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# Integration of Design Thinking and Quizalize Gamification in Problem Based Learning Numerical Literacy

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**ABSTRACT**

This study aims to develop and explore a Problem-Based Learning (PBL) instructional design integrated with the Design Thinking framework and the gamification platform Quizalize to support students' numerical problem-solving skills. The study employed a qualitative exploratory design through the five stages of Design Thinking: empathize, define, ideate, prototype, and test. Data were collected through questionnaires distributed via Google Forms, classroom observations, and interviews involving teachers and students from Al Anfal High School, Al Kamal Sarang Islamic High School, and Al Yaqin Sluke High School. During the empathize stage, the researcher identified students' learning difficulties, classroom needs, and barriers in numerical problem-solving to formulate a more adaptive instructional design. The novelty of this study lies in integrating Problem-Based Learning, Design Thinking, and Quizalize within a human-centered instructional framework that combines contextual problem-solving, interactive gamification, and instant feedback in mathematics learning. The findings indicate that integrating PBL with Design Thinking encourages more student-centered, collaborative learning, while Quizalize provides immediate feedback and strengthens students' conceptual understanding during problem-solving activities. Overall, the proposed instructional design shows potential for creating more interactive, adaptive, and meaningful numerical literacy learning experiences.



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## 1. INTRODUCTION

In the 21st century, students are required to develop critical thinking, analytical reasoning, and problem-solving skills to adapt to rapid digital transformation and the increasing complexity of information. One essential competency supporting these skills is numerical literacy. Numerical literacy refers to the ability to interpret, analyze, and use numerical information in various real-life contexts to support reasoning and decision-making processes [1]. Therefore, numerical literacy is not limited to performing arithmetic

calculations but also involves understanding quantitative relationships, interpreting data, and applying mathematical reasoning to solve contextual problems [2], [3], [4].

In mathematics education, numerical literacy plays an important role in helping students connect mathematical concepts with authentic situations. Previous studies have shown that numerical literacy encompasses several aspects, including basic calculation skills, understanding numerical relationships, and the ability to apply arithmetic operations strategically in problem-solving situations [5]. Consequently, mathematics learning should not merely emphasize procedural mastery but also encourage conceptual understanding, reasoning, and strategic thinking.

However, the numerical literacy performance of Indonesian students remains relatively low. Based on the PISA 2022 Mathematics Framework report, Indonesia achieved an average mathematics score of 366, far below the OECD average of 490 [6]. In addition, approximately 82% of Indonesian students were categorized at or below the minimum proficiency level 2, indicating difficulties in interpreting and applying mathematics in everyday contexts. Previous studies revealed that many students still rely heavily on memorizing formulas without fully understanding mathematical concepts, experience difficulties in analyzing problems, and struggle to determine appropriate problem-solving strategies [2], [3], [7]. From the instructional perspective, conventional teacher-centered learning practices and procedural problem orientations remain dominant in many classrooms, limiting students' opportunities to develop higher-order reasoning and contextual problem-solving skills [8]. To address these challenges, Problem-Based Learning (PBL) has been widely recognized as an instructional approach that can improve students' problem-solving skills and numerical literacy through authentic, contextual learning experiences [9]. PBL encourages students to actively analyze problems, explore alternative solutions, and connect mathematical concepts with real-life situations, making learning more meaningful and relevant [10]. Nevertheless, implementing PBL in contemporary classrooms also requires instructional support to increase student engagement and provide interactive learning experiences.

In this regard, gamification-based learning media offer promising opportunities to strengthen the implementation of PBL. One digital platform that has gained attention is Quizalize. Quizalize provides interactive quiz features, instant feedback, real-time learning analytics, and personalized learning experiences that support formative assessment and student engagement [11], [12]. In line with previous studies, gamified learning environments have been shown to improve students' motivation, classroom participation, and interaction during learning activities. These findings indicate that gamification-based platforms can strengthen the implementation of Problem-Based Learning by creating more engaging and responsive learning experiences. However, technology integration alone is insufficient if instructional innovation is not designed according to students' actual learning needs and classroom conditions. Therefore, a more systematic and human-centered instructional framework is required. Design Thinking offers an approach that emphasizes empathy, problem identification, idea generation, prototyping, and iterative testing to develop user-centered solutions [13], [14]. Within educational contexts, integrating the Design Thinking stages (Empathize, Define, Ideate, Prototype, and Test) with a Problem-Based Learning model makes instructional activities more responsive to students' needs and learning barriers. In this

framework, technology such as Quizalize functions not merely as a digital tool but as an integral part of a meaningful and interactive learning experience. Conceptually, Design Thinking serves as the human-centered framework for identifying students' learning needs, PBL as the pedagogical strategy for contextual problem-solving, and Quizalize as the technological support that enhances engagement and provides formative feedback during the learning process.

