



Numeracy Literacy Based on Learning Styles Through Differentiated Problem-Based Learning with Performance Assessment

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Abstract

This study investigates students' numeracy literacy skills from the perspective of learning styles through differentiated Problem-Based Learning (PBL) assisted by performance assessment. Numeracy literacy is a crucial competency in 21st-century education, enabling students to interpret, analyze, and apply mathematical concepts in real-life contexts. However, preliminary observations at SMP Negeri 4 Jepara revealed low numeracy literacy levels, with students struggling to solve contextual mathematical problems. This research employed a mixed-methods sequential explanatory design, combining quasi-experimental and qualitative approaches. The experimental group received differentiated PBL with performance assessment, while the control group received conventional PBL. Data were collected through pretests, posttests, questionnaires on learning styles, and interviews, and were analyzed using statistical tests and thematic analysis. The results indicate that differentiated PBL with performance assessment significantly improved students' numeracy literacy, with posttest scores surpassing the minimum mastery criteria and achieving classical completeness above 75%. Furthermore, learning style analysis revealed distinct patterns in problem-solving strategies among visual, auditory, and kinesthetic learners. The findings highlight the importance of integrating differentiated instruction with authentic assessment to address students' diverse learning needs and enhance their mathematical literacy in meaningful contexts.

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INTRODUCTION

Numeracy literacy is a fundamental competence for 21st-century learners, enabling them to apply mathematical concepts, procedures, and reasoning in various real-life contexts (Jonas, 2018; Karmeliana & Ladyawati, 2023; Megawati & Sutarto, 2021). It encompasses the ability to interpret quantitative information, solve problems, and make decisions based on mathematical reasoning. According to the OECD, (2019), strong numeracy skills protect individuals from unemployment, low income, and poor health, and are essential for active participation in modern society. In Indonesia, however, students' numeracy literacy remains low. The 2018 Programme for International Student Assessment (PISA) reported that Indonesia ranked 75th out of 80 participating countries, with an average mathematics score of 379, indicating difficulties even in solving problems at the basic levels (Masfufah & Afriansyah, 2021; OECD, 2019; Putrawangsa & Hasanah, 2022).

Similar challenges are observed at the local level. Preliminary observations at SMP Negeri 4 Jepara showed that students struggled with contextual mathematical problems, particularly in interpreting information, identifying relevant concepts, and translating real-world situations into mathematical models. Many students also exhibited low engagement and tended to rely on peers for solutions rather than developing their own reasoning strategies. These issues highlight the need for innovative learning models that address students' diverse characteristics and promote active participation (Holis et al., 2016; Sudirman et al., 2020).

Problem-Based Learning (PBL) offers an authentic, student-centered approach that fosters critical thinking and problem-solving through real-world problems (Aisyah et al., 2022; Alfares, 2021; Blundell & Berardi, 2016; Loyens S. M. et al., 2015). When combined with differentiated instruction, PBL can accommodate students' varying learning styles visual, auditory, and kinesthetic by tailoring content, process, and product to individual needs. Additionally,

performance assessment provides opportunities for students to demonstrate understanding in authentic contexts, aligning with the goals of competency-based education (Masrukan, 2017).

Despite its potential, research on integrating differentiated PBL with performance assessment in the context of numeracy literacy remains limited. Therefore, this study aims to analyze the effectiveness of differentiated PBL assisted by performance assessment in improving students' numeracy literacy and to explore how learning styles influence students' problem-solving strategies in this learning model.

METHOD

This study employed a mixed-methods approach with a sequential explanatory design (Creswell, 2018), integrating quantitative and qualitative methods to obtain comprehensive and valid results. The quantitative phase used a quasi-experimental design with a pretest-posttest control group. The experimental group received differentiated Problem-Based Learning (PBL) with performance assessment, while the control group received conventional PBL. The qualitative phase explored students' numeracy literacy performance based on their learning styles through in-depth interviews.

The study was conducted at SMP Negeri 4 Jepara during the 2024/2025 academic year, involving two classes of eighth-grade students selected through cluster random sampling. Class VIII C served as the experimental group ($n = 32$) and Class VIII A as the control group ($n = 32$). Learning styles were categorized into visual, auditory, and kinesthetic based on questionnaire results, with two representative students from each category selected for interviews.

The instruments included: (1) lesson plans and learning modules, (2) numeracy literacy tests covering quantity content, (3) a learning style questionnaire, (4) observation sheets for learning implementation, (5) student response questionnaires, and (6) interview guidelines. Instruments were validated by experts and tested for reliability, item difficulty, and discrimination index.

The research procedure consisted of three stages: (1) preparation instrument development, validation, and pilot testing; (2) implementation classification of students' learning styles, delivery of treatments over four sessions, administration of pretest and posttest; and (3) evaluation data analysis and interpretation.

Quantitative data were analyzed using normality, homogeneity, and independent sample t-tests to compare groups, as well as proportion tests for classical completeness. Qualitative data from interviews were analyzed thematically to identify patterns in problem-solving strategies across learning styles.

RESULTS AND DISCUSSIONS

The pretest results indicated that both the experimental and control groups had comparable numeracy literacy levels, with mean scores below the minimum mastery criteria (MMC) of 70. After treatment, the experimental group's mean posttest score increased to 82.13, while the control group's mean score was 74.50. An independent sample t-test confirmed a statistically significant difference between the two groups ($p < 0.05$), demonstrating the effectiveness of differentiated PBL with performance assessment.

Classical completeness analysis showed that 84.38% of students in the experimental group achieved scores above the MMC, surpassing the 75% threshold for mastery learning. In contrast, the control group reached 71.88%, slightly below the mastery criterion. These results indicate that the differentiated PBL approach not only improved average performance but also increased the proportion of students meeting mastery standards.

Analysis of students' problem-solving strategies revealed variations based on learning styles. Visual learners tended to rely on diagrams, graphs, and written outlines to interpret problems. Auditory learners preferred discussing

the problems aloud, clarifying concepts through verbal reasoning. Kinesthetic learners engaged actively in manipulating learning

materials and real-life objects to construct solutions. These differences suggest that differentiated instruction allowed students to utilize their preferred cognitive pathways, leading to deeper engagement and more effective problem solving.

The significant improvement in numeracy literacy within the experimental group aligns with previous studies indicating that PBL enhances critical thinking and problem-solving skills through contextualized learning tasks (Aisyah et al., 2022; Alfares, 2021; Blundell & Berardi, 2016; Loyens S. M. et al., 2015). The addition of differentiation addressed the diversity in students' learning preferences, consistent with Tomlinson's (2001) theory that tailoring instruction to students' readiness, interests, and profiles increases learning outcomes. Furthermore, performance assessment provided authentic evaluation opportunities, enabling students to demonstrate understanding in ways that reflect real-world application (Masrukan, 2017).

CONCLUSION

Differentiated Problem-Based Learning (PBL) assisted by performance assessment significantly improved students' numeracy literacy compared to conventional PBL. Students in the experimental group achieved higher mean scores and greater classical completeness, indicating both individual and collective mastery. Differentiation enabled students with different learning styles visual, auditory, and kinesthetic to engage in problem solving through their preferred cognitive approaches. The integration of differentiated instruction with authentic assessment provides an effective framework for addressing students' diverse needs and enhancing their ability to apply mathematical concepts in meaningful contexts. These findings contribute to the growing body of evidence supporting student-centered adaptive pedagogical strategies in mathematics education.

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