Journal of Mathematics Instruction, Social Research and Opinion
Vol. 5, No. 2, June 2026, pp. 1643 – 1648, https://doi.org/10.58421/misro.v5i2.1604
ISSN 2962-7842

Prospective Mathematics Teachers' Perceptions of the Use of *Problem-Based Learning* (PBL) Models in Mathematics Learning

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Article Info

Article history:

Received 2026-05-03
Revised 2026-05-26
Accepted 2026-06-04

Keywords:

Inquiry-based learning
Mathematics education
Pedagogical readiness
Pre-service teachers
Problem-based learning.

ABSTRACT

This study examines prospective mathematics teachers' perceptions of Problem-Based Learning (PBL) in mathematics education, focusing on their understanding of PBL characteristics, the role of problems as learning triggers, and their readiness to implement PBL in future teaching practice. The study addresses the gap between positive perceptions of PBL and pedagogical readiness for inquiry-based mathematics instruction. A mixed-methods approach with a sequential explanatory design was employed. Quantitative data were collected through questionnaires administered to 35 prospective mathematics teachers, while qualitative data were obtained through semi-structured interviews to deepen the interpretation of the quantitative findings. The results indicate that prospective teachers generally hold highly positive perceptions toward PBL, particularly regarding its ability to support critical thinking, collaboration, conceptual understanding, and contextual mathematics learning. Qualitative findings revealed that participants viewed problems in PBL as starting points for conceptual exploration rather than exercises given after instruction. However, participants also identified challenges related to authentic problem design, classroom management, inquiry facilitation, and time allocation. The study highlights the importance of strengthening experiential PBL training, problem design, and facilitation skills in mathematics teacher education programs. Although the limited sample size restricts generalizability, the study contributes to understanding the relationship between perceptions and pedagogical readiness in PBL implementation.

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1. INTRODUCTION

Mathematics education in the 21st century is no longer sufficient if it focuses solely on mastering procedures; rather, it requires the development of critical thinking skills, problem-solving abilities, and a deep conceptual understanding. Effective teaching, through strong *Pedagogical Content Knowledge* (PCK), requires teachers to have a deep understanding of the mathematical content they are expected to teach and to know their students as learners [1] . Teachers must also be able to skillfully select and use a variety of evidence-based pedagogical strategies. These demands align with 21st-century competency frameworks that emphasize the importance of higher-order thinking skills as a prerequisite for students to address the complexity of real-world problems [2][3] . These skills are not limited to solving problems but also involve the ability to analyze, evaluate, and construct knowledge independently [4] . *The Theory of Didactic Situations in Mathematics* states that mathematical knowledge is constructed through didactic situations deliberately designed to place students in conditions where they think and act mathematically [5] . This includes the teacher's ability to select and design problems, manage classroom interactions, and facilitate students' reflection on the strategies and solutions they generate [6] . Therefore, mathematics teachers are required not only to master content knowledge but also to create learning environments that support inquiry, reasoning, and conceptual construction.

Teachers must possess the competence to design instruction using learning models appropriate to the characteristics of the subject matter, students' needs, and the learning objectives to be achieved, as teachers' professional competence influences instructional quality and student learning development [7] . This competence is not merely about procedurally selecting learning models but also involves a conceptual understanding of how a model can facilitate students' thinking processes, interactions, and knowledge construction [8][9] . Consequently, the quality of mathematics instruction depends heavily on teachers' abilities to integrate mathematical knowledge, pedagogical strategies, and students' learning characteristics into meaningful learning experiences [10] . These competencies need to be developed during teacher education programs because prospective teachers are still forming their professional identity, pedagogical understanding, and teaching readiness.

