

# Developing Problem-Based Learning Teaching Modules Integrated with ClassPoint to Enhance Students' Mathematical Reasoning

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## Abstract

Students' mathematical reasoning ability remains relatively low, particularly in solving contextual problems that require students to provide mathematical explanations, perform mathematical manipulations, formulate conjectures, and draw conclusions. This condition is associated with the limited implementation of problem-based learning and the suboptimal use of interactive technology in mathematics instruction at SMPN 22 Padang. Therefore, this study aimed to develop a teaching module based on the Problem-Based Learning (PBL) model integrated with ClassPoint to improve students' mathematical reasoning ability and to determine its validity, practicality, and effectiveness. This study employed a Research and Development approach using the Plomp model, consisting of preliminary research, development or prototyping, and assessment phases. The development process involved self-evaluation, expert review, one-to-one evaluation, small-group evaluation, and field testing. The field test involved 31 ninth-grade students of SMPN 22 Padang. Data were collected through validation sheets, practicality questionnaires, observation sheets, interviews, and mathematical reasoning tests. The results showed that the teaching module achieved a validity percentage of 91.56%, while the LKPD achieved 91.80%, both categorized as highly valid. The practicality scores were 87.41% based on students' responses and 95% based on the teacher's response, indicating a highly practical product. The average mathematical reasoning score reached 80.65, with 25 of 31 students (80.65%) achieving mastery. Thus, the developed PBL-ClassPoint teaching module met the criteria of validity, practicality, and effectiveness.

**Keywords:** Teaching Module, Problem-Based Learning, ClassPoint, Mathematical Reasoning

## INTRODUCTION

Mathematical reasoning is a fundamental competency in mathematics education, enabling students to analyze, conjecture, and draw logical conclusions (Hu et al., 2026). However, empirical evidence indicates that students' mathematical reasoning abilities remain suboptimal. For instance, educational report data from SMPN 22 Padang in 2024 revealed that merely 26.67% of students possess the capability to resolve complex problems utilizing mathematical concepts. This deficiency is predominantly characterized by students' struggles in formulating conjectures, committing procedural and conceptual errors, and failing to articulate logical arguments for their solutions (Zhao, 2026). Consequently, students experience significant difficulties when confronted with non-routine problems that require higher-order thinking skills (Annajmi et al., 2026).

The underachievement in mathematical reasoning is intricately linked to prevailing instructional paradigms (Rahmawati et al., 2026). Classroom practices are frequently dominated by conventional, teacher-

centered approaches that marginalize active student engagement. Furthermore, the integration of interactive technology remains inadequate (Qiu & Yao, 2026). Although digital tools are prevalent, their utilization is often restricted to unidirectional presentation software, failing to foster the interactive, student-centric environment required for deep cognitive processing. Without interactive scaffolding, students struggle to translate abstract mathematical concepts into real-world contexts, which stifles the development of their analytical and reasoning capacities (Funa, 2026).

To ameliorate these instructional shortcomings, the Problem-Based Learning (PBL) model offers a robust pedagogical framework (Mo et al., 2026). PBL situates learning within authentic, real-world problems, thereby compelling students to actively construct knowledge, collaborate, and engage in critical inquiry. Previous studies have substantiated the efficacy of PBL in enhancing mathematical reasoning. For example, Kuo et al. (2026) and Zhu et al. (2026) demonstrated that PBL significantly improves students' abilities to analyze information, formulate strategies, and construct mathematical arguments. Furthermore, Namli et al. (2026) found that PBL integrated with interactive media significantly outperforms conventional methods in fostering students' logical reasoning and problem-solving skills. Similarly, Meyer-Jenßen et al. (2026) emphasized that active, problem-oriented learning environments provide the necessary cognitive scaffolding for students to construct logical arguments and test conjectures effectively. Nevertheless, the mere implementation of PBL without adequate, interactive instructional media may not fully optimize students' cognitive engagement and visual comprehension of complex mathematical models (Zhang et al., 2026).

