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Developing Interactive Teaching Materials using Nearpod to Strengthen Students' Mathematical Literacy

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ABSTRAK

Rendahnya capaian literasi matematika siswa Indonesia pada asesmen internasional seperti *Programme for International Student Assessment* (PISA) menunjukkan perlunya inovasi pembelajaran yang kontekstual dan berbasis teknologi. Penelitian ini bertujuan untuk mengembangkan bahan ajar interaktif berbasis Nearpod yang valid, praktis, dan memiliki efek potensial dalam menguatkan kemampuan literasi matematika siswa SMP. Penelitian ini menggunakan pendekatan *formative evaluation* yang meliputi tahap *preliminary study, self-evaluation, expert review, one-to-one, small group, dan field test.* Subjek penelitian terdiri dari 31 siswa kelas VIII di MTsN 1 Ogan Ilir, Sumatera Selatan. Data dikumpulkan melalui *walkthrough*, wawancara, observasi, dan angket, lalu dianalisis secara deskriptif kualitatif. Hasil penelitian menunjukkan bahwa bahan ajar yang dikembangkan dinyatakan valid dari aspek isi, konstruk, dan bahasa; praktis digunakan dalam pembelajaran; serta memiliki efek potensial dalam memperkuat kemampuan literasi matematika melalui keterlibatan aktif siswa pada proses *Formulate, Employ,* dan *Interpret* sesuai kerangka PISA 2022. Hal ini terlihat dari hasil pekerjaan post-test siswa, yang menunjukkan peningkatan ketepatan dalam memodelkan dan menafsirkan permasalahan kontekstual.Penelitian ini berkontribusi dalam menyediakan model pengembangan bahan ajar interaktif berbasis teknologi yang terstruktur dan berorientasi literasi, yang dapat menjadi acuan dalam inovasi pembelajaran matematika abad ke-21.

Kata kunci : Bahan ajar interaktif, Evaluasi formatif, Literasi matematika, Nearpod, Teknologi pendidikan

ABSTRACT

The low achievement of Indonesian students in international assessments such as the Programme for International Student Assessment (PISA) highlights the need for contextual and technology-based innovations in mathematics learning. This study aims to develop Nearpod-based interactive teaching materials that are valid, practical, and have a potential effect in strengthening junior high school students' mathematical literacy. The research employed a formative evaluation approach consisting of the stages of preliminary study, self-evaluation, expert review, one-to-one, small group, and field test. The participants were 31 eighth-grade students from MTsN 1 Ogan Ilir, South Sumatra. Data were collected through walkthroughs, interviews, observations, and questionnaires, and analyzed using a qualitative descriptive method. The findings revealed that the developed teaching materials were valid in terms of content, construct, and language; practical for classroom implementation; and demonstrated a potential effect in

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enhancing students' mathematical literacy through active engagement in the Formulate, Employ, and Interpret processes as outlined in the PISA 2022 framework. This result from students' post-test work, which showed improved accuracy in modeling and interpreting the contextual problem. This study contributes a structured and literacy-oriented model for developing technology-based interactive teaching materials, which can serve as a reference for mathematics learning innovation in the 21st century.

Keywords : Educational technology, Formative evaluation, Interactive teaching materials, Mathematical literacy, Nearpod

INTRODUCTION

Mathematical literacy has become an essential competency in the 21st century, enabling students to interpret, analyse, and solve real-life problems using mathematical reasoning (OECD, 2022). However, international assessment results reveal that Indonesia continues to face significant challenges in this area. According to the Programme for International Student Assessment (PISA), the average mathematics score of Indonesian students was 371 in 2018, far below the OECD average of 489, and further declined to 366 in 2022 compared to the OECD average of 472 (OECD, 2019, 2023). This downward trend indicates that, despite various curricular reforms and educational innovations implemented over the past decade, classroom practices in Indonesia have not yet succeeded in fostering students' ability to apply mathematics in meaningful, real-world contexts. Consequently, Indonesian students' mathematical literacy remains weak, and their learning experiences often lack relevance to authentic problem situations (Aisyah & Juandi, 2022). Strengthening mathematical literacy has therefore become an urgent priority, both nationally and globally, as it aligns with Sustainable Development Goal 4 (SDG 4) to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all (Siahaan et al., 2023; United Nations, 2025).

At the national level, the Indonesian Ministry of Education, Culture, Research, and Technology (Kemdikbudristek) emphasizes that the implementation of the *Merdeka Curriculum* should foster literacy and numeracy as the foundation of competency-based education and lifelong learning (Kemdikbud, 2022b). Within this framework, mathematics education is expected not only to develop procedural mastery but also to strengthen students' capacity to reason, make informed decisions, and apply mathematical thinking in authentic, real-life situations (Kemdikbud, 2022a). Nevertheless, despite these curriculum aspirations, classroom practices in many schools remain dominated by teacher-centered instruction, abstract problem-solving tasks, and minimal integration of digital tools (Çevikbaş et al., 2023). Such conventional approaches often hinder student engagement and limit opportunities for meaningful, deep learning experiences that connect mathematics with everyday contexts (Utari et al., 2024). Moreover, many schools continue to face infrastructural and pedagogical challenges in effectively utilizing digital learning platforms to support interactive and contextual learning processes (Mardiana & Hidayati, 2022).

Previous studies have increasingly explored the integration of interactive technologies in mathematics education with the aim of enhancing student engagement, conceptual understanding, and mathematical literacy (Avida et al., 2025; Yansen et al.,

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2019). For instance, a study of GeoGebra Classroom-assisted learning in Indonesian secondary schools found positive effects on mathematical literacy (Kurniawan et al., 2024): students showed improved ability to interpret, analyse and apply mathematics, as well as increased engagement when visualisation and exploration were enabled (Avida et al., 2025; Raisatunnisa et al., 2025). Moreover, research on the use of Nearpod in mathematics online learning reported that 88.8 % of vocational students agreed that the tool was very easy to use, and 85.8 % agreed that it supported interactive mathematics learning (Alawiyah & Ahmadi, 2024; Paramita, 2023).

Despite these promising results, many of these studies remain limited to broad learning outcomes, such as improved achievement or motivation (Paramita, 2023) and do not always include a structured development process for the teaching materials (e.g., design, expert validation, pilot testing). Even fewer investigations focus explicitly on Nearpod as a platform for developing contextual and literacy-oriented digital mathematics teaching materials, including validity, practicality and direct impact on mathematical literacy (Powa & Murniarti, 2022). Consequently, although multimedia and interactive platforms show potential, previous research has not yet fully established strong evidence of validity and practicality in tailored interactive teaching materials aimed at improving mathematical literacy.

