JURNAL ABSIS
Jurnal Pendidikan Matematika dan Matematika
Vol. 8 No. 3, December 2025

DEVELOPMENT OF A PATTERN-BASED NUMERACY LEARNING MODULE TO ENHANCE STUDENTS' CREATIVE THINKING AND NUMERACY SKILLS

Yesi Yuniati[1], Tatag Yuli Eko Siswono[2], Tri Dyah Prastiti[3]
[1,3] Universitas Terbuka Surabaya, Indonesia
[2] Universitas Negeri Surabaya, Indonesia
yesiyuniati13@gmail.com

ABSTRACT Numeracy and creative thinking are essential skills for elementary students to solve contextual and complex mathematical problems. This study aims to develop and evaluate a numeracy learning module based on number and visual patterns for fourth-grade students. A research and development approach was applied using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The module was validated by content and media experts, and tested at SDN Banjarkemuning and SDN Semampir 1. Data were collected through expert validation sheets, implementation observations, student response questionnaires, and pretest–posttest instruments. The validation process indicated that the module met high standards of content quality, clarity of language, presentation, and visual design. The implementation of the module resulted in a significant improvement in students' numeracy and creative thinking skills, as reflected in the posttest score gains. The study's main contribution lies in integrating numeracy and creativity in a single contextual, activity-based teaching tool. These findings support the potential of structured and contextualized numeracy instruction to enhance conceptual understanding and student engagement. The implications suggest that such modules can be effectively adopted to enrich elementary mathematics instruction and curriculum design.

Keywords: ADDIE, creative thinking, learning module, numeracy, number patterns

ABSTRAK Numerasi dan kemampuan berpikir kreatif merupakan keterampilan esensial bagi siswa sekolah dasar dalam menyelesaikan permasalahan matematika yang kontekstual dan kompleks. Penelitian ini bertujuan untuk mengembangkan dan mengevaluasi modul pembelajaran numerasi berbasis pola bilangan dan pola visual untuk siswa kelas IV. Penelitian ini menggunakan pendekatan penelitian dan pengembangan dengan model ADDIE (Analysis, Design, Development, Implementation, Evaluation). Modul divalidasi oleh ahli materi dan ahli media, serta diujicobakan di SDN Banjarkemuning dan SDN Semampir 1. Data dikumpulkan melalui lembar validasi ahli, observasi pelaksanaan pembelajaran, angket respons siswa, serta instrumen pretest–posttest. Hasil validasi menunjukkan bahwa modul memenuhi kriteria kualitas isi, kejelasan bahasa, penyajian, dan desain visual yang baik.

Implementasi modul menunjukkan adanya peningkatan yang signifikan pada kemampuan numerasi dan berpikir kreatif siswa, yang tercermin dari peningkatan skor posttest. Kontribusi utama penelitian ini terletak pada integrasi numerasi dan kreativitas dalam satu perangkat pembelajaran yang kontekstual dan berbasis aktivitas. Temuan ini mendukung potensi pembelajaran numerasi yang terstruktur dan kontekstual dalam meningkatkan pemahaman konseptual serta keterlibatan siswa. Implikasi penelitian menunjukkan bahwa modul semacam ini dapat diadopsi secara efektif untuk memperkaya pembelajaran matematika dan pengembangan kurikulum di sekolah dasar.

Kata-kata kunci: ADDIE, berpikir kreatif, modul pembelajaran, numerasi, pola bilangan

INTRODUCTION

Numeracy is a fundamental competence in elementary education, encompassing not only arithmetic skills but also reasoning, data interpretation, pattern recognition, and application of mathematical concepts in real-life contexts. Students with strong numeracy skills can calculate expenses, estimate distances, and understand maps, while developing problem-solving flexibility (Rosnawati, 2013; Amaliyah & Rahmat, 2021; Bell et al., 2023). International assessments such as PISA highlight numeracy as a critical life skill for informed decision-making (OECD, 2023).

From a cognitive perspective, numeracy learning is closely linked to creative thinking. Creative thinking involves generating original solutions, exploring multiple strategies, and adapting prior knowledge to new problems (Bell et al., 2023). Pattern-based numeracy learning provides a theoretical bridge between numeracy and creativity, requiring students to identify structures, generalize patterns, and explore alternative reasoning (Maemanah & Saleh, 2022; Murni, et al, 2023). Therefore, numeracy is not merely procedural fluency but also a cognitive process that fosters creative problem-solving (Haerudin, 2019; Subhaktiyasa, 2024).