Prospective mathematics teachers are a group in the process of forming initial understandings of how mathematics should be taught and how students should learn mathematics. The perceptions, beliefs, and learning experiences they acquire during teacher education will influence how they interpret the teacher's role, select instructional models, and design mathematics activities in the classroom in the future. Perception is a concept related to the process of understanding and giving meaning to experiences [11] , while the beliefs and perceptions of teachers and prospective teachers play a crucial role in explaining pedagogical orientations and educational practices [12] . Perception serves as a key indicator because prospective teachers are in the process of forming their professional identity, pedagogical knowledge, and teaching readiness. Their perceptions of mathematics learning will influence how they interpret the teacher's role, the students' position, the function of problems, and the learning models considered relevant for achieving learning objectives. Therefore, pre-service teacher education must not only equip students with mastery of mathematical content but also develop the pedagogical and didactic skills necessary to transform mathematical knowledge into learning experiences that students can understand [13] . This issue becomes important in the context of Problem-Based Learning (PBL), which requires teachers to facilitate inquiry, collaborative learning, and conceptual exploration through meaningful problems.

This perspective aligns with the theory of planned behavior, which explains that attitudes, subjective norms, and perceptions of behavioral control can influence a person's intentions and actions. Therefore, prospective teachers' perceptions of PBL have the potential to influence their readiness to design and implement problem-based mathematics instruction. This perspective aligns with the theory of planned behavior, which explains that attitudes, subjective norms, and perceptions of behavioral control can influence a person's intentions and actions. Consequently, prospective teachers' perceptions of PBL have the potential to influence their readiness to design and implement problem-based mathematics instruction [14] .

Based on this definition, prospective mathematics teachers' perceptions regarding the use of *Problem-Based Learning* (PBL) can be understood as the ways in which they interpret, evaluate, and make sense of PBL as a mathematics learning model. These perceptions encompass their understanding of the characteristics of PBL, the function of problems as a starting point for learning, the benefits of PBL for the development of students' thinking skills, the relevance of PBL to the characteristics of mathematics, and their readiness to implement it. This is important because PBL is not merely a learning model that places students in group discussions, but rather a learner-centered approach that encourages inquiry, integrates theory and practice, and requires teachers to design meaningful problems.

Problem-Based Learning (PBL) is a learner-centered instructional model that uses problems as the starting point for learning. In PBL, students investigate problems, gather information, and construct knowledge independently rather than receiving direct explanations from teachers [15] . The Problem-Based Learning model emphasizes the use of unstructured and authentic problems as triggers for learning processes [16] . This model encourages students to integrate theory and practice while developing problem-solving abilities [17]. Hung further emphasizes that the quality of problems is a critical factor influencing the success of PBL implementation [18] . In mathematics education, problems are not merely practice exercises but epistemic tools that stimulate reasoning, inquiry, and conceptual understanding.

Previous studies indicate that PBL effectively supports mathematics learning because it promotes active participation, collaboration, and inquiry-based learning experiences [19] . Research also shows that pre-service teachers tend to perceive PBL positively because it helps develop pedagogical content knowledge and encourages meaningful learning experiences [20] . However, previous studies also reveal that prospective teachers frequently experience difficulties in designing authentic mathematical problems, facilitating discussions, providing scaffolding, and managing inquiry-based classrooms effectively [20][21]. Most previous research has focused primarily on attitudes toward PBL or its effectiveness in learning outcomes, while limited studies specifically examine how prospective mathematics teachers simultaneously understand the role of problems, conceptual understanding, and implementation readiness in mathematics classrooms. This limitation constitutes the research gap addressed in the present study.

The Theory of Planned Behavior explains that attitudes, subjective norms, and perceived behavioral control influence individuals' intentions and actions [22]. Within this study, the theory is used to understand how prospective teachers' positive perceptions of PBL may influence their readiness and intention to implement problem-based mathematics instruction. Positive perceptions alone may not guarantee implementation readiness because prospective teachers may still experience limited confidence in managing inquiry, designing contextual problems, and facilitating collaborative learning.

Based on these issues, this study focuses on prospective mathematics teachers' perceptions regarding the use of PBL in mathematics learning. The study aims to analyze prospective teachers' understanding of PBL characteristics, the role of problems as learning triggers, the relevance of PBL to mathematics learning, and their readiness to implement PBL in future teaching practice. This study is expected to provide empirical insights into whether positive perceptions of PBL are accompanied by adequate conceptual understanding and pedagogical readiness. The findings are expected to contribute to the development of teacher education programs by strengthening prospective teachers' competencies in problem design, inquiry facilitation, scaffolding strategies, and problem-based mathematics instruction.