Synthesising the results of these studies shows that, although interactive technologies offer promising advantages, the existing evidence does not yet address several key aspects comprehensively. Research on mathematical literacy consistently emphasizes that students need instructional materials that are well-designed, contextually meaningful, and pedagogically structured to effectively build literacy skills (Aisyah & Juandi, 2022; Bolstad, 2023). However, many technology-based studies primarily report general outcomes, such as gains in achievement, engagement, or motivation, without explaining the systematic development steps required to produce robust and high-quality learning resources. Literature in educational technology and modelling also notes that the use of digital tools brings both benefits and challenges, especially when the pedagogical underpinnings and validation procedures are not thoroughly established (Çevikbaş et al., 2023) Additionally, research on curriculum and learning materials underscores the need for structured design processes, expert evaluation, and iterative refinement to ensure that resources genuinely enhance conceptual understanding and literacy development (Khotimah & Aini, 2022; Rezat & al., 2021). Taken together, these insights indicate a clear research gap despite growing interest in technology-supported mathematics learning, there is still limited evidence on interactive materials that are deliberately designed, rigorously validated, and empirically tested for their effectiveness in developing mathematical literacy, particularly in using Nearpod.

Recognizing the limitations of previous studies, this research focuses on developing Nearpod-based interactive mathematics teaching materials aimed at strengthen students' mathematical literacy. While earlier works have demonstrated that technology can enhance engagement and motivation, many of them have not incorporated a structured development framework to ensure the quality and pedagogical soundness of the resulting materials. To address this gap, the present study adopts a design-based approach guided by Tessmer (1993) & Zulkardi (2002) formative evaluation model, which offers a structured yet flexible process for iterative product refinement. Nearpod serves as the central digital environment for creating and delivering interactive learning experiences (Hakami, 2020). The platform's

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capabilities, such as real-time participation, multimedia integration, and dynamic visual representations, allow for the design of engaging and contextually rich mathematics activities (Alawiyah & Ahmadi, 2024). These features align closely with the principles of active and meaningful learning, emphasizing student participation, conceptual understanding, and the ability to apply mathematical reasoning to authentic problem situations (Paramita, 2023).

Through this integration, the study seeks to design learning materials that support students' mathematical literacy in a more interactive and relevant manner for junior high school classrooms. Therefore, this study aims to develop and validate Nearpod-based interactive mathematics teaching materials that are valid and practical to strengthen junior high school students' mathematical literacy.

METHOD

Research design

This study employed a qualitative descriptive approach within the framework of formative evaluation (Tessmer, 1993; Zulkardi, 2002). The design of this study included two major phases: the preliminary stage (Zulkardi, 2002) and the formative evaluation stage (Tessmer, 1993), which consists of self-evaluation, expert review, one-to-one evaluation, small-group evaluation, and field test. Figure 1 was the flow diagram of formative evaluation in this study.

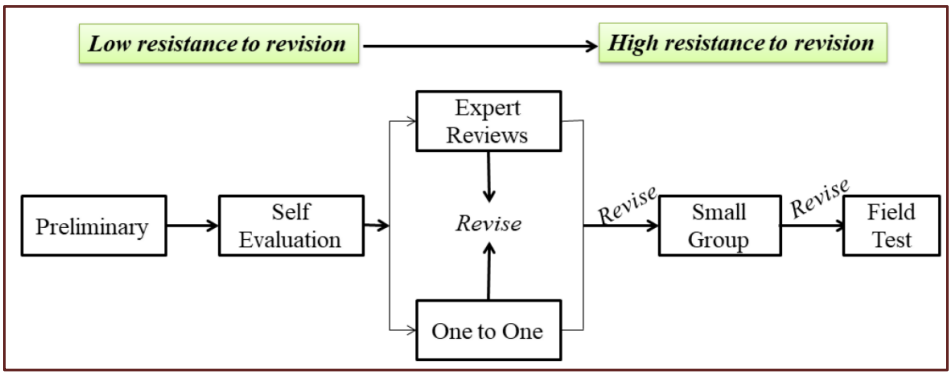

Figure 1. The flow diagram of formative evaluation (Tessmer, 1993; Zulkardi, 2002)

In this study, several instruments were used, including expert validation sheets, interview guidelines, observation sheets, and practicality questionnaires. The expert validation sheet assessed content accuracy, alignment with mathematical literacy indicators, clarity of construction, and media quality based on criteria adapted from and design research principles (van den Akker et al., 2010). Practicality indicators referred to (Tessmer (, 1993) framework, focusing on clarity, usability, and feasibility during classroom implementation.

The development of the Nearpod-based interactive teaching materials was guided by the mathematical literacy framework from the PISA (OECD, 2022). In this framework, mathematical literacy is defined as an individual's capacity to formulate, employ, and interpret mathematics in various real-life contexts. Accordingly, the design of the materials was structured around these three indicators: (a) formulate, students identify relevant information and recognize important mathematical aspects

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within a contextual problem; (b) Employ, students design and apply appropriate strategies to find mathematical solutions for the given context; and (c) Interpret, students interpret mathematical results and evaluate their relevance and reasonableness in the original problem situation. Each Nearpod activity was developed to integrate these three processes Nearpod in this study served as an interactive learning platform that allows real-time participation, multimedia integration, and dynamic visual tasks (Hakami, 2020) These features support the creation of contextual and literacy-oriented tasks aligned with PISA indicators.

Research participants

The study was conducted at Madrasah Tsanawiyah Negeri (MTsN) 1 Ogan Ilir, South Sumatra, Indonesia, during the 2025 academic year. A total of 31 junior high school students participated in the study. Participants were involved in different evaluation stages: two students participated in the one-to-one evaluation, five students in the small-group evaluation, and twenty-four students in the field test. Additionally, two lecturers one specializing in mathematics education and the other in instructional media were involved as expert validators to assess the content validity, media quality, and alignment with mathematical literacy indicators.