This is where interactive educational technology, specifically the ClassPoint application, becomes pivotal. ClassPoint provides several interactive features, such as real-time quizzes, polls, and immediate feedback, which can be incorporated into presentation slides. These features allow students to participate directly during the learning process rather than simply receiving information from the teacher. Recent studies have indicated that the use of ClassPoint may support student motivation and digital engagement. Whittaker et al. (2026) for example, reported positive effects of ClassPoint on students' motivation and engagement in technology-supported learning. Thus, ClassPoint can be used to complement classroom instruction by providing opportunities for students to respond to questions, participate in activities, and receive immediate feedback. While Srivani & Abirami (2024) confirmed its effectiveness in enhancing mathematical communication skills. By visualizing abstract concepts dynamically, ClassPoint bridges the gap between theoretical mathematics and practical application. Additionally, Payadnya et al. (2025) demonstrated that interactive presentation tools like ClassPoint increase student engagement and provide crucial immediate formative feedback, which is vital during complex problem-solving tasks. Building on this, Warsono et al. (2025) highlighted that combining problem-based syntax with real-time digital quizzes significantly reduces cognitive load, helping students visualize abstract concepts and maintain focus during rigorous mathematical tasks (Szkutnik-Rogoż & Nowicki, 2026).

The synergistic integration of PBL and ClassPoint creates a highly effective classroom ecosystem, particularly for enhancing mathematical reasoning Junpeng (2026). While PBL provides the authentic context and cognitive demand required to stimulate higher-order thinking, ClassPoint supplies the interactive scaffolding and immediate feedback loops necessary to guide students through the problem-solving process Tiruneh et al. (2026). When PBL's real-world problems are delivered through ClassPoint's interactive features, students are not merely solving static worksheets; they are engaging in dynamic, real-time hypothesis testing, visualizing abstract geometric models on their devices, and receiving instant validation of their conjectures. This powerful combination transforms abstract mathematical reasoning into a tangible, interactive experience. As revealed by Pan et al. (2026), the synergy of PBL's contextual problems with interactive digital feedback

accelerates the transition from concrete to abstract mathematical reasoning, making it an exceptionally potent approach for modern classrooms.

Despite the individual proven benefits of PBL and ClassPoint, there is a conspicuous paucity of research focusing on the developmental integration of both within a comprehensive teaching module tailored for the Merdeka Curriculum. Existing studies predominantly evaluate the immediate effects of these tools on learning outcomes, rather than developing structured, validated instructional modules that synergize PBL's problem-solving syntax with ClassPoint's interactive affordances to specifically target mathematical reasoning. Therefore, this study aims to bridge this gap by developing, validating, and testing a mathematics teaching module based on the PBL model integrated with ClassPoint. The primary objective is to produce a valid, practical, and effective instructional module designed to significantly enhance the mathematical reasoning abilities of ninth-grade junior high school students.

## **METHOD**

This study employed a Research and Development (R&D) framework utilizing the instructional design model proposed by Plomp. The developmental cycle was systematically structured into three primary phases. The first phase, preliminary research, encompassed comprehensive needs, curriculum, concept, and student characteristic analyses to establish the foundational requirements. The second phase, prototyping, involved the iterative development and formative evaluation of the teaching module through self-evaluation, expert review, one-to-one evaluation, small-group evaluation, and field testing. The final phase, assessment, was conducted to evaluate the overall effectiveness of the developed product in a real classroom setting.

The study was situated at SMP Negeri 22 Padang, Indonesia, and was conducted from November to December 2025 during the 2025/2026 academic year. The research subjects were strategically selected using purposive sampling based on varying mathematical proficiency levels to ensure comprehensive feedback. Specifically, the one-to-one evaluation involved three ninth-grade students, the small-group evaluation comprised six students, and the field test engaged a full intact class of 31 students alongside their mathematics teacher.