2. METHOD

This study employs a *mixed-methods* approach with a *sequential explanatory* design. The design aims to obtain a quantitative overview of prospective mathematics teachers' perceptions regarding the use of the *Problem-Based Learning* (PBL) model, followed by an in-depth exploration of these findings through qualitative data in the form of interviews. In a *sequential explanatory* design, data collection and analysis are conducted sequentially, starting with quantitative data, followed by qualitative data to explain the quantitative results in greater depth [23]. In the first stage, this study used a questionnaire to measure prospective mathematics teachers' perceptions of PBL based on five indicators. The mixed-methods design was selected because perceptions of PBL cannot be fully understood through numerical tendencies alone but also require exploration of participants' conceptual understanding, pedagogical reasoning, and implementation readiness.

This study was conducted in several stages. The first stage involved a literature review on PBL, prospective teachers' perceptions, problem-based mathematics learning, and prospective teachers' competencies in designing instruction. The second stage involved the development of research instruments. The quantitative instrument consisted of a questionnaire assessing prospective mathematics teachers' perceptions of PBL. The third stage involved instrument validation. Validation was conducted through expert review to ensure the alignment of items with the research indicators, clarity of wording, and relevance of items to the construct of prospective teachers' perceptions of PBL. Content validation is essential to ensure the instrument accurately measures the intended indicators in the research [24]. Three experts in mathematics education and educational research methodology reviewed the questionnaire and interview guide. Revisions were conducted based on suggestions related to wording clarity, indicator relevance, and alignment with PBL theoretical constructs. Prior to large-scale distribution, the questionnaire was piloted on respondents outside the main sample to ensure item readability and response clarity. Reliability testing was conducted using Cronbach's Alpha to examine the internal consistency of the questionnaire items. The fourth stage involved the collection of quantitative data. The questionnaire was administered to prospective mathematics teachers who met the participant criteria. The fifth stage is the collection of qualitative data. Interviews were conducted after the questionnaire results were analyzed. The selection of interview respondents could be done purposively based on the questionnaire results, for example, selecting respondents with high, moderate, and low scores, or selecting respondents who demonstrated specific response patterns. Interview participants were selected purposively from questionnaire results to represent diverse perception categories, including respondents with consistently positive perceptions, moderate perceptions, and respondents who showed contradictions between perceived benefits and implementation readiness. The sixth stage is data integration. Quantitative and qualitative results are compared and linked to arrive at a more comprehensive conclusion. Integration is performed by examining whether positive perceptions in the questionnaire align with prospective teachers' conceptual understanding in the interviews.

The participants in this study were prospective mathematics teachers from the mathematics education program. Participant selection was conducted using *purposive sampling* because the study required respondents with specific characteristics aligned with the research objectives [25] . Participant criteria included: active students in the mathematics education program, having taken or currently taking courses related to mathematics learning strategies or models, and possessing prior knowledge of PBL**.** The number of participants in the quantitative phase was 35 prospective mathematics teachers, while in the qualitative phase, some respondents were selected as interview informants based on the questionnaire results. Although the quantitative sample size was relatively limited, this study emphasized descriptive interpretation rather than statistical generalization, while the qualitative phase was intended to deepen understanding of participants' perceptions and pedagogical reasoning.