During the preliminary stage, a Focus Group Discussion (FGD) was conducted with lecturers and undergraduate students from the Mathematics Education Study Program at Universitas Sriwijaya. The discussion aimed to (1) analyze students' learning needs in mathematics, (2) review relevant curriculum content in relation to mathematical literacy indicators, and (3) identify potential real-life contexts suitable for designing literacy-oriented tasks. The findings from this stage served as the foundation for developing the initial prototype of the Nearpod-based interactive teaching materials.

Data collection techniques and analysis

Data were collected qualitatively through walkthroughs, interviews, observations, questionnaires, and documentation at each stage of the formative evaluation. Data were analyzed using qualitative descriptive analysis. The analysis focused on evaluating three primary aspects of the developed materials: validity, practicality, and potential effect on mathematical literacy. Validity was examined using indicators adapted from (Tessmer, 1993) formative evaluation criteria and Akker's ((van den Akker et al., 2010)) educational design dimensions, including content accuracy, alignment with mathematical literacy indicators, clarity of structure, and media quality. Practicality was assessed using indicators also based on (Tessmer, 1993), namely clarity of instructions, ease of use, feasibility in classroom implementation, and student engagement during activities. Potential effect was inferred from observed improvements in students' mathematical reasoning, problem interpretation, and application of mathematical concepts in context. To ensure credibility, data triangulation was applied across multiple data sources, including experts, students, and FGD results. Revisions to the teaching materials were conducted iteratively after each stage based on evaluation outcomes.

RESULT AND DISCUSSION

The initial design stage involved three mathematics education lecturers and two undergraduate students through a Focus Group Discussion (FGD) to establish the

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theoretical and practical foundations for developing the Nearpod-based interactive teaching materials. The selected topic, Systems of Linear Equations in Two Variables (SLETV), belongs to the Change and Relationships (Algebra) domain in the PISA framework (OECD, 2022) and was considered relevant for promoting students' mathematical literacy. The design was guided by the Formulate, Employ, and Interpret indicators of mathematical literacy and aligned with Phase D learning outcomes in the Indonesian Merdeka Curriculum (Kemdikbud, 2022a). Considering the characteristics of eighth-grade students who benefit from visual and interactive learning, Nearpod was chosen as the platform for integrating contextual problems, multimedia, and real-time student engagement. The results of the theoretical and contextual analyses conducted during the initial design stage are summarized in Table 1. These findings provided the foundation for developing the first prototype of the Nearpod-based interactive teaching materials.

Table 1. Results of the initial design stage

Aspect Examined	Findings and Focus	Contribution to Material Design
Mathematical Content	Systems of Linear Equations in Two Variables (SLETV), categorized under *Change and Relationships (Algebra)* in PISA (OECD, 2022).	Provides authentic problem contexts involving variable relationships (e.g., price and quantity) that can be represented mathematically.
Mathematical Literacy Indicators	*Formulate, Employ, Interpret* (OECD, 2022).	Serve as the foundation for designing Nearpod activities that require students to identify, apply, and interpret mathematical ideas in context.
Phase D Learning Outcomes	Students are expected to solve contextual problems using simple algebraic representations.	Ensures that task complexity aligns with the cognitive level of eighth-grade students.
Learner Characteristics	Students need visual, interactive, and immediate feedback to comprehend algebraic concepts.	Activities include visual representations, interactive polls, and reflective prompts to enhance conceptual understanding.
Learning Platform	Nearpod as an interactive medium supporting contextual and participatory learning.	Enables active, collaborative, and real-time monitoring of students' responses during instruction.

The initial design produced the first prototype of the Nearpod-based interactive teaching materials, which included contextual activities such as the school canteen sales problem. This prototype was later refined during the self-evaluation stage to test its feasibility and learning flow. Figure 2 shows the main interface of the Nearpod-based student worksheet developed in this study.

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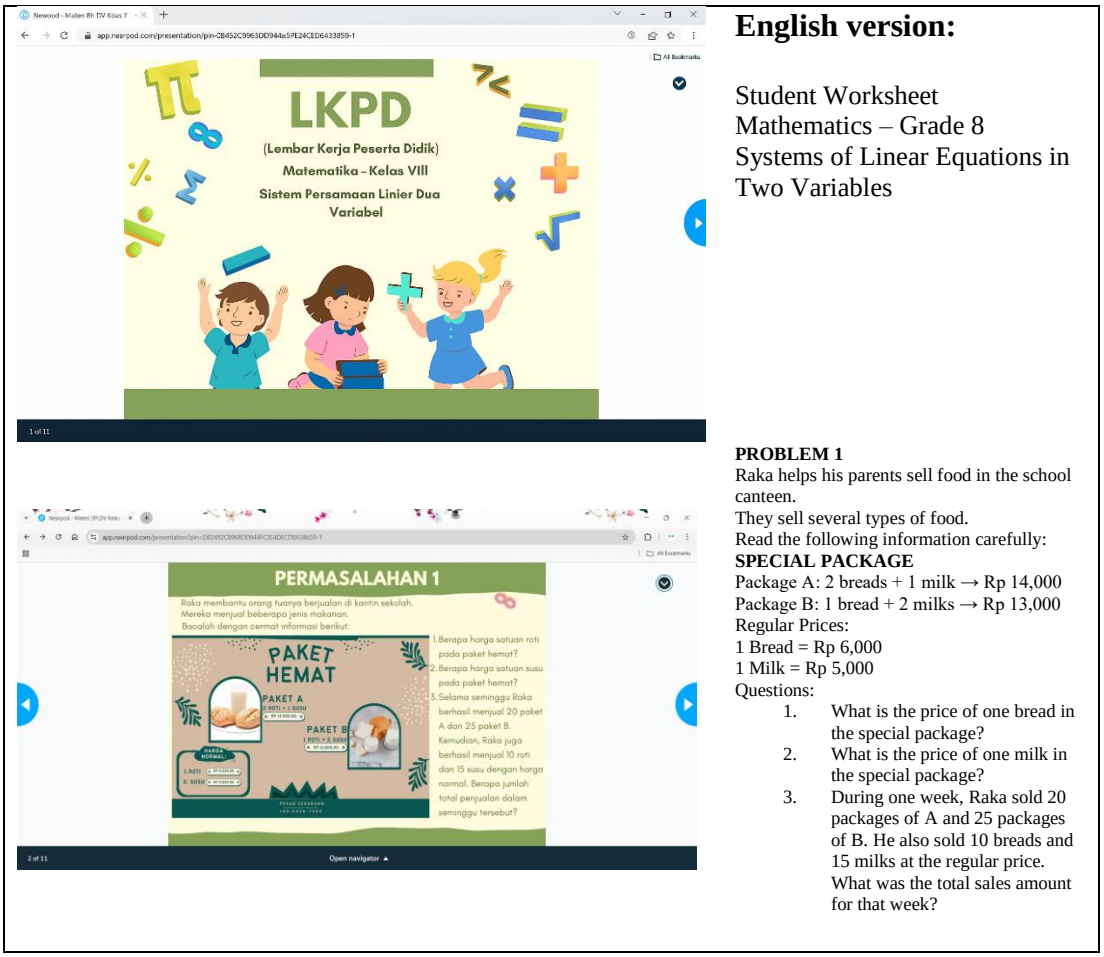