Previous studies have emphasized either numeracy or creative thinking development. Simanjuntak et al (2022) found that strong declarative knowledge supports numeracy literacy, while Primasatya et al (2025) stressed contextual and creative approaches to enhance numeracy. Research by English (2020) similarly shows that problem-posing and exploratory tasks foster creativity but are seldom integrated with structured numeracy instruction. In addition, studies on module development indicate that teaching materials can enhance both engagement and learning outcomes when carefully designed (Muis, et al, 2022; Siswanto et al, 2022; Cartini, et al, 2024).

Classroom observations in Grade IV at SDN Banjarkemuning, Sidoarjo, revealed that approximately 55% of students scored below the Minimum Mastery Criteria (KKM) in mathematics. Students struggled with pattern recognition, flexible problem-solving, and generating multiple solutions. Instructional materials were predominantly teacher-centered and rote-based, offering limited opportunities for creative exploration (Engelbrecht & Borba, 2024). This highlights the need for structured learning approaches that integrate numeracy and creative thinking.

https://doi.org/10.30606/absis.v8i3.3484

Developing a teaching module is a strategic solution. A well-designed module allows self-directed learning, is systematic, communicative, and engaging, and supports student-centered instruction (Rohim & Rofiki, 2024; Uyen, Trong & Tram, 2021). Modules integrating problem-based learning or contextual approaches have been shown to enhance numeracy and literacy skills simultaneously (Amaliyah & Rahmat, 2021; Kurniawati, et al, 2023; Nur'aini, et al, 2024; Firdausy, et al, 2024). However, most existing modules do not explicitly integrate creative thinking within numeracy instruction (Branch, 2009; Morgan, 2020).

The research gap, therefore, lies in the scarcity of numeracy modules that systematically develop both numeracy and creativity through structured, measurable learning activities. Most previous studies focus on only one cognitive dimension, lacking a holistic approach to elementary mathematics learning.

Based on this background, this study aims to develop and evaluate a pattern-based numeracy learning module using the ADDIE model to improve fourth-grade students' numeracy and creative thinking skills. Specifically, this study addresses the following research questions:

1. How valid is the developed pattern-based numeracy learning module in terms of content, design, and language?
2. How practical is the module when implemented in fourth-grade mathematics learning?
3. How effective is the module in improving students' numeracy and creative thinking skills?
4. How do students respond to the implementation of the pattern-based numeracy learning module in classroom practice?

METHODS

This study employed a quantitative approach using the research and development (R&D) method, focusing on the design and evaluation of a pattern-based numeracy teaching module. The ADDIE model, which consists of Analysis, Design, Development, Implementation, and Evaluation, was chosen due to its structured, systematic, and learner-centered approach that supports innovative and authentic learning experiences (Branch, 2009; Plomp & Nieveen, 2013). This model allows iterative refinement of the module, ensuring alignment between learning objectives and activities for both numeracy and creative thinking skills.

Research Design

A pre-experimental, one-group pretest–posttest design was used. In this design, a single group of students was assessed before and after the intervention to measure the effect of the module on numeracy and creative thinking skills (Sugiyono, 2016). While this design limits internal validity due to the absence of a control group, it is suitable for preliminary evaluation of module effectiveness. Potential threats to

internal validity, such as maturation or testing effects, were minimized by maintaining a short intervention period and using standardized assessments.

Subjects and Sampling

The study population consisted of fourth-grade students from two elementary schools in Sidoarjo Regency. Purposive sampling was applied, selecting schools that were willing to participate and met criteria such as adequate infrastructure, teacher support, and comparable student academic performance. A total of 60 students participated, representing a typical Grade IV cohort in the region.

Instruments and Operational Definitions

The instruments used included validation sheets completed by content and media experts, practicality questionnaires for teachers and students, and pretest–posttest assessments to measure numeracy and creative thinking skills. Numeracy skills were operationalized as the ability to perform calculations, identify patterns, and solve contextual problems (Novianti & Primana, 2022). Creative thinking skills were measured through four indicators: fluency, flexibility, originality, and elaboration (Bell et al., 2023). All instruments were validated by three experts, and reliability was assessed using Cronbach's alpha, yielding 0.87 for numeracy items and 0.85 for creative thinking indicators, indicating high internal consistency.

Data Collection

Data were collected through observation, documentation, questionnaires, and written tests. The module was implemented over four weeks, with pretests administered before the intervention and posttests immediately after module completion (Kurniawati, Wardani, Asikin, & Dewi, 2023).

Data Analysis

Descriptive statistics summarized module validity, practicality, and pretest–posttest scores. N-Gain scores were calculated to evaluate improvements in students' numeracy and creative thinking skills (Uyen, Trong & Tram, 2021). Data normality was assessed using the Shapiro–Wilk test. Paired t-tests were applied for normally distributed datasets, while the Wilcoxon signed-rank test was planned for non-normal data.