The research instruments consisted of a perception questionnaire and a semi-structured interview guide. The perception questionnaire was used to obtain quantitative data regarding prospective mathematics teachers' perceptions regarding the use of PBL for mathematics learning. The questionnaire used a four-point Likert scale: strongly agree, agree, disagree, and strongly disagree. The Likert scale was used because it is suitable for measuring respondents' attitudes, perceptions, and views toward a research object [26]. Perception categories were operationally interpreted based on mean score intervals, with higher scores indicating stronger positive perceptions toward PBL implementation in mathematics learning. The questionnaire was developed based on the following five indicators:

Table 1. Questionnaire outline

Indicator	Sub-indicators Used	Statement Instrument
Understanding of PBL Characteristics	Understands that PBL is problem-centered and *student-centered*	I understand that the PBL model uses problems as the primary basis for the learning process
		I understand that the PBL model positions students as active participants in learning
	Understand that PBL involves group work, independent learning, investigation, discussion, and reflection	I understand that the PBL model encourages students to investigate problems before reaching conclusions
		I understand that group discussions are an important part of implementing the PBL model
		I understand that in PBL, the teacher acts as a facilitator who guides the students' learning process
Perceptions of the Benefits of PBL	PBL is seen as capable of improving problem-solving, critical thinking, collaboration, communication, motivation, and understanding of mathematical concepts	I believe PBL can help students develop their ability to solve mathematical problems
		I believe PBL can encourage students to think critically when understanding mathematical problems
	PBL is seen as a way to improve communication and collaboration	I believe PBL can help students understand mathematical concepts more meaningfully
		I believe PBL can improve student cooperation and communication in mathematics learning
	PBL is seen as a way to improve understanding of mathematical concepts	I believe PBL can make students more motivated to learn mathematics.
Perceptions of the Relevance of PBL for Mathematics Learning	PBL is considered well-suited to the nature of mathematics, which requires reasoning, exploration, representation, conceptual connections, and contextual problem-solving	I believe PBL is suitable for use in mathematics instruction because mathematics is about problem-solving.
		I believe PBL can help students connect mathematical concepts to real-life situations.
	PBL is considered suitable for the nature of mathematics, which demands reasoning	I believe PBL is suitable for training students to reason when solving mathematical problems.
		I believe PBL can support students in exploring various problem-solving strategies.
	Alignment with learning objectives	I believe PBL is relevant to mathematics learning objectives that emphasize conceptual understanding and problem-solving.
Perceptions of PBL Implementation	Ability to design problems, organize groups, facilitate	I feel I can design mathematical problems suitable for use in PBL-based learning

Indicator	Sub-indicators Used	Statement Instrument
	investigations, manage time, guide discussions, and evaluate the problem-solving process	I feel I can organize students into learning groups when implementing the PBL model.
	Learning Management	I feel I can guide students in conducting investigations to solve mathematical problems I feel confident in managing learning time when using the PBL model.
	Use of Problems	I feel confident in evaluating the process and outcomes of students' problem-solving in PBL learning.
Perceptions of Readiness to Implement PBL	Self-confidence, pedagogical readiness, ability to select mathematical problems, readiness to manage the classroom, and intention to use PBL as a teacher	I feel ready to use the PBL model in mathematics instruction when I become a teacher I am confident that I can implement PBL steps in mathematics instruction I feel ready to select mathematical problems that are appropriate for students' abilities ( ). I feel ready to manage a classroom that uses problem-based learning. I intend to use the PBL model to help students learn mathematics actively and meaningfully

Interviews were used to explore the respondents' reasons, understanding, and thought processes behind their answers, particularly regarding the characteristics of PBL, the role of problems, readiness for implementation, and challenges in applying the model. The type of interview used was a semi-structured interview. The interviews were designed to determine whether prospective teachers understand PBL as a learning model that uses problems as the starting point for knowledge construction, or merely interpret it as discussion and the presentation of problems after the material has been explained. The interviews served as the explanatory phase in a *sequential explanatory mixed-methods* design, wherein qualitative data was used to explain the quantitative results obtained through the questionnaire.

Table 2. Interview Guide

No	Aspects Explored	Interview Indicators	Main Questions	Follow-up Questions
1	Understanding the characteristics of PBL	Understanding PBL as problem-based, student-centered learning that requires inquiry	In your opinion, what is the *Problem-Based Learning* model in mathematics education?	What distinguishes PBL from conventional learning?
2	Understanding the function of problems	Understanding problems as the starting point of learning, not merely practice questions	In your opinion, what is the function of a problem in the PBL model?	Should the problem be presented before or after the material is explained? Why?