Although previous studies have separately examined PBL, gamification-based learning media, and Design Thinking, research integrating these three components into a unified instructional framework for improving students' numerical literacy remains limited. Most previous studies primarily focused on measuring the effectiveness of learning media through experimental approaches, while relatively few applied a human-centered Design Thinking framework before developing instructional interventions. This gap highlights the need for a more integrative instructional model that not only incorporates technology but also aligns with students' needs, teachers' readiness, and contextual classroom challenges.

Therefore, this study proposes a "Numerical Learning Revolution" by integrating Problem-Based Learning, Design Thinking, and Quizalize within a human-centered instructional framework. The study focuses on how the synergy among problem-based pedagogy, Design Thinking processes, and gamified digital learning environments can support the improvement of students' numerical problem-solving skills through more collaborative, interactive, and meaningful learning experiences.

## 2. METHOD

The research method used in this study is a qualitative research design with a design thinking approach. The design thinking framework is used as a structured approach to analyze a problem and derive relevant solutions in a contextual manner [15]. Design thinking is defined as a cognitive process or way of thinking manifested in the act of designing a thought process [16]. Therefore, design thinking offers concrete solutions to solve complex problems that are well-defined yet difficult to understand. The following are the 5 stages or phases of the Stanford School of Design Thinking.

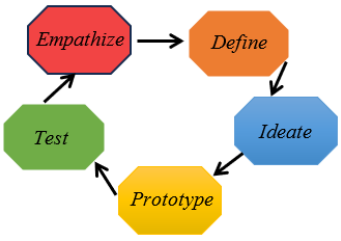


Figure 1. Phase of Design Thinking

1) Empathize Phase

In the empathize Phase, the identified problem is addressed with solutions to address student challenges. The empathize Phase involves gaining a deep understanding of the problems faced by students and teachers [14]. This understanding is derived through empathetic methods such as experiencing the user's perspective, asking questions and listening, observing, and prioritizing user needs as the design objective Pemahaman

tersebut didapatkan dari cara-cara empatis seperti menggalami pengalaman user, bertanya dan mendengarkan, observasi dan menempatkan kebutuhan user sebagai tujuan rancangan.

2) Define stage

The Define phase is used to understand and analyze the results obtained in the Empathize phase. In this Phase, the objectives are specified based on user needs [17].

3) Ideate Stage

Based on the user needs analysis formulated into objectives, designers then need to develop solutions [18]. The Ideate phase includes mind mapping and brainstorming.

4) Prototype Stage

The prototype phase is the stage where designers create models to bring ideas to life and showcase the solution's features. These models are used to quickly test and validate ideas while gathering appropriate feedback to refine the design, enabling improvements to the product before it is fully tested

5) Test Stage (Prototype Testing)

Testing is conducted to gather various user feedback on the final designs formulated during the previous prototyping process [19].

The population of this qualitative study consists of high school students and mathematics teachers from Al Anfal High School, Al Kamal Sarang Islamic High School, and Al Yaqin Sluke High School. For data collection, the instruments used were questionnaires and user interviews. The following is the number of users included in this study.

Table 1. Number of Student Users

| School | Number of Student Users | Percentage (%) |
|---|---|---|
| Al Anfal High School | 56 | 49 |
| Al Kamal Islamic High School | 37 | 32 |
| Al Yaqin High School | 22 | 19 |
| Total | 115 | 100 |

From the student users above, it can be seen that the total number of users from the three different high schools consists of 56 students from Al Anfal High School (49%), 37 students from Al Kamal Islamic High School (32%), and 22 students from Al Yaqin High School (19%). The number of teacher users included in this study is as follows:

Table 2. Number of Teachers Users

| School | Number of Student Users | Percentage (%) |
|---|---|---|
| Al Anfal High School | 1 | 33 |
| Al Kamal Islamic High School | 1 | 33 |
| Al Yaqin High School | 1 | 33 |
| Total | 3 | 100 |

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From the teacher respondents above, it can be seen that the sample of users from the three schools consists of 3 teachers, with each school (Al Anfal High School, Al Kamal Islamic High School, and Al Yaqin High School) having 1 teacher (33.33%).