Ethical Considerations

Ethical approval was obtained from the Ethics Committee of Universitas Terbuka with approval number 078/UT/EC/2025. Parental consent was secured for all participating students. Participation was voluntary, confidentiality was ensured, and no personal identifiers were included in reporting the results (Windasari, Kharisma & Hanifah, 2024).

FINDING AND DISCUSSION

The development model applied in this study followed the ADDIE framework, consisting of five stages: Analysis, Design, Development, Implementation, and

https://doi.org/10.30606/absis.v8i3.3484

Evaluation, all conducted at SDN Banjarkemuning and SDN Semampir 1. The process is outlined as follows:

1. **Analysis Stage**

The initial stage involved observations and interviews at SDN Banjarkemuning and SDN Semampir 1 between November 22 and December 15, 2024. The researcher identified learning needs, student characteristics, school conditions, and issues in mathematics instruction. The analysis revealed that numeracy content had not been explicitly developed in Grade IV; students' creative thinking skills were low, and the learning media used were unengaging and lacked contextual relevance. Further observations (January 7–21, 2025) showed that teaching was still teacher-centered, students had low engagement, and classroom tools like projectors were underutilized. Teachers reported that current materials such as textbooks and PowerPoint presentations did not effectively support student understanding and enthusiasm.

2. **Design Stage**

Based on the analysis, the researcher designed an initial draft of the numeracy module tailored to student characteristics. The module included learning objectives, activities targeting four creative thinking indicators (fluency, flexibility, originality, elaboration), as well as formative and summative assessments. The main content developed focused on number patterns and visual patterns, using Discovery Learning and Problem-Based Learning approaches. The learning media included worksheets, pattern picture cards, and visual aids to support interactive and contextual learning.

3. **Development Stage**

In this phase, the teaching product was developed based on the previously designed plan. The numeracy teaching module was produced in physical form and then validated by subject matter and media experts. The feedback obtained from the validation process was used for revisions and improvement before field testing. Suggestions from the experts are summarized in Table 1.

Table 1. Suggestions for improving the initial teaching material product from experts

Aspect Evaluated	Expert Type	Mean Score	Validity Level	Key Feedback	Revision Decision	Revision Status
Content organization	Material expert	4.30	Very valid	The material should begin with a concept map to help students organize	A concept map was added at the beginning of the module	Implemented

Aspect Evaluated	Expert Type	Mean Score	Validity Level	Key Feedback	Revision Decision	Revision Status
				mathematical concepts		
Content depth	Material expert	4.15	Valid	Additional and more varied practice questions are needed for number and visual patterns	Supplementary exercises were added to each subtopic	Implemented
Visual design	Design expert	4.20	Very valid	The module design should include more attractive and colorful illustrations	Illustrations and layout were revised to be more engaging for elementary students	Implemented

Table 1 presents a summary of expert validation results, including validity levels, key feedback, and corresponding revisions. The mean scores indicate that the developed module met the validity criteria, with content organization and visual design classified as very valid and content depth as valid. All expert recommendations were implemented prior to the classroom implementation stage.

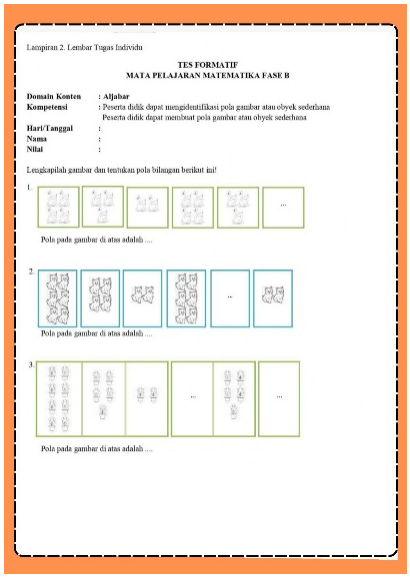
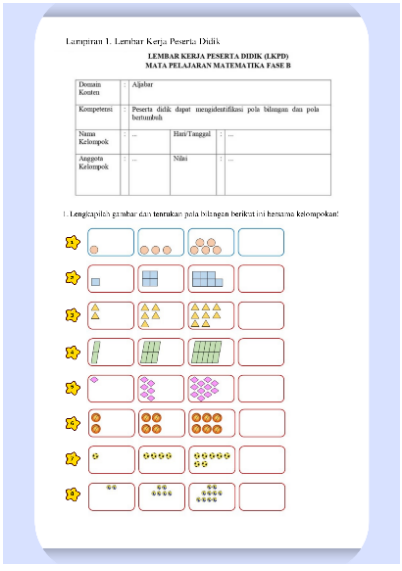
4. **Implementation Stage**