No	Aspects Explored	Interview Indicators	Main Questions	Follow-up Questions
3	Understanding the role of the teacher	Understanding the teacher as a facilitator, an inquiry guide, and a provider of *scaffolding*	In your opinion, what is the teacher's role when teaching mathematics using PBL?	Does the teacher need to explain the material first? Why?
4	Perceptions of the benefits of PBL	Assessing the benefits of PBL for problem-solving, critical thinking, collaboration, and independent learning	In your opinion, how can PBL help students solve math problems?	Can PBL help students develop critical thinking skills? Explain your reasoning
5	Perceptions of conceptual understanding	Assessing the relationship between PBL and the construction and understanding of mathematical concepts	In your opinion, can PBL help students understand mathematical concepts more deeply?	How can problems help students discover or understand mathematical concepts?
6	Perceptions of the relevance of PBL in mathematics-	Assessing the Suitability of PBL for the Characteristics of Problem-Based Mathematics Learning	In your opinion, is PBL suitable for use in mathematics education?	What kind of math material do you think is suitable to be taught using PBL?
7	Perceptions of problem context	Understanding the importance of contextual, authentic, and meaningful problems in PBL	In your opinion, do problems in PBL need to be related to real life?	How do you select appropriate problem contexts for mathematics learning?
8	Perceptions regarding the implementation of PBL	Understanding the steps for implementing PBL in mathematics learning	If you teach mathematics using PBL, what steps would you take?	How do you begin and conclude PBL-based learning?
9	Perceptions of managing discussions	Understanding how to manage group work, discussions, and student investigations	How would you manage group discussions in PBL learning?	What will you do if students have trouble understanding the problem?
10	Perceptions of problem design	Understanding the criteria for good mathematical problems for PBL	In your opinion, what makes a good mathematical problem for use in PBL?	What should be considered when designing problems for PBL?
11	Perceptions regarding readiness to implement PBL	Assessing prospective teachers' self-confidence and pedagogical readiness in implementing PBL	Do you feel ready to implement PBL in mathematics instruction?	Which aspects do you feel most confident about, and which ones are still challenging?
12	Perceptions of implementation barriers	Identifying the perceived barriers prospective teachers face in implementing PBL	In your opinion, what is the biggest challenge in implementing PBL in mathematics education?	How do you overcome these challenges?

Data collection was conducted in two stages in accordance with a *sequential explanatory* design. The first stage involved collecting quantitative data through a questionnaire. The questionnaire was administered to 35 prospective mathematics teachers who met the study's criteria. The second stage involved collecting qualitative data through semi-structured interviews. The interviews were conducted after the questionnaire data had been preliminarily analyzed. The interview data served to deepen and validate the meaning of the quantitative results. Ethical considerations were implemented throughout the research process. Participants were informed about the objectives of the study, the voluntary nature of participation, and the confidentiality of their responses prior to data collection. Informed consent was obtained from all participants before completing the questionnaire and interviews. Participant identities were anonymized during data analysis and reporting to maintain confidentiality.

Quantitative data were analyzed using descriptive statistics. The analysis involved assigning scores to each response, calculating the mean for each item, calculating the mean for each aspect, and interpreting the perception categories. Qualitative data were analyzed thematically through several stages, including interview transcription, repeated reading of responses, initial coding, categorization of similar meanings, theme identification, and interpretation of participants' narratives. Coding was conducted iteratively to identify recurring perceptions regarding the characteristics of PBL, the role of problems, readiness for implementation, and perceived pedagogical challenges. In the final stage, quantitative and qualitative data were integrated. Integration was performed by comparing the questionnaire results with the interview results.