Figure 2. Main display of the Nearpod-Based Interactive student worksheet

The activity shown in Figure 2 represents one of the contextual problems developed during the design stage of the Nearpod-based interactive teaching materials. At this stage, the focus was on constructing relevant mathematical content, aligning it with the topic of Systems of Linear Equations in Two Variables (SLETV) under the Change and Relationships (Algebra) domain in PISA (OECD, 2022) and ensuring consistency with the Phase D learning outcomes of the Merdeka Curriculum (Kemdikbud, 2022a). The design emphasized contextual authenticity and visual clarity, allowing students to connect variable relationships (such as price and quantity) through a familiar situation, school canteen sales. The Nearpod platform was chosen for its capacity to integrate multimedia elements, structured layouts, and interactive features such as polls and quizzes, creating an engaging and coherent digital learning environment. Similar to the design principles reported by Avida et al. (2025) and Hakami (2020) this stage prioritized usability, content validity, and visual appeal as the basis for further refinement in subsequent formative evaluation phases.

The self-evaluation stage was carried out to review and refine the first prototype of the Nearpod-based interactive teaching materials before proceeding to expert validation. At this stage, the researchers examined the content structure, visual layout, and linguistic clarity of the student worksheet. Several revisions were made, particularly in the use of terminology, sentence phrasing, and spelling to ensure that the instructional language was accurate, concise, and aligned with proper Indonesian orthography. Minor adjustments were also applied to the slide sequence to improve

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the logical flow of activities within the Nearpod platform. As a result of this process, the improved version, referred to as Prototype 2, was produced, serving as the foundation for the next stage of expert review in the formative evaluation process.

The expert review and one-to-one stage were conducted simultaneously to validate the content, construct, and language aspects of the Nearpod-based interactive teaching materials. Two expert validators participated in the review: Expert Review 1 (ER1), a mathematics education specialist, and Expert Review 2 (ER2), a media and instructional technology expert. The experts assessed the materials using a validation sheet focusing on three dimensions, content validity (accuracy and relevance of mathematical concepts), construct validity (logical structure, coherence, and pedagogical flow), and language clarity (appropriateness, readability, and grammatical accuracy).

In parallel, the one-to-one involved two eighth-grade students representing different ability levels: one with high mathematical ability and another with low mathematical ability. The selection aimed to ensure that the materials were understandable and accessible to students with varying learning capacities. This diversity provided broader insight into the clarity of instructions, the difficulty level of contextual problems, and the effectiveness of Nearpod's interactive features in supporting comprehension. Table 2 was the result of expert review and one-to-one stage.

Table 2. Results of Expert Review and One-to-One

Evaluator	Focus of Evaluation	Aspect Evaluated	Feedback Summary	Action Taken
ER 1	Mathematical content accuracy and literacy alignment	Content	The contextual problems align with algebraic learning objectives and OECD literacy indicators. Suggested refining numerical values in examples to avoid ambiguity.	Revised numerical data and ensured alignment between equations and contextual scenarios.
		Construct	Logical flow of the slides supports progressive reasoning but needs clearer transition from contextual problem to equation model.	Added short guiding questions between slides to improve reasoning continuity.
		Language	Mathematical terminology is correct; however, some instructions could be simplified for junior high students.	Simplified sentence structures and verified spelling consistency.
ER 2	Visual design and user interaction	Content	Content is relevant and well-integrated with Nearpod features. Recommended including short recap slides after each activity.	Added recap slides with summary questions.

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Evaluator	Focus of Evaluation	Aspect Evaluated	Feedback Summary	Action Taken
		Construct	Interface layout is clear and consistent but could use more color contrast for emphasis.	Adjusted background color and font contrast for readability.
		Language	Language style is suitable, but font size on some slides should be increased for accessibility.	Adjusted font sizes across slides.
S1 (High Ability)	Problem comprehension and usability	Content	Quickly understood problem structure; appreciated interactive features. Found reflection questions engaging.	No major revision needed.
		Language	Instructions clear; minor suggestion to shorten long sentences.	Simplified instruction phrasing.
S2 (Low Ability)	Readability and navigation	Content	Understood contextual situation but needed additional hints to connect context to equations.	Added visual cues and step-by-step hints.
		Language	Some terms still too formal; suggested using simpler phrasing.	Replaced technical terms with student-friendly alternatives.

During the one-to-one stage (see Figure 3), the high-ability student demonstrated fluency in identifying contextual information and forming mathematical equations, while the low-ability student benefited from visual cues and scaffolding provided in Nearpod. This stage helped ensure that the materials were not only valid in content and structure but also accessible for students with diverse learning profiles. The feedback gathered from both experts and students informed the revision process, resulting in Prototype 3, which demonstrated improved readability, coherence, and usability for subsequent testing in the small-group stage.

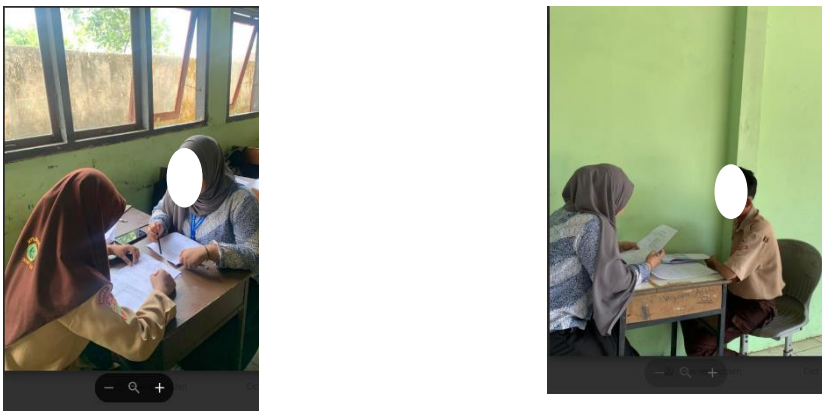

Figure 3. One-to-one stage

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Figure 3 present the one-to-one stage, where two eighth-grade students interacted individually with the Nearpod-based learning materials (the using handphone to access Nearpod). The feedback, summarized in Table 2, revealed that the content, construct, and language aspects were clear and accessible for both students, though minor adjustments were made to simplify instructions and strengthen contextual cues. The S1 demonstrated fluency in identifying relationships and forming equations, while the S2 required additional hints and visual scaffolding, confirming that the materials effectively supported differentiated learning.

