

Development of mobile learning-based geometric numeracy media (*nuget-mo*) using a contextual approach on quadrilateral area material

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Abstract

This study develops a mobile learning-based geometry numeracy media called *Nuget-Mo*. The media integrates a contextual learning approach into the topic of quadrilateral area. The primary objective of the study is to improve students' numeracy literacy significantly. The method used is Research and Development with the ADDIE model. The study involves 30 seventh-grade students from SMPN 16 Jambi City. The purposive sampling technique is used to determine the research sample. Data were obtained through expert validation, student questionnaires, and numeracy tests. Expert validation showed scores above 85%. These scores placed *Nuget-Mo* in the "very valid" category. Student questionnaires indicated a very high level of practicality. The practicality score reached 85,43%. Students found the media very easy to use and engaging. The effectiveness test showed a very significant improvement in learning outcomes. The average pretest score was 64,06. The posttest score increased to 89,53 after the use of the media. The N-Gain value of 0,71 belonged to the high category. This improvement indicated much better concept mastery. The media also enhanced students' problem-solving abilities. The findings confirmed that *Nuget-Mo* was highly effective in improving numeracy literacy. The media was valid, practical, and highly suitable for implementation in geometry learning. *Nuget-Mo* proved to provide a significant learning impact for students.

Keywords: Learning Media; Geometry Numeracy; Mobile Learning; Contextual Approach; Quadrilateral Area.

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INTRODUCTION

In the 21st century, students are required to master three core competencies: character, skills, and literacy. One form of literacy related to thinking and analytical abilities is mathematical literacy (Han et al., 2017). PISA results show that Indonesian students' numeracy literacy remains low, with a mathematics score of 379 in 2018. Findings from TIMSS 2016 also confirm this issue, as Indonesia only achieved a score of 395, far below the international average of 500 (OECD, 2016; OECD, 2018). Meanwhile, PISA 2022 shows that Indonesian students' numeracy literacy score is only 366, far below the OECD international average of 472 (OECD, 2022). Numeracy literacy skills include the ability to analyze, construct arguments, and communicate ideas efficiently across various forms and contexts (Novitasari, 2022).

Several studies indicate that junior high school students still possess low numeracy skills, which makes it difficult for them to understand geometry problems (Kristianti & Handayani, 2023). They are unaware of the correct calculation methods, face difficulties in connecting mathematical symbols, and often arrive at incorrect conclusions (Rezky et al., 2022; Ate & Lede, 2022). Geometry is often perceived as a challenging subject due to students' limited understanding of its abstract concept (Tralisno & Alfi, 2025; Tralisno & Alfi, 2023; Tralisno, 2021). Additionally, teachers' insufficient ability to design Higher Order Thinking Skills (HOTS) questions and students' low habit of solving literacy-based problems contribute to weak numeracy literacy (Sari & Aini, 2022).

Limited use of technology also negatively affects numeracy literacy, despite its positive role in supporting numeracy learning (Ambarwati & Kurniasih, 2021). Furthermore, the scarcity of engaging learning media reduces both numeracy literacy and problem-solving skills, highlighting the need for innovative learning media to enhance students' numeracy competence (Ramadhan et al., 2023). One crucial element that supports the learning process is the use of technology in educational media. A type of technology that can be utilized for developing learning media is mobile learning (Nja et al., 2024).

One crucial factor in supporting the learning process is the integration of technology in educational media. Mobile learning, which utilizes portable devices as learning tools, has been proven effective in improving students' covariational reasoning, conceptual understanding, and higher-order thinking skills (Alfi & Tralisno, 2023; Annisah et al., 2023). Studies have shown that mobile learning is a valid, practical, and effective learning medium, contributing to improved conceptual comprehension, learning achievement, and student motivation (Padli et al., 2021). These findings align with research indicating that mobile learning applications enhance numeracy literacy. Effective media development also requires approaches that actively engage students, such as the contextual approach (Nurlita & Jailani, 2023).

Contextual learning allows teachers to connect academic content with real-life situations (Mukhtar et al., 2022). Research demonstrates that the contextual approach has a positive impact on the development of effective, high-quality learning media (Arini & Agustika, 2021; Rahmayani et al., 2022). Moreover, it enhances learning outcomes, critical thinking skills, and collaboration among students (Wijayanti, 2020). Studies

combining mobile learning and contextual approaches consistently report positive outcomes (Lestari et al., 2023).

The urgency of this study arises from students' low habit of solving literacy-based problems and the lack of engaging learning media, which contribute to their low numeracy literacy. Numeracy literacy is essential for tackling more complex mathematical problems. Therefore, innovative learning media are needed to improve numeracy literacy among junior high school students. This research focuses on assessing the feasibility, practicality, and effectiveness of *Nuget-Mo*, a mobile learning media based on a contextual approach, in enhancing students' numeracy literacy. To address this, the researcher develops *Nuget-Mo* to make geometry learning more meaningful and to strengthen students' numeracy skills.