3. RESULTS AND DISCUSSION

3.1. Results

The results of the study indicate that prospective mathematics teachers tend to have positive perceptions regarding the use of the Problem-Based Learning (PBL) model for mathematics instruction. These findings are evident across all aspects measured by the questionnaire, namely understanding of PBL characteristics, perceptions of the benefits of PBL, perceptions of the relevance of PBL in mathematics instruction, perceptions of PBL implementation, and readiness to implement PBL. In general, the average scores for each aspect fall into the high category. This indicates that prospective mathematics teachers accept PBL as a relevant learning model to support active, contextual, and problem-solving-oriented mathematics learning. Perception categories were interpreted based on percentage intervals derived from the four-point Likert scale, where higher percentages reflected stronger positive perceptions toward PBL implementation. The results of the perception questionnaire can be seen in the table below.

Table 3. Descriptive analysis of perceptions

Description	Perception Score
Mean	85.23
Standard Deviation	12.21
Minimum	31
Maximum	100

The table above shows the results of a descriptive analysis of respondents' perception scores. The mean perception score is 85.23, indicating that respondents generally demonstrated positive perceptions toward PBL implementation in mathematics learning. Additionally, the standard deviation of 12.21 indicates variation in respondents' perceptions. The recorded minimum score is 31, while the maximum score reaches 100, suggesting that although most respondents showed positive perceptions, differences in conceptual understanding and readiness were still identified among participants.

The distribution of prospective teachers' perception categories regarding the use of the PBL model for mathematics learning can be seen in the following table.

Table 4. Perception categories of prospective teachers

No	Interval	Category	Frequency	
			Frequency	%
1	25% - 43.75%	Very Low	1	2.86
2	43.76% - 62.50%	Low	0	0
3	62.51% - 81.25%	High	10	28.57
4	81.26% - 100%	Very High	24	68.57

Based on Table 4, a *pie chart* can be created, as shown in the figure below

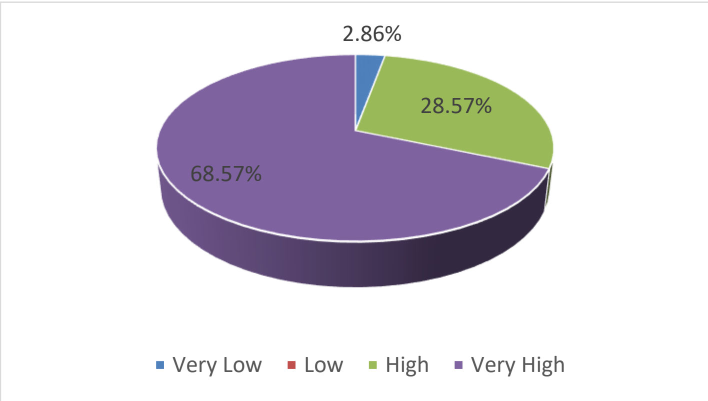

Figure 1. *Pie Chart of* Prospective Teachers' Perception Levels

Based on Table 4, the majority of respondents were categorized in the "Very High" perception category, with 68.57% of respondents demonstrating highly positive perceptions toward PBL. The "High" category accounted for 28.57%, while only 2.86% fell into the "Very Low" category. No respondents were categorized as "Low." These findings indicate that most prospective mathematics teachers perceive PBL as relevant for supporting inquiry, active participation, and problem-solving processes in mathematics learning.

To deepen the quantitative findings, semi-structured interviews were conducted with selected participants representing different perception categories. The interview findings are presented in the following narratives

Narrative 1: Understanding the Characteristics of PBL

Respondents explained that they understand PBL as a learning model that prioritizes problem-solving, where students play an active role in finding solutions to given problems. Teachers function as facilitators who guide students during inquiry and exploration processes. In the context of mathematics, respondents emphasized that PBL not only teaches theory but also demonstrates how mathematical concepts can be applied in real-life situations. One respondent stated:

“PBL helps students understand mathematics because they directly solve problems related to everyday situations.”

Interpretation: This finding indicates that respondents view PBL as an approach that supports conceptual understanding through contextual problem-solving activities. Respondents also demonstrated an understanding that problems in PBL function as learning triggers rather than merely exercises provided after concept explanation.

Narrative 2: The Benefits of PBL in Learning

Respondents described that PBL encourages students to become more active during learning activities. Students are required to analyze problems, discuss alternative solutions, and communicate their reasoning collaboratively. Respondents also perceived that PBL supports the development of critical thinking and communication skills. One respondent explained:

“Students become more confident in expressing ideas because discussions in PBL require everyone to participate.”