These findings align with Paramita (2023) who reported that Nearpod's interactive features enhance student engagement and comprehension, and with (Alawiyah & Ahmadi, 2024) who found that contextualized algebraic problems improve students' conceptual understanding when supported by visual representations. However, unlike previous studies that focused primarily on classroom implementation, the present research emphasized design validity and usability through iterative formative evaluation, ensuring that the developed materials were theoretically grounded (Bakker, 2018) and pedagogically coherent before broader application (Mckenney & Reeves, 2012). Building on these validated design results, the next phase focused on examining the practicality of the developed materials through a small-group evaluation to ensure their usability and effectiveness in a real classroom context.

The small-group stage was conducted to examine the practicality of the Nearpod-based interactive teaching materials. Five eighth-grade students participated in this stage, representing a range of abilities and learning characteristics. The session aimed to explore whether the learning materials were easy to use, engaging, and understandable when implemented in a collaborative learning setting (Tessmer, 1993). Observations were carried out during the learning process, and students' responses were collected through short reflective interviews at the end of the activity. The results revealed that the materials were practical in terms of usability, instructional clarity, and engagement. Students reported that the Nearpod interface was intuitive and easy to navigate, the contextual problems were interesting and relatable, and the instructions were simple to follow. Teachers also noted that the lesson could be conducted within the allocated time and that students were motivated to complete each task. Table 3 was the finding in small group stage.

Table 3. Summary of practicality findings from the small-group stage

Aspect Evaluated	Observation / Student Response	Interpretation
Ease of Use	Students could navigate slides, respond to polls, and complete quizzes independently without assistance.	Practical
Instructional Clarity	Instructions were clear and concise; only minor clarifications were needed on numerical notations.	Practical
Engagement	Students actively participated in every activity, discussed answers in pairs, and showed enthusiasm during interactive quizzes.	Practical
Visual Attractiveness	Visual layout and color combination were appealing and did not distract attention.	Practical
Feasibility of Use	The entire learning session was completed within 50 minutes using a single device per group.	Practical

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The findings indicate that the developed materials are practical and feasible to be implemented in small learning groups. This aligns with Tessmer (1993) notion that practicality reflects the degree to which materials can be used effectively by both teachers and students in learning. The observations also support the findings of Powa & Murniarti (2022) who reported that Nearpod's interactive features enhance students' engagement and motivation, and (Alawiyah & Ahmadi F., 2024) who found that contextual problem designs promote active collaboration in digital learning environments. Unlike those studies, however, the present research focused on the formative refinement process rather than outcome evaluation, emphasizing usability, clarity, and coherence of the learning design. The positive responses in this stage demonstrate that the Nearpod-based materials achieved the intended practicality standards, providing a strong foundation for the subsequent field test implementation.

Following these findings, the final prototype of the Nearpod-based interactive materials was refined and finalized for use in the field test stage. The completed version of the student worksheet, as implemented during the classroom trial, is shown in Figure 4.

PROBLEM 1
Raka helps his parents sell food in the school canteen.
They sell several types of food.
Read the following information carefully:
SPECIAL PACKAGE
Package A: 2 breads + 1 milk → Rp 14,000
Package B: 1 bread + 2 milks → Rp 13,000
Regular Prices:
1 Bread = Rp 6,000
1 Milk = Rp 5,000
Questions:

1. What is the price of one bread in the special package?
2. What is the price of one milk in the special package?
3. During one week, Raka sold 20 packages of A and 25 packages of B. He also sold 10 breads and 15 milks at the regular price. What was the total sales amount for that week?

Question:
From the given problem, what information can be identified?

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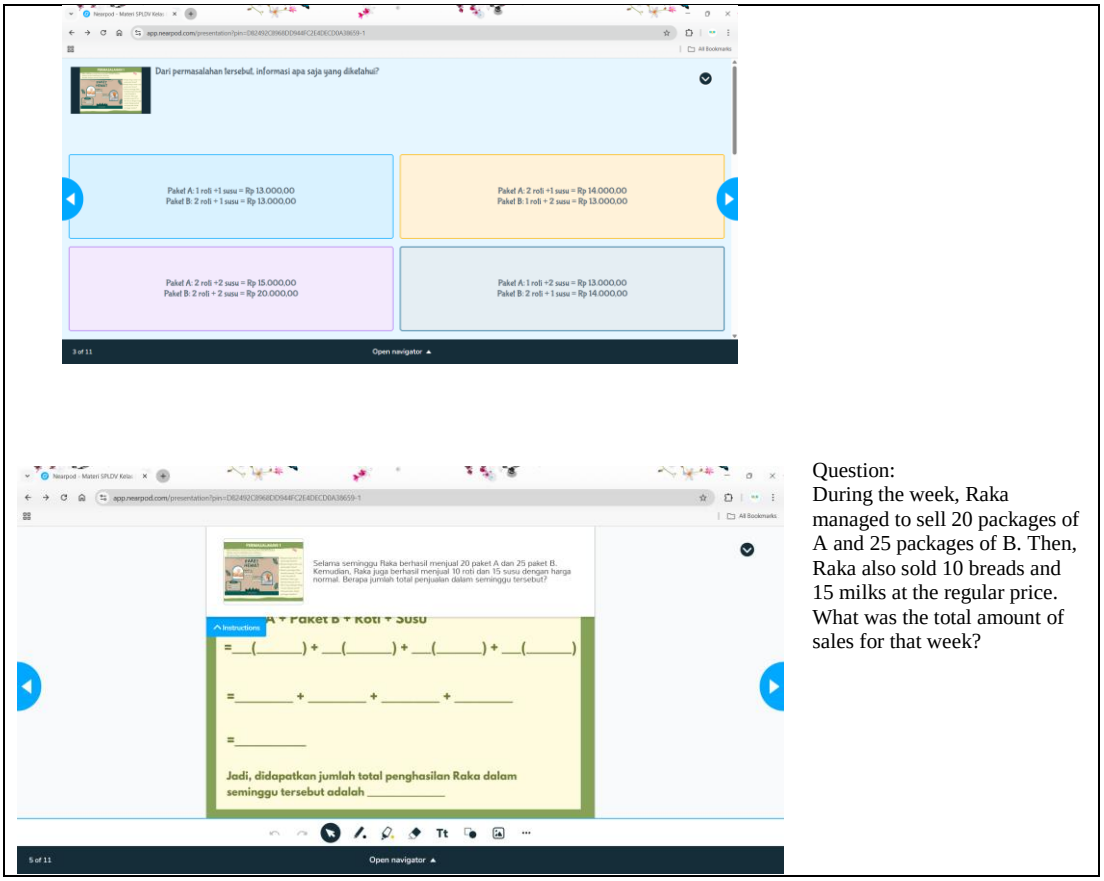