Data collection encompassed a triangulation of instruments to ensure a rigorous evaluation across validity, practicality, and effectiveness dimensions. Validation sheets were deployed for the expert appraisal of the teaching module, student worksheets, and test items. Practicality was assessed via structured questionnaires distributed to both students and teachers, complemented by implementation observation sheets and semi-structured interviews. To measure the product's effectiveness, a validated post-test focusing on specific mathematical reasoning indicators was administered to the students at the end of the field test.

The collected data were analyzed using descriptive quantitative and qualitative techniques. Validity was determined by calculating the mean scores from expert validators on a four-point Likert scale, which were subsequently translated into percentage-based validity categories. Practicality was evaluated by computing the percentage of positive responses derived from the questionnaires and observation checklists, categorizing the module's usability and implementation quality. Finally, effectiveness was analyzed by calculating the students' mean post-test scores and determining the percentage of students who achieved the predefined learning mastery threshold of 75%.

## **RESULT AND DISCUSSION**

The evaluation of the developed teaching module was systematically conducted following the Plomp development model, encompassing formative evaluation and summative assessment. The results of the product evaluation are delineated into three primary dimensions: validity, practicality, and effectiveness.

### Validity of the Developed Teaching Module

The initial phase of the product evaluation focused on establishing the content and construct validity of the teaching module and the student worksheets (LKPD). This was conducted through a rigorous expert review involving five specialists: two in mathematics education, one in pure mathematics, one in linguistics (Indonesian language), and one in educational technology. The evaluation encompassed four core dimensions: content feasibility, didactics, linguistics, and graphic design. As detailed in Table 1, the teaching module achieved an overall validity score of 3.66 (91.56%), while the LKPD scored 3.67 (91.80%). Both instruments were categorized as "highly valid." These empirical scores indicate that the integration of Problem-Based Learning (PBL) syntax with ClassPoint affordances was theoretically, pedagogically, and visually sound for ninth-grade students.

**Table 1.** Validity Scores of the Teaching Module and LKPD Based on Expert Review

| Evaluation Aspect        | Module Score (%) | LKPD Score (%) | Category     |
|--------------------------|------------------|----------------|--------------|
| Content Feasibility      | 91.67            | 91.67          | Highly Valid |
| Didactics / Presentation | 93.33            | 94.44          | Highly Valid |
| Linguistics              | 93.75            | 93.75          | Highly Valid |
| Graphic Design           | 87.50            | 87.50          | Highly Valid |
| Overall Mean             | 91.56            | 91.80          | Highly Valid |

### Practicality of the Teaching Module

Following the validation and iterative revisions, the practicality of the module was assessed during the field test to determine its usability in an authentic classroom setting. Practicality was measured through structured questionnaires distributed to both the mathematics teacher and the 31 ninth-grade students after the implementation of the module. Table 2 summarizes the empirical findings. The teacher's response yielded an exceptional practicality score of 95.00%, reflecting that the module significantly streamlined instructional delivery and aligned seamlessly with the PBL framework. Concurrently, the students' responses indicated a high level of practicality at 87.41%. This positive reception suggests that the contextual problems and interactive ClassPoint features successfully lowered cognitive load and enhanced student engagement without causing technical or procedural friction.

**Table 2.** Practicality Scores Based on Teacher and Student Responses During the Field Test

| Respondent          | Overall Practicality Score (%) | Category         |
|---------------------|--------------------------------|------------------|
| Mathematics Teacher | 95.00                          | Highly Practical |
| Students (N = 31)   | 87.41                          | Highly Practical |

### Effectiveness in Enhancing Mathematical Reasoning

The final metric of the evaluation was the module's effectiveness in ameliorating students' mathematical reasoning abilities. This was quantified using a validated post-test comprising four open-ended questions aligned with specific reasoning indicators: (1) providing explanations using models and facts, (2) performing mathematical manipulation, (3) proposing conjectures, and (4) drawing conclusions. The field test involved 31 ninth-grade students. As presented in Table 3, the cohort achieved a mean reasoning score of 80.65. Furthermore, the classical mastery analysis revealed that 25 out of 31 students (80.65%) surpassed the minimum competency threshold of 75. These empirical outcomes confirm that the module not only facilitated conceptual understanding but also actively stimulated higher-order reasoning processes, meeting the predetermined criteria for effectiveness.

