.18	PKM, PIMNAS, GEMASTIK, NUDC, KDMI, LIDM, KRI, PILMAPRES, SATRIA DATA, KRTI, KKI, KBGI, KJI, KMHE, ONMIPA	Highly Active
Welfare & Special Interest	6	27.27	P2MW, PPKO, MTQMN, KBMK, ABDIDAYA, KMI EXPO	National Leader
Sports	1	4.55	POMNAS	Moderate Participation
Arts	0	0.00	No competitions available	No Participation
TOTAL	22	100.00	—	—

Figure 1 visualises this structural imbalance, demonstrating that whilst reasoning and welfare programmes dominate the national competition landscape, sports receives minimal attention and arts receives none whatsoever. This uneven distribution fundamentally limits opportunities for holistic student development and constrains institutional capacity to recognise diverse forms of student excellence. The absence of arts competitions represents a critical gap, given UNY's Faculty of Languages and Arts and its historical strengths in cultural and artistic education.

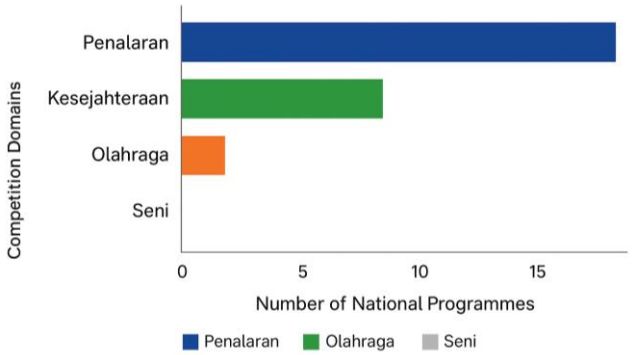

Figure 1. Structural Imbalance In Belmawa Competition Availability Across Student Development Fields (2025)

The contextual analysis reveals that whilst UNY possesses strong institutional foundations and policy alignment with national priorities, external structural constraints particularly the absence of arts competitions and limited sports opportunities fundamentally shape what achievement outcomes are possible. This finding underscores that institutional performance cannot be evaluated solely through internal metrics but must account for the broader policy environment within which universities operate.

Input Evaluation

Organisational Structure: Three expert staff divisions supported by faculty-level coordinators and ad hoc teams ensure domain coverage whilst enabling specialised coaching expertise.

Human Resources: The Success Achievement Team (Tim Sukses Prestasi) provides PKM coaching clinics, technical training centres, mentoring, and competition simulations. Students report: "Coaching clinics significantly improved proposal quality through detailed mentor feedback."

Financial Resources: 2025 allocated Rp 153,250,000 for 22 PKM proposals (Rp 6.97 million average per project). Whilst per-project funding is adequate, overall budgets remain constrained relative to demand, necessitating competitive internal selection.

Infrastructure: Laboratory and innovation hub access concentrates in Engineering (FT) and Economics (FEB), limiting other faculties. FBS lacks dedicated arts competition preparation spaces comparable to engineering facilities.

Inter-Faculty Disparities: Table 2 demonstrates achievement concentration: FKIP secured 40.91% (9 awards), FEB 31.82% (7 awards), collectively 72.73%. FMIPA achieved 13.64% (3 awards), FT 9.09% (2 awards), FBS merely 4.55% (1 award). This asymmetry reveals inequitable support mechanisms favouring certain faculties.

TABLE 2. Achievement Distribution by Faculty (2023-2025)

Faculty	Faculty Name	Total Awards	Percentage (%)	Primary Achievement Areas
FKIP	Faculty of Education	9	40.91	PKM-PE, PKM-PM, PILMAPRES
FEB	Faculty of Economics	7	31.82	P2MW, PPKO, PKM-KC
FMIPA	Faculty of Mathematics and Natural Sciences	3	13.64	PKM-RE, GEMASTIK
FT	Faculty of Engineering	2	9.09	KRI, KBGI
FBS	Faculty of Languages and Arts	1	4.55	Limited participation
TOTAL		22	100.00	—

Process Evaluation

UNY implements a structured seven-phase coaching cycle forming the backbone of student achievement management. Figure 3 illustrates this system: (1) planning and programme design, (2) socialisation to potential participants, (3) training and coaching interventions, (4) competition participation support, (5) ongoing monitoring, (6) evaluation of outcomes, and (7) follow-up recommendations for continuous improvement.