Figure 4. Final prototype of the Nearpod-Based Interactive student teaching material

Figure 4 presented the final prototype of the Nearpod-based interactive learning materials, which were implemented during the field test stage. The activities shown in this figure reflect tasks designed to strengthen students' mathematical literacy through contextual problem solving. The sequence of slides guides students to interpret the "school canteen" situation, identify mathematical relationships between quantities, and construct equations representing the problem (Formulate). Students then solve the equations to find the prices of bread and milk (Employ), and finally, they interpret the results to determine the total weekly sales in the given context (Interpret). This design aligns with the OECD (2022) mathematical literacy framework, emphasizing the ability to connect mathematical reasoning with real-life contexts. The interactive layout, use of colors, and embedded question prompts in Nearpod provided scaffolding that supported students in transitioning from understanding the context to performing structured mathematical reasoning.

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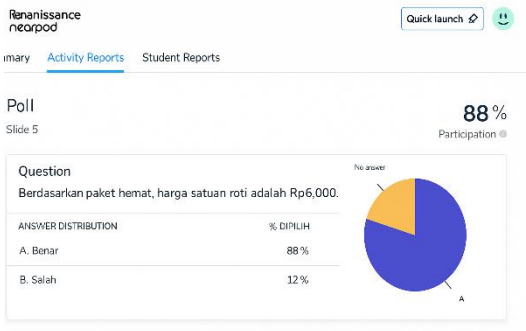

Poll
Slide 5
Question:
Based on the special package, the price of one bread is Rp6,000.
Answer Distribution
A. True – 88%
B. False – 12%
Participation: 88%

Figure 5. The sample of Nearpod activity report

Figure 5 presents the sample of Nearpod activity report, which shows students' responses to one of the poll questions derived from the contextual problem. The report indicates that 88% of students correctly answered that the price of one bread was Rp6,000 in normal price, demonstrating their ability to identify and reason mathematically from the contextual data, while 12% either selected the incorrect option or did not respond. This result shows the effectiveness of the Nearpod interactive feature, where feedback is displayed immediately after submission, allowing students to verify their reasoning in real time. The integration of such digital interactivity provides evidence of the materials' potential effect in promoting active engagement and supporting the development of mathematical literacy, as students can directly connect their conceptual understanding to real-world problem-solving situations.

In addition to the Nearpod polling results, the post-test provided richer evidence of students' mathematical literacy, as the task required them to interpret contextual information, construct a system of linear equations, and apply an appropriate solution method to determine the prices of carrots and potatoes. This problem enabled students to demonstrate the Formulate–Employ–Interpret processes more fully: identifying the relevant quantities from the transactions presented (Formulate), selecting and executing a strategy such as elimination or substitution (Employ), and interpreting the computed values to determine the total cost for Saturday's planned purchase (Interpret). The post-test thus served as an essential measure of how well students could transfer their understanding from the interactive Nearpod activities to a more complex, multi-step contextual problem. Figure 6 presents the post test questions and sample student responses and emphasizes the extent to which learners were able to connect mathematical procedures with the contextual scenario.

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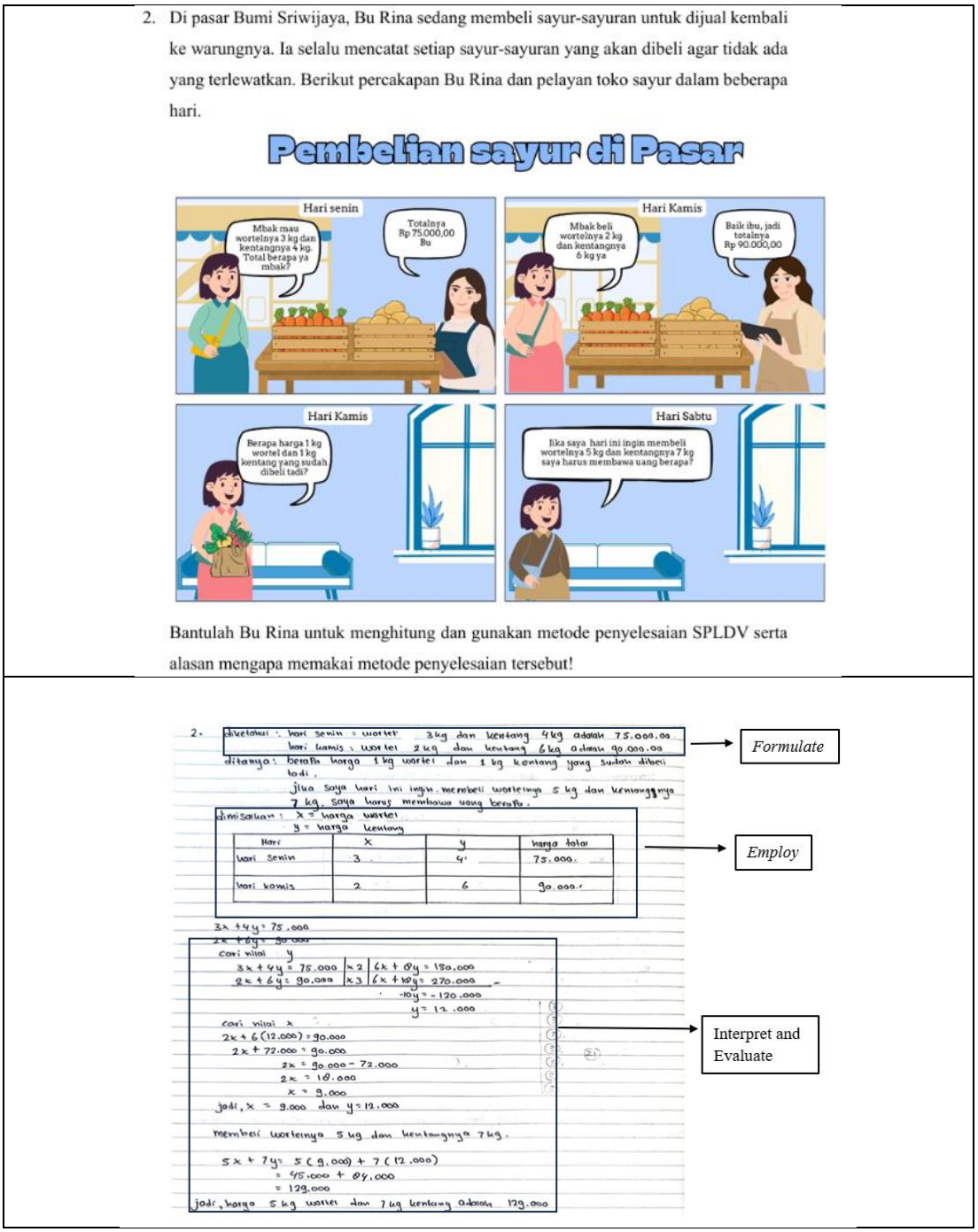