Interpretation: PBL is perceived as beneficial for promoting active engagement, collaboration, and higher-order thinking skills. The findings suggest that respondents associate PBL with student-centered learning processes that encourage independent and collaborative knowledge construction.

Narrative 3: The Role of Problems in PBL

Respondents emphasized that problems in PBL should be contextual and connected to real-life situations. They explained that meaningful problems help students understand why mathematics is important and encourage deeper investigation processes. One respondent stated:

“If the problem is related to daily life, students become more interested because they know why mathematics is important.”

Interpretation: Respondents understood that problems in PBL function as the starting point for inquiry and conceptual exploration. The findings indicate that prospective teachers recognize the importance of authentic problem design in supporting students’ reasoning and conceptual understanding.

Narrative 4: Challenges in Implementing PBL

Respondents identified time management and differences in student readiness as major challenges in implementing PBL. Group discussions and inquiry activities were considered more time-consuming compared to conventional instruction. Some respondents also explained that students accustomed to teacher-centered learning often struggle to participate actively in open-ended problem-solving activities. One respondent explained:

> *"Some students wait for direct explanations because they are not used to solving problems independently."*

Interpretation: These findings indicate that positive perceptions toward PBL are not always accompanied by confidence in implementation readiness. Respondents acknowledged that successful implementation requires classroom management skills, facilitation strategies, and student adaptation to inquiry-based learning environments.

Narrative 5: The Relevance of PBL to Mathematics Education

Respondents assessed that PBL is highly relevant to mathematics learning because it connects mathematical concepts with practical applications. Students are encouraged to apply mathematical reasoning in solving contextual problems. One participant stated:

> *"Mathematics becomes easier to understand when students can relate it to real situations around them."*

Interpretation: Respondents perceived PBL as suitable for mathematics learning because it supports reasoning, conceptual connections, and contextual understanding. These findings reinforce the view that mathematics learning becomes more meaningful when linked to authentic situations.

Overall, the quantitative findings indicate that prospective mathematics teachers generally hold positive perceptions toward PBL implementation in mathematics education. The qualitative findings complement these results by providing deeper explanations regarding respondents' conceptual understanding, perceived benefits, and implementation challenges. The integration of quantitative and qualitative findings indicates that although prospective teachers perceive PBL positively, implementation readiness remains influenced by pedagogical confidence, classroom management skills, and the ability to design authentic mathematical problems.

3.2. Discussion

The findings of this study indicate that prospective mathematics teachers generally hold positive perceptions regarding the use of the Problem-Based Learning (PBL) model in mathematics education. The quantitative findings show that the average perception score reached 85.23, with most respondents categorized in the "Very High" perception level. These findings reinforce previous studies stating that PBL is considered effective in supporting mathematics learning because it promotes active participation, collaboration, and inquiry-based learning experiences. Qualitative findings further demonstrate that prospective teachers perceive PBL as an instructional approach capable of encouraging critical thinking, communication, and meaningful conceptual understanding. These findings are consistent with studies indicating that direct experiences with PBL help prospective teachers strengthen pedagogical content knowledge and envision its classroom implementation.

The findings also indicate that prospective teachers understand problems in PBL not merely as exercises presented after instruction, but as triggers for conceptual exploration and knowledge construction. This finding is important because the essence of PBL lies in the use of meaningful problems that initiate inquiry processes and encourage students to construct mathematical understanding independently. Respondents recognized that contextual problems help students connect abstract mathematical concepts with real-life situations, making learning more meaningful and relevant. This finding strengthens arguments within mathematics education literature that problem-centered learning supports deeper conceptual understanding and reasoning development [27].