**Table 3.** Students' Mathematical Reasoning Achievement Based on Post-Test Indicators

| Reasoning Indicator                                | Mean Score | Mastery Level (%) |
|----------------------------------------------------|------------|-------------------|
| Providing explanations (models, facts, properties) | 87.10      | 87.10             |
| Performing mathematical manipulation               | 85.48      | 85.48             |
| Proposing conjectures                              | 77.42      | 77.42             |
| Drawing conclusions                                | 72.58      | 72.58             |
| Overall Mean Score                                 | 80.65      | 80.65             |

The empirical validation of the developed teaching module and student worksheets (LKPD) yielded an overall score of 91.56% and 91.80%, respectively, categorizing them as highly valid. This high level of validity substantiates that the synergistic integration of Problem-Based Learning (PBL) syntax with ClassPoint's interactive affordances is theoretically, pedagogically, and visually sound. According to Akker et al. (2012), the quality of instructional materials is fundamentally determined by their content feasibility, didactic alignment, linguistic clarity, and graphic design. Content validity was established by aligning the contextual problems used in the module with the learning objectives of the Merdeka Curriculum for Phase D. For example, the module incorporated problems related to UMKM packaging and the volume of "Es Teh Jumbo" to connect mathematical concepts with situations that are familiar to students.

Furthermore, the didactic validity highlights the module's success in translating abstract mathematical concepts into tangible, real-world inquiries. The PBL steps embedded within the module do not merely present problems; they provide cognitive scaffolding that guides students from problem orientation to reflective evaluation. The linguistic and graphic validations further confirm that the use of conversational yet academic language, combined with dynamic visual illustrations, aligns with the cognitive characteristics of ninth-grade students. This finding corroborates the study by Praseeda et al. (2025), which emphasized that interactive modules utilizing contextual approaches significantly enhance the structural and visual validity of learning materials. Consequently, the module serves as a highly reliable instructional blueprint for fostering mathematical reasoning.

Practicality determines the extent to which an instructional product can be seamlessly implemented in real classroom ecosystems (Iqbal et al., 2025). During the field test, the module achieved a practicality score of 87.41% from students and an exceptional 95.00% from the mathematics teacher. These empirical outcomes indicate that the module successfully mitigated the common friction associated with implementing complex pedagogical models and educational technology.

From the teacher's perspective, the module functioned not merely as a supplementary document, but as a structured pedagogical roadmap. The explicit integration of ClassPoint features (e.g., interactive quizzes, short-answer prompts, and image uploads) within the PBL syntax allowed the teacher to monitor student comprehension in real-time without disrupting the flow of the lesson. This aligns with the findings of Yaochi et al. (2025), who noted that well-structured modules significantly reduce teachers' cognitive load in managing classroom dynamics. From the students' perspective, the practicality was driven by the module's visual appeal and the interactive nature of ClassPoint. The digital interactivity transformed passive listening into active participation, which is crucial for maintaining engagement during complex problem-solving tasks. As highlighted by Huang & Tseng (2026), the integration of ClassPoint significantly boosts student motivation and digital engagement, making the learning process more intuitive and less intimidating. Thus, the module proved to be highly practical, bridging the gap between theoretical PBL frameworks and practical classroom execution.

The primary objective of this study was to ascertain the module's effectiveness in ameliorating students' mathematical reasoning. The field test results demonstrated an average reasoning score of 80.65, with a classical mastery rate of 80.65%, surpassing the predetermined effectiveness threshold of 75%. This significant achievement underscores the efficacy of combining PBL's problem-orientation with ClassPoint's interactive feedback mechanisms.