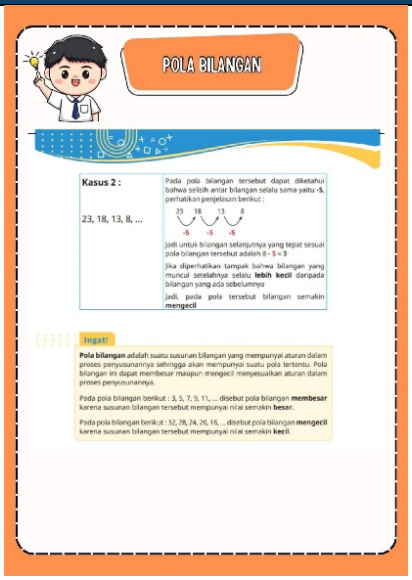
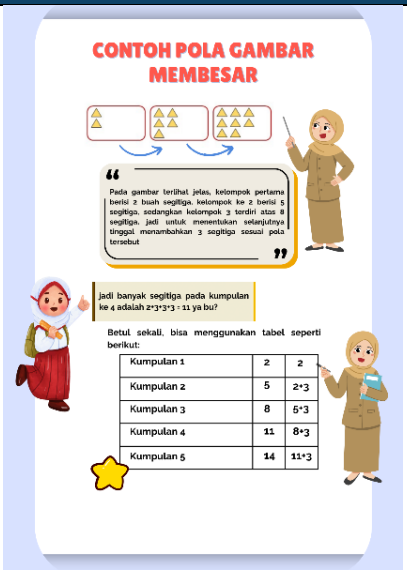
The instructional product that had been developed and validated was implemented in real classroom settings at SDN Banjarkemuning and SDN Semampir 1. The aim of this implementation stage was to assess the effectiveness, usefulness, and acceptability of the module. During this phase, the researcher observed how the module was used in actual teaching and documented students' responses as well as challenges encountered. Based on feedback from experts, improvements were made to the content structure by adding concept maps and incorporating more colorful and engaging illustrations to better suit the characteristics of elementary school students.

Table 2. Product Implementation

No	Expert	Input	Improvement Suggestions
1.	Material	The material should begin with a concept map to help students easily organize mathematical concepts.	The material begins with a concept map.

https://doi.org/10.30606/absis.v8i3.3484

No	Expert	Input	Improvement Suggestions
			
		The material appears dull due to black-and-white images that are unclear, resembling photocopied modules.	The module should be designed with more character, aligned with the content being taught.
			
2.	Design	The design should be further adjusted to include more engaging and colorful illustrations.	The illustrations are colorful and appropriate for elementary school students.

No	Expert	Input	Improvement Suggestions
			

Content experts recommended that the material begin with a concept map to facilitate understanding and be enhanced with colorful and engaging illustrations. Meanwhile, design experts emphasized the importance of appealing visuals. Improvements were made by adding a concept map at the beginning and refining the module's layout to better suit the characteristics of elementary school students.

5. Evaluation Stage

Evaluation was carried out formatively throughout the development and implementation process and summatively after the product was tested. Data were collected through questionnaires and analysis of student learning outcomes. The results of the evaluation were used to improve the product to ensure its broader applicability in schools.

At SDN Semampir 1, among 26 students, there was a significant improvement in learning outcomes after the intervention. The Pre-Test scores showed wide variation (ranging from 9 to 100), whereas Post-Test scores were concentrated between 80 and 90. Students with initially low scores, such as Ryana (from 9 to 80) and Rafki and Ridho (from 20 to 80), showed remarkable progress. Students who already had high scores remained stable at 90. These results indicate that the instructional intervention helped equalize learning outcomes and improved students' numeracy skills.

In contrast, at SDN Banjarkemuning (20 students), Pre-Test scores were generally low (30–50), and Post-Test scores increased to 40–60. Although there was a general improvement, the highest score only reached 60, with no students exceeding 70.

https://doi.org/10.30606/absis.v8i3.3484

This suggests that while the progress was uniform, it was not significant, highlighting the need for further evaluation of the teaching approach used.