METHODS

This study takes place at SMPN 16 in Jambi city, with 30 seventh-grade students participating. The research applies the ADDIE development model (Analyze, Design, Develop, Implement, Evaluate), which is suitable for various types of learning media. The *Nuget-Mo* development process follows five main stages, with evaluation conducted at the end of each stage (Branch, 2009).

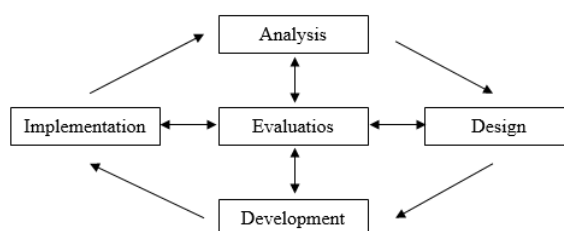


Figure 1. Steps of the ADDIE Development Model

Stage 1: Analyze

In this stage, the researcher identifies issues students face in numeracy literacy and examines the strategies currently used in geometry learning at the school. Relevant literature is reviewed to support the problem identification process. The researcher also analyzes the needs for developing *Nuget-Mo* using a contextual approach aimed at strengthening students' numeracy literacy while considering their characteristics.

Stage 2: Design

Nuget-Mo is designed to support mathematics learning by linking content to real-life situations. The design process includes preparing materials and completing problem-solving tasks focused on numeracy literacy, creating flowcharts and storyboards, and planning the development of the media, which is produced in HTML format. To ensure alignment with student needs and characteristics, the researcher evaluates and revises the product throughout this stage.

Stage 3: Develop

During development, *Nuget-Mo* is validated by media and content experts. Feasibility assessment sheets evaluate the content quality and appropriateness of the material. After analyzing the validation results, the media is deemed suitable for limited trials. Validation uses a Likert scale of 1–4, and the media is considered valid if the average score reaches 3.00 or higher.

Stage 4: Implement

The media is tested in the classroom as an initial evaluation to gather feedback on the application of the contextual approach. This stage examines the practicality and effectiveness of the media in improving students' numeracy literacy. Practicality is measured using teacher and student response questionnaires, and the media is considered practical if it achieves a score of 76% or higher (on a scale of 0–100%). Effectiveness is determined by N-Gain scores, comparing pretest and posttest improvements with the maximum possible gain. The trial involves 30 seventh-grade students selected through purposive sampling. During implementation, students complete pretests and posttests and participate in interviews to evaluate their learning outcomes and responses to the media. Data collection uses numeracy literacy tests, observation sheets, and interview guides.

Stage 5: Evaluate

Evaluation occurs at the end of each stage—analysis, design, development, and implementation to ensure that the objectives of each stage are achieved. Revisions are made if discrepancies arise between the analysis results and target indicators, or based on suggestions from experts and feedback from students.

RESULTS AND DISCUSSION

The displays of the *NuGet-Mo* media developed by the researcher are presented in Figure 2 and Figure 3.



Figure 2. Learning Material Display in *Nuget-Mo*

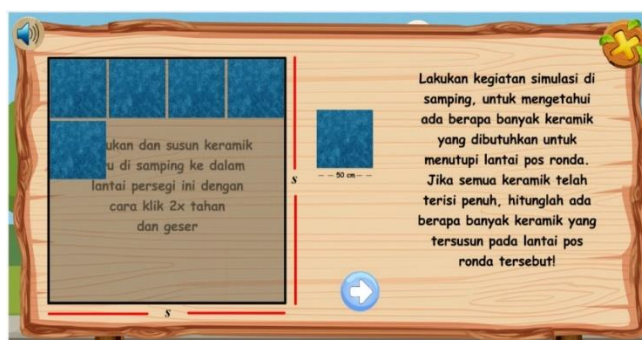


Figure 3. Simulation Display in *Nuget-Mo*

Figure 2 contained the learning materials on plane shapes, the learning objectives, and the profile of the *Nuget-Mo* media developers. Figure 3 illustrates one of the plane shape simulations, specifically a square, where students could drag and move smaller squares into the larger square. The use of simulations in learning plane shapes helped students improve their understanding of the concepts being taught (Tralisno, 2025). Before the media was implemented in the trial, it was first validated by media experts and content experts to ensure its feasibility. The validation results from both experts are presented in Table 1.

Table 1. Results of the Material Expert Validation

Assessed Aspect	Score	Category	Description
Content Aspect	4,83	Strongly Agree	Valid
Display Aspect	4,70	Strongly Agree	Valid
Average Score	4,76	Strongly Agree	Valid

Table 2. Media Expert Validation Results

Assessed Aspect	Score	Category	Description
Media Aspect	4,71	Strongly Agree	Valid
Program Display Aspect	4,65	Strongly Agree	Valid
Technical Quality and Program Effectiveness Aspect	4,75	Strongly Agree	Valid
Average Assessment Score	4,70	Strongly Agree	Valid

The results in Table 1 showed that the content expert rated the content of *Nuget-Mo* as feasible and valid, with an average score of 4.76. Meanwhile, Table 2 showed that the media expert gave an average score of 4.70 for aspects of appearance, technical quality, and effectiveness, indicating that *Nuget-Mo* was valid. After validation by the media and content experts, the researcher conducted small-scale and field trials to measure the practicality and effectiveness of the developed *Nuget-Mo* media. During the implementation stage, *Nuget-Mo* was tested in real classroom situations as part of the initial evaluation. This activity aimed to collect feedback on the application of context-based media through a small-group trial involving eight seventh-grade students.