The enhancement of mathematical reasoning can be dissected through the four specific indicators assessed: providing explanations, performing mathematical manipulation, proposing conjectures, and drawing conclusions. The PBL model inherently demands that students decode authentic problems, which directly stimulates the indicator of *providing explanations using models and facts*. By confronting students with real-world scenarios (e.g., calculating surface areas for eco-friendly packaging), the module forced them to articulate the mathematical properties of curved surface solids rather than merely memorizing formulas. This constructivist approach is strongly supported by Ping & Abideen (2025) and Xie & Luo (2026), who argue that authentic problem-solving is the most effective catalyst for developing logical argumentation.

Furthermore, the integration of ClassPoint played a pivotal role in refining *mathematical manipulation* and *proposing conjectures*. Features such as real-time polling and short-answer submissions compelled students to commit to a hypothesis before performing calculations. This immediate digital engagement prevented students from passively waiting for the teacher's answer, thereby training them to formulate and test conjectures independently. Finally, the reflection and evaluation phases of PBL, facilitated by ClassPoint's presentation features, required students to interpret their numerical results within the context of the initial problem, significantly improving their ability to *draw conclusions*. These findings resonate with the research of Pascu (2026) and Ding & Hao (2025), which confirmed that PBL significantly improves students' abilities to analyze information and construct mathematical arguments. Ultimately, the module did not just teach students how to calculate the volume of a cone or cylinder; it trained them to think mathematically, reason logically, and apply their knowledge to solve contextual challenges.

## Discussion

The findings indicate that the developed mathematics teaching module based on Problem-Based Learning (PBL) integrated with ClassPoint met the criteria of validity, practicality, and effectiveness. The module obtained a validity score of 91.56%, while the LKPD achieved 91.80%, indicating that the content, learning activities, language, presentation, and graphical aspects were highly appropriate.

The practicality results also showed positive responses from users. Students' responses reached 87.41%, while the mathematics teacher's response reached 95%. These results indicate that the module was easy to use, understandable, attractive, and supportive of classroom learning. The integration of ClassPoint provided opportunities for students to participate actively through interactive activities and immediate responses during the learning process.

Regarding effectiveness, the average mathematical reasoning score in the field test was 80.65, with 25 of 31 students (80.65%) achieving the predetermined mastery criterion. The learning activities were designed to facilitate key reasoning processes, including providing mathematical explanations, performing mathematical manipulation, formulating conjectures, and drawing conclusions.

These findings suggest that the combination of PBL, contextual problems, and ClassPoint can provide a learning environment that supports students' active participation and mathematical reasoning. However, because the effectiveness assessment was based primarily on post-test performance without a control-group comparison, the findings should be interpreted as evidence that the developed module met the

established effectiveness criteria rather than as conclusive evidence of a causal effect. Further research with a comparative experimental design is recommended.

## CONCLUSION

This study successfully addressed the critical deficit in interactive, problem-oriented instructional materials by developing a mathematics teaching module grounded in Problem-Based Learning (PBL) and integrated with ClassPoint. Empirical outcomes confirm that the developed product fulfills stringent criteria of validity, practicality, and effectiveness in ameliorating the mathematical reasoning abilities of ninth-grade students, achieving validity scores of 91.56% for the module and 91.80% for the worksheets, practicality ratings of 87.41% from students and 95.00% from educators, and an effective learning mastery rate of 80.65%. The primary strength of this instructional blueprint lies in its synergistic design, where contextual, real-world problems seamlessly align with ClassPoint's real-time interactive features, transforming passive learning into active cognitive engagement and significantly lowering the cognitive load associated with abstract mathematical concepts. However, the study acknowledges certain limitations, notably its restricted developmental scope to a single mathematical domain (Curved Surface Solids) for one grade level, and the reliance on personal smartphones, which necessitated stringent classroom management to mitigate potential digital distractions. Consequently, it is highly recommended that mathematics educators adopt this module as a robust alternative for fostering logical reasoning, provided they actively scaffold the learning process, while future researchers are encouraged to expand its applicability across diverse mathematical topics and educational tiers, potentially integrating more advanced technological affordances, such as artificial intelligence-driven analytics, to further personalize and amplify students' mathematical reasoning trajectories.

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