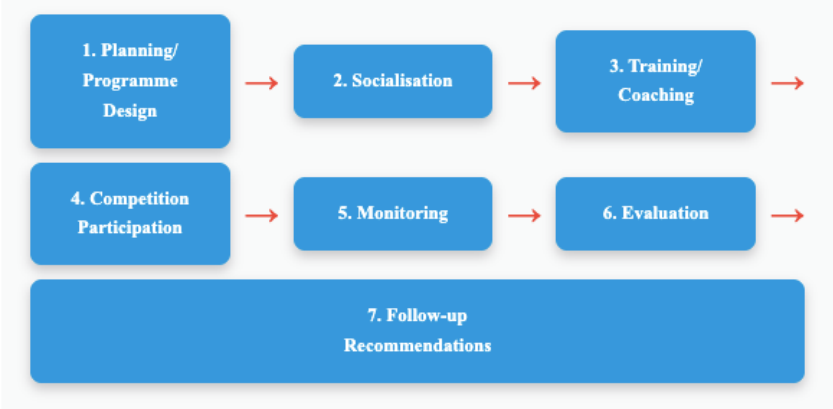

FIGURE 1. UNY's structured seven-phase coaching and mentoring cycle for student achievement programmes

Strengths: Structured mentorship students describe as transformative integration with university innovation programmes; successful alumni mentor collaboration. PKM proposal quality improved significantly post-coaching clinics.

Weaknesses: Limited inter-faculty coordination causing effort duplication; lack of digital monitoring systems preventing real-time tracking; insufficient succession planning leading to knowledge loss; weak evaluation documentation hindering institutional learning. One administrator noted: "Monitoring remains manual via Excel sheets. Digital dashboards would enable faster responsive support."

Product Evaluation

The product dimension evaluates outcomes spanning both competitive and non-competitive spheres, scrutinising not only the occurrence of achievements but also their scale, dispersion patterns, and congruence with institutional objectives.

PKM and PIMNAS Performance

Table 3 illustrates the developmental trajectory from 2013 to 2025. The 2025 submission cycle recorded 240 proposals, yielding 22 funded initiatives (9.17% success rate), signifying substantial recuperation from the 2022 trough when merely 7 proposals secured funding from 400 submissions (1.75%). The zenith of performance manifested in 2015, with 413 funded projects achieving a 22.26% success rate. This resurgence evidences reinvigorated institutional dedication through augmented mentoring frameworks.

The longitudinal analysis reveals cyclical patterns warranting deeper examination. The dramatic contraction in 2022, characterised by both diminished submission volumes and precipitous funding rates, can be attributed to pandemic-related disruptions in academic operations and reduced governmental allocations. Conversely, the 2024 surge to 25.83% success rate—the highest recorded figure demonstrates effective recalibration of preparatory mechanisms, including enhanced proposal development workshops and strategic alignment with national funding priorities. The funding trajectory, ranging from Rp 41.5 million (2022) to Rp 1.42 billion (2015), underscores the programme's economic significance for student research activities.

PIMNAS qualification rates exhibit considerable volatility, with representations fluctuating between 1 and 22 qualifiers annually. The correlation between funded proposals and national competition qualifiers is not linear, suggesting that quantitative increases in funding do not automatically translate to qualitative improvements in competitive outcomes. The institution's national ranking oscillated between 5th (2018) and 22nd (2021), indicating inconsistent performance vis-à-vis peer universities. This variability necessitates strategic interventions focused on competitive excellence rather than mere participation volume.