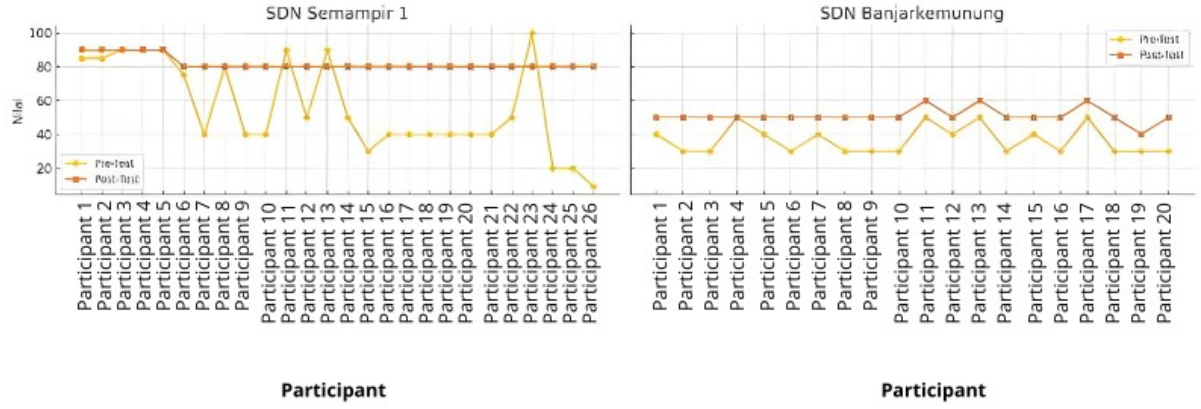


Figure 1. Comparison of Pre-Test and Post-Test Scores for Anonymized Participants at SDN Semampir 1 and SDN Banjarkemuning

Data Analysis

Table 2. Summary of Statistical Analysis of Learning Outcomes

Statistical Test	Main Finding	Explanation
N-Gain Score	Average: 0.679 (Moderate category)	Indicates an increase in learning outcomes, but most students remain in low range (59.2%)
Effectiveness Estimate	Average: 63.3 (Moderately effective category)	Intervention was moderately effective in improving understanding
Normality Test	Shapiro-Wilk: Pre & Post-Test Sig. < 0.05	Data are not normally distributed
Homogeneity Test	Levene's Test: Sig. = 0.106 > 0.05	Data are homogeneous (equal variance)
Wilcoxon Signed-Rank Test	Pre-Test Mean: 47.8 → Post-Test Mean: 69.4, p = 0.000 < 0.05	Significant difference; the intervention improved student scores

The analysis of student learning outcomes indicated a moderate level of improvement. The average N-Gain score was 0.679, which falls within the moderate category; however, 59.2% of students remained in the low category. In addition, the learning effectiveness estimate averaged 63.3, indicating that the intervention was moderately effective. These findings suggest meaningful improvement while still leaving room for further refinement of the instructional approach. The Shapiro–Wilk

test indicated that both pre-test and post-test data were not normally distributed (Sig. < 0.05). However, the Levene's homogeneity test showed that the data were homogeneous (Sig. = 0.106 > 0.05). Therefore, a non-parametric Wilcoxon signed-rank test was employed. The results revealed a statistically significant difference between pre-test (M = 47.8) and post-test scores (M = 69.4), p < 0.05. This finding indicates that the learning module contributed to a significant improvement in students' learning outcomes, although the overall level of effectiveness remained moderate.

The findings of this study indicate that the numeracy learning module developed through the ADDIE model resulted in a statistically significant improvement in students' learning outcomes, although the overall level of improvement remained moderate. This is reflected in the average N-Gain score of 0.679 and an effectiveness estimate of 63.3, both of which fall within the moderate category. Despite the significant difference between pre-test and post-test scores, more than half of the students (59.2%) remained in the low gain category. These results emphasize that statistical significance does not necessarily correspond to high instructional effectiveness, a distinction also highlighted in previous studies on learning effectiveness evaluation (Pentury, 2017; Ndoang et al., 2024; Turmuzi et al., 2021; Rahman et al., 2024).

The moderate level of improvement suggests that the module functioned adequately as a learning facilitation tool but has not yet maximized students' numeracy development. Numeracy competence requires sustained engagement, repeated exposure to contextual problem situations, and opportunities for reflection across varied contexts. Prior studies emphasize that meaningful improvement in numeracy skills is more likely to occur through continuous, context-embedded practice rather than short-term instructional interventions (Novianti & Primana, 2022; Rosnawati, 2013). This view aligns with the OECD (2023), which characterizes numeracy development as a cumulative and longitudinal process.

The differences in learning outcomes between SDN Semampir 1 and SDN Banjarkemuning highlight the role of contextual and learner-related factors in shaping instructional effectiveness. At SDN Semampir 1, the wide variability in students' pre-test scores enabled the intervention to generate more visible learning gains, particularly among students with very low initial abilities. The post-test score distribution became more balanced, indicating that the module effectively supported students who required structured guidance and instructional scaffolding.