Figure 5. Small Group Trial

The researcher distributed response questionnaires to students during the small group trial to assess their evaluation of *Nuget-Mo*. The average score from the questionnaire analysis was 3.82. The results of the small group trial indicated a positive response from students towards the developed *Nuget-Mo* media. Next, the researcher conducted a field trial with a larger group of 30 students. Before the field trial, a pretest

was administered to determine students' initial numeracy literacy on plane shapes. The average score of the 30 students was 64.06, which was still below the minimum passing grade of 75. The researcher then implemented *Nuget-Mo* during the learning process. During the activities, students appeared enthusiastic in using *Nuget-Mo* and actively solved plane shape problems in front of the class.

In the evaluation stage, the researcher assessed the achievement of indicators for the practicality and effectiveness of *Nuget-Mo* in improving students' numeracy literacy in relation to plane shapes. The practicality evaluation, analyzed based on student and teacher response questionnaires, resulted in a percentage of 85.43% > 76% on a scale of 0%-100%. This indicated that *Nuget-Mo* was practical for classroom use, reflecting that it was easy to use, engaging, and helped students understand the area of quadrilaterals. Students also evaluated that the contextual features in the application made the learning process more relevant and easier to comprehend.

The results of the students' numeracy literacy pretest and posttest are presented in Table 3. Table 3 shows the analyzed pretest and posttest scores along with the N-Gain results.

Table 3. N-gain Score Results

Pretest Score	Posttest Score	N-gain	Category
64,06	89,53	0,71	High

The students' pretest and posttest scores were analyzed using the N-Gain test, which produced a score of 0,71, based on the criteria: $g \geq 0,70 \rightarrow$ High Category. The improvement in students' learning outcomes using the *Nuget-Mo* media was classified as high, indicating that the media was valid, easy to use, and effective in enhancing students' numeracy literacy skills.

These results were in line with several studies that have shown numeracy-based media to be valid, effective, and practical in improving students' literacy skills (Leyn & Yugopuspito, 2025). Numeracy media had a positive impact on the learning process, particularly in strengthening conceptual understanding, application, and problem-solving abilities (Zaenal et al., 2022). Relevant and engaging learning media significantly improved students' numeracy literacy, enhanced the learning process, and aligned with curriculum demands (Fazriyati et al., 2024). The developed numeracy media presented

learning in an attractive and interactive manner, fostering students' critical thinking and contributing to improved numeracy literacy (Roslita Anggraeni et al., 2024). *Nuget-Mo* was equipped with interactive simulation displays that facilitated students' mastery of plane shape concepts.

These findings were consistent with the study conducted by Tralisno et al. (2025), which demonstrated that using simulation media enabled students to explore changes in the shape, size, and area of plane figures interactively, thereby helping them build conceptual understanding through hands-on experience. The use of technology in learning has been shown to strengthen students' numeracy literacy by increasing their concentration, motivation, and ability to understand and solve mathematical problems (Ma'sumah et al., 2025; Amidi, 2024). Furthermore, context-based learning media have been shown to improve mathematics learning outcomes, especially in geometry, as students can see the connection between the material and real-life situations (Putri et al., 2020). Through the development of numeracy media, students were given opportunities to practice linking mathematical concepts to real-world contexts, which ultimately strengthened numeracy literacy as a 21st-century competency (Lindang & Wewe, 2024).

CONCLUSION

Theoretically, the development of *NuGet-Mo* media using a contextual approach has been proven to be valid. The validation results showed that *Nuget-Mo* obtained a "very valid" category with an average score of over 85%. These findings supported the theory that integrating real-life contexts into mathematics learning could enhance the quality of the media and the suitability of the material to students' characteristics. Practically, the *Nuget-Mo* media was considered very practical based on student responses, with an overall practicality score of 85,43%. Students demonstrated interest, ease of use, and relevance of the content to daily life, confirming that *Nuget-Mo* could be directly used by teachers and students as an additional learning resource that effectively supported numeracy learning. The effectiveness of the media was evidenced by the improvement in students' numeracy literacy, with the average score increasing from 64,06 to 89,53 and an N-Gain value of 0.71. These results indicated that the context-based *Nuget-Mo* was an effective alternative for teaching plane shapes in junior high schools. The implications were that this media could be applied in various schools with similar

characteristics to enhance students' numeracy skills. The generalizability of the findings was relevant to mathematics learning at the junior high school level, which emphasized conceptual understanding through application in real-life contexts.

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