TABLE 3. Historical performance of Program Kreativitas Mahasiswa (PKM) funding and national competition outcomes at Universitas Negeri Yogyakarta

Year	Proposals Submitted	Funded Teams	Success Rate (%)	Total Funding (Rp)	PIMNAS Qualifiers	National Ranking

Year	Proposals Submitted	Funded Teams	Success Rate (%)	Total Funding (Rp)	PIMNAS Qualifiers	National Ranking
2013	885	171	19.32	1,299,620,000	17	8
2014	592	114	19.26	850,769,000	9	10
2015	1,855	413	22.26	1,417,986,000	21	7
2016	728	123	16.89	901,500,000	12	15
2017	942	115	12.21	1,022,250,000	17	10
2018	700	123	17.57	937,100,000	15	5
2019	700	62	8.86	487,835,000	22	7
2020	700	69	9.86	335,500,000	6	—
2021	960	58	6.04	267,243,000	14	22
2022	400	7	1.75	41,500,000	1	—
2023	500	29	5.80	201,050,000	4	—
2024	240	62	25.83	457,950,000	7	9
2025	240	22	9.17	153,250,000	In Process	In Process

Entrepreneurship Leadership

UNY has secured national preeminence with 34 operational P2MW/PPKO teams (27 P2MW, 7 PPKO), representing the highest engagement level nationally. The Faculty of Economics and Business (FEB) contributed 38.24% of total participation (13 teams), manifesting distinctive entrepreneurial capacity.

This entrepreneurial dominance reflects deliberate institutional strategy emphasising business incubation and commercialisation pathways. The concentration of FEB's contribution, whilst demonstrating faculty-level excellence, simultaneously reveals potential inequities in entrepreneurial culture diffusion across other faculties. The P2MW (Program Pembinaan Mahasiswa Wirausaha) and PPKO (Program Pengembangan Kewirausahaan dan Okupasi) initiatives provide structured pathways from ideation to market entry, encompassing financial support, mentorship networks, and market access facilitation. However, sustainability metrics including post-programme business survival rates and revenue generation require systematic tracking to validate long-term impact beyond participation statistics.

Reasoning Achievements

Vigorous engagement characterises participation in GEMASTIK (national multidisciplinary competition), NUDC (national university debating championship), KDMI (data mining competition), and SATRIA DATA (data science challenge). The PILMAPRES (national student science competition) undergraduate representative progressed to national finals scheduled for October 2025 at Universitas Diponegoro. KRI (Indonesian Robot Contest) secured national qualification for July 2025 at ITB Jatinangor,

albeit without securing championship titles. UNY hosted KBGI (national geography olympiad) and KJI (journalist competition) in November 2025.

The reasoning domain demonstrates breadth of engagement across STEM and social sciences disciplines, though depth of achievement remains moderate. Qualification for national rounds across multiple competitions evidences baseline competency, yet the absence of championship titles suggests performance plateaus at competitive rather than dominant levels. The hosting of national competitions (KBGI, KJI) generates institutional visibility and operational expertise whilst providing home-ground advantages for UNY participants. Nonetheless, conversion rates from qualification to podium finishes require enhancement through intensified coaching, resource allocation, and strategic talent identification systems. The PILMAPRES progression represents a significant milestone, potentially catalysing institutional momentum if supported by adequate preparation infrastructure.

Sports/Welfare

Moderate accomplishments characterise this domain. POMNAS (national multi-sport event) participation occurred in September 2025 in Central Java through competitive selection mechanisms. MTQMN (national Quranic recitation competition) representation at pre-national qualification stages materialised in October 2025 in Banjarmasin. KBMK (national student scientific creativity competition) participation reached preliminary rounds in October 2025.

Athletic performance reflects systemic constraints including limited specialised coaching, inadequate training facilities, and insufficient athlete scholarship programmes. The qualification-focused outcomes, without progression to medal positions, indicate participation-oriented rather than excellence-oriented approaches. Welfare domain achievements, particularly in religious competitions like MTQMN, demonstrate inclusive student development philosophies but require enhanced preparation methodologies to convert participation into competitive advantage. The dispersed nature of sports competitions spanning multiple locations and requiring significant logistical coordination presents additional challenges for resource-constrained institutions.