In contrast, students at SDN Banjarkemuning demonstrated relatively uniform but low initial abilities. Although post-test scores showed improvement, the gains remained limited and did not exceed a score of 60. This suggests that baseline numeracy competence, classroom learning climate, instructional readiness, and available learning support systems substantially influenced the extent of improvement. When students enter instruction with uniformly low prior knowledge,

https://doi.org/10.30606/absis.v8i3.3484

short-term interventions may be insufficient without additional reinforcement. Similar findings have been reported in previous research, indicating that the effectiveness of Problem-Based Learning in elementary mathematics is mediated by prior knowledge, teacher facilitation quality, and classroom support structures (Kushendrawan et al., 2024; Firdausy et al., 2023).

From a theoretical perspective, the observed learning improvements can be interpreted through constructivist learning principles. The use of Problem-Based Learning aligns with Vygotsky's Zone of Proximal Development, where learning occurs optimally through guided problem-solving and scaffolding (Santrock, 2011). In this study, structured tasks and guided activities within the module functioned as scaffolding mechanisms that supported students—particularly those with lower initial abilities—in constructing numeracy concepts beyond their independent capabilities.

Additionally, the integration of visual representations, number patterns, and contextual tasks is consistent with Piaget's theory of concrete operational thinking, which emphasizes the importance of concrete and visual experiences in elementary learning (Rohim & Rofiki, 2024). These design features facilitated the connection between abstract numerical concepts and tangible experiences, supporting conceptual understanding (Kurniawati et al., 2023).

The module's emphasis on creative thinking indicators—fluency, flexibility, originality, and elaboration—reflects contemporary perspectives that view mathematical creativity as a developable skill rather than an innate trait (Fitriana & Sukarto, 2022). Research suggests that creativity in mathematics emerges through exposure to open-ended problems, multiple solution strategies, and reflective thinking (Leikin, 2021; Murni et al., 2023). The moderate improvement observed in these indicators suggests that the module successfully initiated creative thinking processes, although longer implementation periods and sustained instructional support may be required for more substantial development (Basri et al., 2021; Nainggolan et al., 2025).

CONCLUSIONS AND RECOMMENDATIONS

This study aimed to develop and evaluate a pattern-based numeracy learning module using the ADDIE model for fourth-grade students. The findings indicate that the developed module meets the criteria of validity, practicality, and effectiveness at a moderate level. Expert validation confirmed that the module is appropriate in terms of content accuracy, language clarity, presentation, and graphic design, while classroom implementation demonstrated that the module is feasible and supportive of learning activities.

The implementation of the module resulted in a statistically significant improvement in students' numeracy learning outcomes, particularly in number and visual pattern recognition. However, the magnitude of improvement remained moderate, as

reflected in the N-Gain results. The findings further suggest that the module is especially beneficial for students with lower initial numeracy abilities and has potential to support the development of creative mathematical thinking. Accordingly, the module may be used as a complementary instructional resource in fourth-grade mathematics learning.

Despite these findings, this study has several limitations. The sample was limited to two elementary schools, the duration of the intervention was relatively short, and no control group was employed, which may restrict the generalizability of the results and the isolation of intervention effects. Future research is recommended to involve larger and more diverse samples, extend the duration of implementation, and employ experimental or quasi-experimental designs. Further development may also include greater integration of differentiated instruction, digital learning elements, and culturally contextualized tasks to enhance the effectiveness of numeracy learning modules.

REFERENCES

Amaliyah, A., & Rahmat, A. (2021). Developing students' self-potential through the educational process. *Attadib: Journal of Elementary Education, 5*(1), 28–45. https://doi.org/10.32507/attadib.v5i1.926

Basri, H., Kurniadi, B., Syarifuddin, Tafriliyanto, C. F., & Nugroho, P. B. (2021). Investigasi kemampuan numerasi mahasiswa calon guru matematika. *Proximal: Jurnal Penelitian Matematika dan Pendidikan Matematika, 4*(2), 72–79. https://doi.org/10.30605/proximal.v4i2.1318

Bell, M. F., Segal, L., Dennison, S., Kinner, S. A., Dawe, S., Spittal, M. J., & Preen, D. B. (2023). Numeracy and literacy attainment of children exposed to maternal incarceration and other adversities: A linked data study. *Journal of School Psychology, 100*, Article 101241. https://doi.org/10.1016/j.jsp.2023.101241