Despite these positive perceptions, the study reveals that implementation readiness remains a significant challenge. Several respondents expressed concerns regarding time management, facilitating group discussions, and supporting students who are unfamiliar with inquiry-based learning. These findings indicate that positive attitudes toward PBL do not automatically reflect pedagogical readiness to implement the model effectively. This condition can be interpreted through the Theory of Planned Behavior, which explains that behavior is influenced not only by attitudes but also by perceived behavioral control and confidence in implementation capabilities. In this context, prospective teachers may value PBL positively while still feeling uncertain about their ability to design authentic problems, facilitate investigations, and provide appropriate scaffolding during mathematics learning.

The findings further suggest that pedagogical readiness in PBL requires more than procedural understanding of instructional steps. Prospective teachers need stronger conceptual understanding regarding how to design contextual mathematical problems, facilitate inquiry processes, and manage collaborative learning environments. Previous studies similarly report that the implementation of PBL is often constrained by difficulties in designing authentic tasks and managing classroom interactions effectively [28]. These findings indicate that teacher education programs should not only introduce PBL theoretically but also provide direct opportunities for prospective teachers to experience inquiry-based learning practices.

Another important finding concerns the importance of experiential learning during teacher preparation programs. Respondents who had experienced collaborative discussions, contextual investigations, and problem-solving activities demonstrated stronger conceptual understanding regarding the role of problems in mathematics learning. This finding reinforces arguments that teacher education programs need to integrate microteaching, problem design activities, reflective discussions, and inquiry-based learning experiences to strengthen prospective teachers' pedagogical readiness [29][30]. Such experiences allow prospective teachers to understand how mathematical concepts emerge through investigation processes rather than through direct explanation alone.

This study also highlights several limitations of PBL implementation in mathematics classrooms. Respondents identified time constraints, varying student readiness, and difficulties in maintaining active participation during discussions as practical barriers. These findings are consistent with broader international studies reporting that prospective teachers often experience challenges when transitioning from teacher-centered instruction to inquiry-oriented learning environments [31][32]. This indicates that successful PBL implementation requires adequate classroom support, pedagogical training, and gradual adaptation processes for both teachers and students.

The findings of this study provide practical implications for mathematics teacher education programs. Programs preparing future mathematics teachers need to strengthen training related to authentic problem design, scaffolding strategies, classroom management, collaborative inquiry facilitation, and reflective teaching practices. Strengthening these aspects is important so that prospective teachers do not merely understand PBL procedurally but are also capable of implementing meaningful inquiry-based mathematics learning.

However, this study also has limitations. The number of participants involved in the quantitative phase was relatively limited, consisting of only 35 respondents, which restricts the generalizability of the findings. In addition, qualitative data were obtained through limited interview sessions, so the depth of participants' experiences may not be fully represented. Future studies are recommended to involve larger participant groups, broader institutional contexts, and more extensive qualitative observations to explore more deeply how prospective teachers develop readiness for implementing PBL in mathematics classrooms.

4. CONCLUSION

This study indicates that prospective mathematics teachers generally hold positive perceptions regarding the use of Problem-Based Learning (PBL) in mathematics instruction because PBL is considered capable of supporting inquiry, collaboration, problem-solving, and meaningful conceptual understanding through authentic mathematical problems. The findings also show that prospective teachers understand problems in PBL as learning triggers that encourage students to construct knowledge actively rather than merely complete exercises after instruction. However, positive perceptions do not always reflect strong pedagogical readiness because prospective teachers still experience difficulties related to authentic problem design, inquiry facilitation, classroom management, scaffolding strategies, and time allocation during implementation. These findings reinforce the Theory of Planned Behavior, which explains that positive attitudes alone are insufficient without adequate perceived behavioral control and implementation confidence [14] . This study contributes theoretically to discussions regarding the relationship between perceptions, pedagogical readiness, and inquiry-based mathematics learning in teacher education, while practically emphasizing the importance of integrating direct PBL experiences, microteaching, reflective discussions, authentic problem design, and inquiry facilitation training into mathematics teacher education programs. The study is limited by the relatively small number of participants and limited interview scope; therefore, future research is recommended to involve broader institutional contexts, larger participant groups, classroom observations, and longitudinal exploration of prospective teachers' readiness to implement PBL in mathematics classrooms.

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