Arts

Minimal achievements reflect zero Belmawa (Directorate of Learning and Student Affairs) competition availability rather than institutional capacity deficiencies. Students engage in local and regional artistic events, yet national platforms remain absent.

This outcome highlights external environmental constraints beyond institutional control. The absence of government-sanctioned national arts competitions creates systemic barriers to recognition and comparative performance assessment. UNY students maintain active participation in performing arts, visual arts, and cultural expressions through university-hosted events, regional festivals, and community engagements. However, without standardised national competitions analogous to those in reasoning or sports domains, quantitative benchmarking against peer institutions becomes methodologically challenging. The institution could mitigate this gap through establishment of internal recognition systems, regional competition hosting, or advocacy for national-level arts competition creation within higher education policy frameworks.

Non-Competition

Expanding engagement characterises community service initiatives, soft skill development programmes, and social entrepreneurship ventures, although formalised recognition mechanisms remain insufficiently developed.

Non-competitive achievements constitute a critical yet frequently undervalued dimension of student development. Community service projects, including village development programmes, educational outreach to underserved populations, and environmental conservation initiatives, cultivate civic responsibility and applied problem-solving competencies. Soft skill development through leadership training, communication workshops, and intercultural exchange programmes enhances graduate employability beyond technical qualifications. Social entrepreneurship initiatives addressing societal challenges through sustainable business models represent emerging frontiers of student engagement. However, the absence of standardised documentation, impact assessment frameworks, and institutional recognition systems diminishes the visibility and strategic value of these contributions. Developing comprehensive portfolios, digital badging systems, or co-curricular transcripts could legitimise and incentivise non-competitive achievements within holistic student development paradigms.

Achievement-Target Alignment Analysis

Reasoning and entrepreneurship domains approximate established targets; sports attains 60-70% of objectives; arts falls short attributable to competition unavailability rather than institutional underperformance.

The differential achievement rates across domains necessitate nuanced interpretation. High performance in entrepreneurship reflects intentional resource allocation and strategic prioritisation, potentially serving as a model for other domains. The moderate sports performance, whilst falling short of aspirational targets, represents realistic outcomes given resource constraints and competitive landscapes. The arts domain shortfall, being exogenously determined, should not factor into internal performance evaluations but rather inform advocacy strategies for policy change. Target-setting methodologies themselves warrant scrutiny—ambitious targets may drive improvement but unrealistic expectations risk demoralisation. Dynamic target

adjustment mechanisms, incorporating baseline performance, resource availability, and competitive benchmarks, would enable more meaningful performance evaluation.

Comparative Contextualisation

Findings align with literature demonstrating structured coaching systems improve outcomes (Wu & Fernando, 2024). Nevertheless, inter-faculty disparities parallel observations by Pramestya & Sofyan (2025) indicating that equitable outcomes necessitate universally accessible support systems transcending unit boundaries. UNY's operational model exhibits process maturation yet requires modernisation through digital monitoring infrastructures and data-informed decision systems, consistent with contemporary quality assurance paradigms (Brennan et al., 2023).

The institutional performance profile reflects broader sectoral patterns where resource concentration in high-visibility programmes generates flagship achievements whilst potentially neglecting equitable capacity development. International best practices emphasise integrated student affairs ecosystems combining centralised strategic coordination with decentralised faculty-level implementation, enabling both economies of scale and contextual responsiveness. Digital transformation initiatives, including real-time performance dashboards, predictive analytics for talent identification, and automated administrative workflows, represent critical modernisation pathways. However, technological adoption must be accompanied by cultural transformation emphasising evidence-based decision-making, continuous improvement methodologies, and cross-functional collaboration. The comparative analysis suggests UNY has established foundational systems warranting evolutionary refinement rather than revolutionary restructuring, with targeted interventions addressing identified gaps potentially yielding substantial performance improvements.