Branch, R. M. (2009). *Instructional design: The ADDIE approach*. Springer. https://doi.org/10.1007/978-0-387-09506-6

Cartini, N., Rosita, C. D., & Setiyani. (2024). Integrated PBL differentiated instruction: An effort to improve students' literacy and numeracy skills. *International Journal of Educational Research Excellence, 3*(2), 1–15. https://doi.org/10.55299/ijere.v3i2.1177

Engelbrecht, J., & Borba, M. C. (2024). Recent developments in using digital technology in mathematics education. *ZDM–Mathematics Education, 56*(2), 281–292. https://doi.org/10.1007/s11858-023-01530-2

Fauzan, F., Arifin, F., Lubis, M. A., & Firdaus, F. M. (2022). Lecturer's digital literacy ability in the pandemic. *Cypriot Journal of Educational Sciences, 17*(4), 1130–1142. https://doi.org/10.18844/cjes.v17i4.7122

https://doi.org/10.30606/absis.v8i3.3484

Firdausy, Z. S., Sumantri, S., & Zakiah, L. (2023). Hubungan kemampuan literasi numerasi siswa kelas V dalam penyelesaian masalah soal cerita matematika. *Didaktik: Jurnal Ilmiah PGSD FKIP Universitas Mandiri, 9*(2), 2298–2308. https://doi.org/10.36989/didaktik.v9i2.901

Fitriana, M. A., & Sukarto. (2022). Analisis kemampuan numerasi dalam memecahkan masalah matematika di sekolah dasar. *JUPE: Jurnal Pendidikan Mandala, 7*(4), 943–945. https://doi.org/10.58258/jupe.v7i4.4564

Hodiyanto. (2017). Kemampuan komunikasi matematis dalam pembelajaran matematika. *AdMathEdu, 7*(1), 9–17.

Kurniawati, A., Wardani, S., Asikin, M., & Dewi, N. R. (2023). The effectiveness of the problem-based learning model with a realistic mathematics education approach to problem-solving ability. *International Journal of Research and Review, 10*(1), 491–497. https://doi.org/10.52403/ijrr.20230156

Kushendrawan, A., Miyono, N., & Sofiati, R. N. (2024). Efektivitas model problem based learning terhadap hasil belajar matematika kelas I SD. *Journal on Education, 6*(4), 18672–18681. https://doi.org/10.31004/joe.v6i4.5842

Ma'arifah, E., & Mareza, L. (2024). Kemampuan literasi numerasi peserta didik SD Muhammadiyah Purwokerto. *Jurnal PGSD Universitas Lamappapoleonro, 2*(2), 59–64. https://doi.org/10.57093/jpgsdunipol.v2i2.35

Maemanah, S., & Saleh, H. (2022). Analisis kemampuan numerasi dan motivasi diri mahasiswa calon guru matematika. *Seminar & Conference Proceedings of UMT, 1*, 37–45. https://doi.org/10.31000/cpu.v0i0.6851

Morgan, C. (2020). Mathematical language. In S. Lerman (Ed.), *Encyclopedia of mathematics education* (pp. 540–543). Springer. https://doi.org/10.1007/978-3-030-15789-0_99

Muis, A. A., Djollong, A. F., & Aripail, M. (2022). Pengembangan guru kreatif dan inovatif dalam meningkatkan mutu peserta didik pada mata pendidikan agama Islam di SMP Muhammadiyah Parepare. *Islamic Education: Jurnal Pendidikan Islam, 11*(2), 737–758. https://doi.org/10.30868/ei.v11i02.2418

Murni, D., Mudjiran, M., & Mirna, M. (2023). Analisis terhadap kreativitas dan inovasi guru dalam membuat media pembelajaran matematika sekolah dasar. *Jurnal Cendekia: Jurnal Pendidikan Matematika, 7*(2), 1118–1128. https://doi.org/10.31004/cendekia.v7i2.2066

Nainggolan, S. I., Heleni, S., & Suanto, E. (2025). Development of iSpring-assisted interactive learning media to support students' self-regulated learning on flat-sided geometric solids. *Jurnal Absis: Jurnal Pendidikan Matematika dan Matematika, 8*(1), 70–82. https://doi.org/10.30606/absis.v8i1.2661

Ndoang, T. I., Laksana, D. N. L., Noge, M. D., & Lawe, Y. U. (2024). Kemampuan literasi dan numerasi siswa SD melalui adaptasi teknologi program Kampus Mengajar. *Jurnal Cahaya Mandalika, 3*(3), 2594–2609. https://doi.org/10.36312/jcm.v3i3.3436