Figure 6. Students answer in field test stages

Figure 6 presents the work of Student S1. S1 was able to identify the key information, construct the correct system of linear equations, and perform the algebraic steps accurately. The final answer was interpreted correctly within the context of the problem, showing that S1 could connect the mathematical results to the real situation. Interview data also confirmed that S1 understood each step and was able to justify the reasoning clearly.

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Although many studies on digital learning materials rely on numerical scores or percentages to indicate effectiveness, it is essential to emphasize that the potential effects on mathematical literacy can also be observed qualitatively, through students' ability to engage in the key processes of mathematical literacy, namely Formulate, Employ, and Interpret (OECD, 2022, 2023). For instance, evidence such as students' responses in identifying contextual variables, constructing mathematical equations, and interpreting results in real-life contexts demonstrates that the developed materials successfully stimulated mathematical literacy skills (Bolstad, 2023), even when the data were not expressed quantitatively. This qualitative perspective aligns with (Reza (2021) who argue that the quality and effectiveness of digital mathematical media should be evaluated through the cognitive processes they foster rather than solely through quantitative outcomes.

In the context of this study, observations and classroom activities during the field test revealed that the Nearpod-based materials were not only engaging and easy to use but also supported the development of mathematical literacy processes. Students actively identified relevant information, modeled relationships mathematically, and evaluated solutions within contextual situations. These findings reinforce previous research, such as that of Khotimah & Aini (2022) & Paramita (2023), which reported that Nearpod's interactive features enhance student participation and comprehension, and Alawiyah & Ahmadi (2024) who found that contextual algebraic tasks strengthen conceptual understanding. Unlike most prior studies that focused primarily on quantitative learning outcomes (Khotimah & Aini, 2022; Vera et al., 2024), the present research emphasizes the development of valid, practical, and literacy-oriented design principles embedded throughout the formative evaluation process, from the initial development stage to classroom implementation.

The development of the Nearpod-based interactive materials demonstrates that integrating real-world contexts, digital interactivity, and formative evaluation stages can produce learning resources that are not only classroom-ready but also hold strong potential for strengthen students' mathematical literacy. The narrative findings from the field implementation highlight that students were able to engage in authentic mathematical reasoning, supporting the argument that strengthening mathematical literacy should be assessed through the processes of reasoning and contextual understanding, rather than through numerical scores alone.

Moreover, the novelty of this study lies in integration of the Formulate–Employ–Interpret framework with a formative evaluation approach to design Nearpod-based materials specifically oriented toward mathematical literacy. Unlike previous research that mainly reports general gains in engagement or achievement, this study provides a structured, theory-informed design model that intentionally targets literacy-related cognitive processes. The findings also align with constructivist learning principles and design research perspectives (Tessmer, 1993; van den Akker et al., 2010; Zulkardi, 2002) which emphasize iterative refinement and meaningful contextual engagement. Thus, the contribution of this study is not only empirical but also theoretical, offering a clear design pathway for developing interactive digital materials that support the processes essential to mathematical literacy.

CONCLUSION

The findings of this study demonstrate that the Nearpod-based interactive teaching materials developed through a formative evaluation process are valid in terms

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of content, construct, and language; practical in supporting teachers and students during classroom implementation; and possess a potential effect in strengthening students' mathematical literacy through active engagement in the processes of Formulate, Employ, and Interpret. Nevertheless, this study has certain limitations, including the relatively small number of participants and the implementation limited to a single mathematical topic, which may restrict the generalizability of the findings. Future research is therefore recommended to involve a larger and more diverse sample, explore long-term effects across multiple mathematical domains, and integrate additional digital platforms to further enhance the development and assessment of students' mathematical literacy in broader learning contexts.

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REFERENCES

Aisyah, A., & Juandi, D. (2022). The description of Indonesian student mathematics literacy in the last decade. *International Journal of Trends in Mathematics Education Research, 5*(1), 105–110. https://doi.org/10.33122/ijtmer.v5i1.114

Alawiyah & Ahmadi F., I. A. (2024). Developing Nearpod-Based Interactive Multimedia on the Topic of Indonesian Cultural Diversity for 4th Grade Elementary School Students. *Journal of Indonesian Educational Research and Development*. https://doi.org/10.21580/jieed.v4i2.22022

Avida, A., Asmarani, Y., Junaidi, J., Romalinda, I., Utari, R. S., Azka, D. A., Nugraha, I. V., & Susanti, E. (2025). *Improvement of Numeracy Skills of Elementary School Students in Statistical Materials using GeoGebra* (pp. 458–468). https://doi.org/10.2991/978-2-38476-390-0_38