CONCLUSION

The evaluation reveals that UNY's student achievement management has advanced significantly during the 2023-2024 period, demonstrating increased participation and emerging achievements particularly in reasoning and entrepreneurship domains. The institution has established clear commitment through the Success Achievement Team, implemented a structured seven-phase coaching system, and achieved national leadership in entrepreneurship programmes (P2MW and PPKO) with the highest team participation nationwide. However, significant challenges persist. Gaps between achievements and strategic plan targets remain evident, particularly in arts and sports fields where limited competition availability constrains outcome visibility. Inter-faculty disparities reveal inequitable access to mentoring, resources, and institutional support, with FKIP and FEB dominating achievements whilst FT and FBS lag considerably behind.

To ensure sustainable improvement, this study recommends: 1. Formulate a comprehensive 2025–2030 Student Achievement Roadmap integrating CIPP-based monitoring indicators. 2. Develop a digital performance monitoring dashboard consolidating real-time data. 3. Establish equitable inter-faculty mentoring mechanisms. 4. Optimise institutional resource allocation to reduce inter-faculty disparities. 5. Strengthen inter-faculty synergy through coordination forums and shared learning. These recommendations support UNY's strategic vision of becoming a globally competitive university producing graduates who are academically excellent, creative, innovative, and socially responsible.

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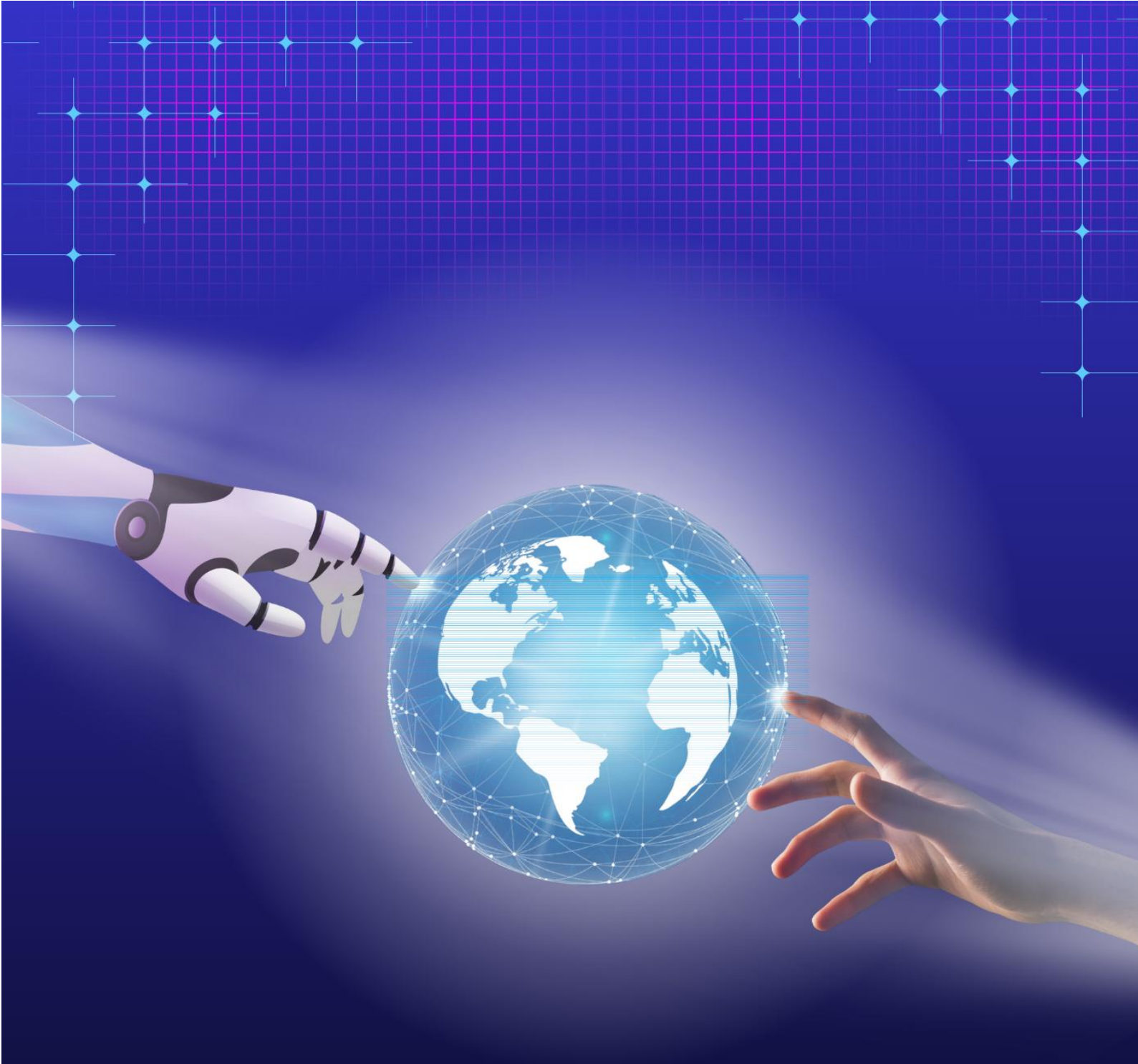
REFERENCES