Novianti, A., & Primana, L. (2022). Faktor-faktor keluarga yang mempengaruhi perkembangan kreativitas anak usia dini. *Journal of Obsession: Journal of Early Childhood Education, 6*(5), 4367–4391. https://doi.org/10.31004/obsesi.v6i5.2628

Nur'aini, S., Primasatya, N., Nusantara, U., & Kediri, P. (2024). Analisis kebutuhan media congklak ekspresif berbasis etnomatematika untuk menumbuhkan numerasi siswa kelas IV. *Jurnal Dedikasi Nusantara, 4*(2). https://doi.org/10.29407/dedikasi.v4i2.24254

OECD. (2023). *PISA 2022 results (Volume I): The state of learning and equity in education*. OECD Publishing. https://doi.org/10.1787/53f23881-en

Pentury, H. J. (2017). Pengembangan kreativitas guru dalam pembelajaran kreatif pelajaran bahasa Inggris. *Faktor: Jurnal Ilmiah Kependidikan, 4*(3), 265–272. https://doi.org/10.30998/fjik.v4i3.1923

Primasatya, N., Nurfahrudhianto, A., Saidah, K., Permana, E. P., Kurnia, I., Daniswara, N. D., & Putri, V. P. A. (2025). Optimalisasi kompetensi literasi numerasi guru SD melalui platform pembelajaran daring menuju sekolah yang dicita-citakan. *Jurnal ABDINUS: Jurnal Pengabdian Nusantara, 9*(3), 640–648. https://doi.org/10.29407/ja.v9i3.24767

Rahman, M. H. A., Jaafar, J., & Huda, M. (2024). Information and communication skills for higher learners competence model. In *Software engineering methods in systems and network systems* (pp. 357–375). Springer. https://doi.org/10.1007/978-3-031-53549-9_36

Rohim, A., & Rofiki, I. (2024). Profil kemampuan berpikir kritis siswa dalam menyelesaikan soal AKM numerasi. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika, 4*(1), 183–193. https://doi.org/10.51574/kognitif.v4i1.893

Rosnawati, R. (2013). *Literasi dan numerasi dalam pembelajaran kontekstual*. UNY Press.

Santrock, J. W. (2011). *Educational psychology* (5th ed.). McGraw-Hill.

Simanjuntak, R. M., Banurea, E. G. N. M., Siregar, Y. P., Simanjorang, E. L., Sagala, H., & Gultom, D. (2022). Bimbingan belajar untuk meningkatkan literasi, numerasi, dan pengenalan teknologi di SD Negeri 033923 Sumbul. *Jurnal ADAM: Jurnal Pengabdian Masyarakat, 1*(2). https://doi.org/10.37081/adam.v1i2.984

Siswanto, A. E., Yanti, N. D., Isa, V. N., Syahrial, S., & Noviyanti, S. (2022). Teachers' creativity in the SBDP learning process in elementary school grade V. *Journal of*

Education and Counseling, 4(3), 166–178. https://doi.org/10.31004/jpdk.v4i3.4288

Subhaktiyasa, P. G. (2024). Menentukan populasi dan sampel: Pendekatan metodologi penelitian kuantitatif dan kualitatif. *Jurnal Ilmiah Profesi Pendidikan, 9*(4), 2721–2731. https://doi.org/10.29303/jipp.v9i4.2657

Sugiyono. (2016). *Metode penelitian pendidikan: Pendekatan kuantitatif, kualitatif, dan R&D*. Alfabeta.

Turmuzi, M., Wahidaturrahmi, W., & Kurniawan, E. (2021). Analysis of students' mathematical communication ability on geometry material. *Edumatica: Jurnal Pendidikan Matematika, 11*(1), 50–61. https://doi.org/10.22437/edumatica.v11i01.12394

Uyen, B. P., Tong, D. H., & Tram, N. T. B. (2021). Developing mathematical communication skills for students in grade 8 in teaching congruent triangle topics. *European Journal of Educational Research, 10*(3), 1287–1302. https://doi.org/10.12973/eu-jer.10.3.1287

Warsini. (2021). Upaya meningkatkan hasil belajar matematika materi bangun datar melalui strategi cardsort. *Journal of Dikdas Bantara, 3*(1), 82–95. https://doi.org/10.32585/dikdasbantara.v5i1.2222

Windasari, W., Kharisma, A. N., & Hanifah, N. K. (2024). Mengembangkan model pengembangan tenaga kependidikan untuk meningkatkan mutu pelayanan di SD Lidah Wetan 4. *Jurnal Pendidikan Guru Sekolah Dasar, 1*(3), 1–13. https://doi.org/10.47134/pgsd.v1i3.440