Bakker, A. (2018). Design Research in Education. In *Design Research in Education* (1st ed.). Routledge. https://books.google.com/books/about/Design_Research_in_Education.html ?id=6jhjDwAAQBAJ

Bolstad, O. H. (2023). Lower secondary students' encounters with mathematical literacy. *Mathematics Education Research Journal*. https://doi.org/10.1007/s13394-021-00386-7

Çevikbaş, M., Greefrath, G., & Siller, H.-S. (2023). Advantages and challenges of using digital technologies in mathematical modelling education – a descriptive systematic literature review. *Frontiers in Education*. https://doi.org/10.3389/feduc.2023.1142556

Hakami, M. (2020). Using Nearpod as a Tool to Promote Active Learning in Higher Education in a BYOD Learning Environment. *Journal of Education and Learning*, *9*(1), 119. https://doi.org/10.5539/jel.v9n1p119

Submitted : 09 November 2025
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Published : 19 Desember 2025

Kemdikbud. (2022a). *Capaian Pembelajaran Matematika SD - SMA*. Kementrian Pendidikan, Kebudayaan, Riset Dan Teknologi. https://guru.kemdikbud.go.id/kurikulum/referensi-penerapan/capaian-pembelajaran/sd-sma/matematika/fase-e/

Kemdikbud. (2022b). *Kurikulum Merdeka*. Kementrian Pendidikan, Kebudayaan, Riset Dan Teknologi. https://kurikulum.kemdikbud.go.id/kurikulum-merdeka/

Khotimah, K., & Aini, K. (2022). Pengembangan LKPD Berbasis Problem-Based Learning (PBL) untuk Memfasilitasi Kemampuan Literasi Matematis Siswa. *Indiktika : Jurnal Inovasi Pendidikan Matematika*, *5*(1), 90–99. https://doi.org/10.31851/indiktika.v5i1.9840

Kurniawan, A. A., Cahyaningsih, D., Sari, M., Ramadhaniyah, M., Yukans, S. S., Kurniadi, E., & Utari, R. S. (2024). Motivasi Belajar Siswa Gen-Alpha dalam Pembelajaran Geometri Berbantuan Geogebra. *Plusminus: Jurnal Pendidikan Matematika*, *4*(3), 521–532. https://doi.org/10.31980/plusminus.v4i3.2418

Mardiana, V. D., & Hidayati, D. (2022). Transformasi Digital Pelaksanaan Pembelajaran Tematik Di Sekolah Pada Masa Pandemi. *Journal of Education and Teaching (Jet)*, *3*(2), 213–223. https://doi.org/10.51454/jet.v3i2.180

Mckenney, S., & Reeves, T. C. (2012). *Conducting Educational Design Research* (1st ed.). Routledge.

OECD. (2019). *PISA 2018 Results (Volume I): What Students Know and Can Do*. OECD Publishing. https://doi.org/10.1787/5f07c754-en

OECD. (2022). PISA 2022 Results (Volume I): The State of Learning and Equity in Education. *OECD Publishing, Paris*. https://doi.org/10.1787/53f23881-en

OECD. (2023). PISA 2022 Results (Volume II): Learning During – and From – Disruption. *OECD Publishing, Paris*. https://doi.org/10.1787/18d360f5-en

Paramita, P. E. (2023). Exploring Student Perceptions and Experiences of Nearpod: A Qualitative Study. *Journal of Online Education*. https://doi.org/10.31004/joe.v5i4.4249

Powa, N. W., & Murniarti, E. (2022). The Analysis of Nearpod Use in Mathematics Online Learning at Vocational School. *Jurnal Dinamika Pendidikan*, *15*(2), 83–89. https://doi.org/10.51212/jdp.v15i2.139

Raisatunnisa, Suryadi, D., Fatimah, S., Priatna, N., & Nasir, N. (2025). Enhancing Mathematical Literacy Through GeoGebra Classroom-Assisted Learning: A Case Study in Indonesia Secondary Schools. *Matematika Dan Pembelajaran*, *13*(1), 64–84. https://doi.org/10.33477/mp.v13i1.8938

Rezat, S., & al., et. (2021). Mathematics textbooks and curriculum resources as instruments for change in mathematics education. *ZDM – The International Journal on Mathematics Education*, *53*(2), 215–229. https://doi.org/10.1007/s11858-021-01304-3

Siahaan, R. L. M., Arianti, J., & Thalib, N. (2023). Perkembangan Pendidikan Berkualitas Di Indonesia: Analisis SDGs 4. *Indo-Mathedu Intellectuals Journal*, *4*(2), 975–985. https://doi.org/10.54373/imeij.v4i2.316

Submitted : 09 November 2025
Accepted : 07 Desember 2025
Published : 19 Desember 2025

Tessmer, M. (1993). *Planning and Conducting Formative Evaluation: Improving The Quality of Education and Training*. Kogan Page.

United Nations. (2025). *The Sustainable Development Goals Report*. https://doi.org/https://unstats.un.org/sdgs/report/2025/

Utari, R. S., Amalia, L., & Rohman. (2024). Developing a Local Instructional Theory using TPACK Framework to Support Students' Collaborative Skills. *AIP Conference Proceedings*, *3052*(1). https://doi.org/10.1063/5.0201052

van den Akker, J., Bannan, B., Kelly, A. E., Nieveen, N., & Plomp, T. (2010). *An Introduction to Educational Design Research* (Plomp Tjeerd & Nieveen Nienke, Eds.; 3rd ed.). www.slo.nl/organisatie/international/publications. https://doi.org/https://ris.utwente.nl/ws/portalfiles/portal/14472302/Introduction_20to_20education_20design_20research.pdf

Vera, V. Y., Zulkardi, Z., & Putri, R. I. I. (2024). Kemampuan Literasi Matematis Siswa pada Materi Operasi Hitung Menggunakan Soal Tipe PISA. *Indiktika : Jurnal Inovasi Pendidikan Matematika*, *7*(1), 10–18. https://doi.org/10.31851/indiktika.v7i1.17231

Yansen, D., Putri, R. I. I., Zulkardi, & Fatimah, S. (2019). Developing PISA-Like Mathematics Problems on Uncertainty and Data Using Asian Games Football Context. *Journal on Mathematics Education*, *10*(1), 37–46.

Zulkardi. (2002). *Developing A Learning Enviroment on Realistics Mathematics Education for Indonesian Students Theacers*. University of Twente.