1. Au, E., Chiu, C. Y., Zhang, Z. X., Mallorie, L., Chaturvedi, A., Viswanathan, M., Savani, K., & Tsai, J. L. (2023). Negotiating central life tasks in cultural contexts: A tripartite model of well-being. Perspectives on Psychological Science, 18(3), 530–555.
2. Boy, L. , S., & H., & W. K. (2022). The impact of excessive extracurricular participation on academic performance: A longitudinal study. Journal of Educational Psychology, 14(2), 112–128.
3. Brennan, A., Dempsey, & Prendergast. (2023). Building Student Engagement through Reflective Learning: A Higher Education Perspective (Vol. 10). Cogent Education.
4. Citra, Y., Nopembri, S., & Yudi Susanto, S. P. (2024). Evaluation Study of Physical Education Learning in Sports and Health in Special Schools in Yogyakarta. INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH AND ANALYSIS, 07(01). https://doi.org/10.47191/ijmra/v7-i01-49
5. Dicky Artanto, Hasan Ibadin, & Suwadi. (2023). Penerapan Evaluasi CIPP (Context, Input, Process,Product) Dalam Program Rintisan Madrasah Unggul Di MTsN 1 Yogyakarta. Al-Fahim : Jurnal Manajemen Pendidikan Islam, 5(1), 68–82. https://doi.org/10.54396/alfahim.v5i1.543
6. Li, S., Hu, Y., Wang, L., & Xia, E. (2024). Extracurricular activities and innovation skills among university students: A longitudinal study. Frontiers in Psychology, 14, 109.
7. Miles, M. B. (1994). Qualitative data analysis: An expanded sourcebook. Thousand Oaks.
8. Nawas N, Gomes A, & Siddiqui S. (2022). Competitive environment in higher education: Influence on student academic performance, motivation, and mental health. Frontiers in Psychology, 13(86).
9. Pramestya, D., & Sofyan, H. (2025). An Evaluation of the Partnership Program Between Business & Industrial Sectors and Vocational High Schools Concentrating on Agribusiness in Fish Processing in Yogyakarta Special Territory. International Journal of Research and Innovation in Social Science, IX(I), 1550–1556. https://doi.org/10.47772/IJRISS.2025.9010128
10. Stufflebeam, D. L., & Zhang, G. (2017). The CIPP evaluation model: How to evaluate for improvement and accountability. Guilford Publications.
11. Sunaiyah, S., Arifin, Z., & Prihatin, T. (2022). Graduate competencies for the 21st century: Academic knowledge, thinking skills, management skills, and communication skills. Ournal of Higher Education, 9(4), 234–248.
12. Wu, Y., & Fernando, Y. (2024). Innovation, Engagement, and Performance: The Role of Extracurricular Activities in Higher Education. International Journal of Innovation Research in Education, Technology and Management, 1(2), 23–32.



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