The data collection process consisted of Google Forms questionnaires for students and teachers, observations, and interviews. The research procedure flow was structured based on a qualitative research design grounded in the design thinking framework. The first step in the research process focused on empathy and defined phases to systematically map students' learning needs before developing user-centered learning interventions. User selection was the second step, with participation voluntary and confidentiality guaranteed. The third step is the creation of research instruments, including student and teacher questionnaires, observation guidelines, and interview questions, all of which were reviewed, validated, and approved by experienced expert lecturers. Subsequently, the questionnaires were distributed to three schools. Data were collected using the developed instruments.

## 3. RESULTS AND DISCUSSION

### 3.1. Results

**Empathize Phase**

In this first Phase, the researcher began by creating questionnaires and interview guides containing several questions for initial data collection from high school students and mathematics teachers at three schools: Al Anfal High School, Al Kamal Sarang Islamic High School, and Al Yaqin High School. Subsequently, the questionnaires and interviews—which had been reviewed by an experienced expert—were distributed to students and teachers, and in-depth interviews were conducted with several mathematics teachers at these schools.

The results of the student questionnaire, completed by 115 respondents at three schools (Al Anfal High School, Al Kamal Islamic High School, and Al Yaqin High School in Sluke), revealed that, from a cognitive perspective, 62.9% of students experienced learning difficulties. The main obstacle for students was difficulty in solving essay questions (42.6%), followed by numerical literacy questions (40%), which users considered the most difficult to solve and time-consuming, as shown in Figure 2 below.


Figure 2. Types of Math Problems

Students' numerical literacy skills in learning activities emphasize real-world experiences and active learning so that students can directly solve problems in their surrounding environment [20].

Furthermore, based on the results of interviews and questionnaires, the primary reason students cannot solve numerical literacy problems is that, on average, 77% students do not know the solution steps and have forgotten the solution formulas. In comparison, an excessive text accounts for 65%, difficulty understanding the material accounts for 50% of why students cannot solve numerical literacy problems, laziness in reading accounts for 24%, and the remainder is due to not receiving answers from peers. The causes of low numerical literacy among students in this study align with those reported by [20].

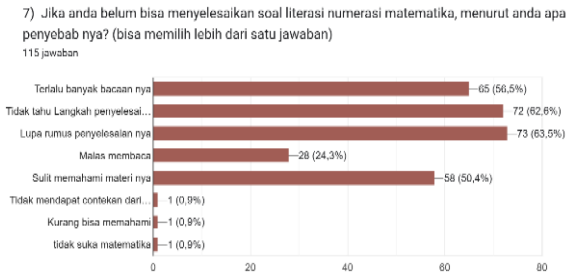


Figure 3. The Cause of Students Not Being Able to Talk About Litnum

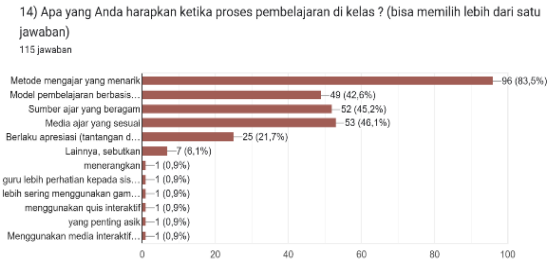


Figure 4. Students' Expectations During The Learning Process

If analyzed further based on Figure 3, the various difficulties students face when learning mathematics include difficulty understanding the concepts of the material (76.7%), difficulty analyzing the intent of the problems (63.8%), not knowing the solution steps (50%), and the learning media used by teachers being monotonous (25%).

As shown in Figure 4 above, 83% of students hope that during classroom instruction, teachers use engaging, problem-based teaching methods; 45.2% prefer innovations in teaching methods implemented by teachers; 27.8% favor innovations in learning models; and 19.1% prioritize learning media. Additionally, a pleasant learning atmosphere is a major expectation among students, with 43.5% expressing it. According to students, the use of interactive learning media (45.2%) makes the mathematics learning environment more engaging and enjoyable (Figure 5).

According to the questionnaire, 65% of teachers still rely on monotonous, manual-based teaching materials such as textbooks, 24% use PowerPoint presentations, and 10% use YouTube. Meanwhile, the learning media that students hope will be used in classroom instruction—particularly to help them solve linear equations—is interactive gamification-based media (79%). One such gamification-based tool that 52.6% of teachers have never used is Quizalize (Figure 6).

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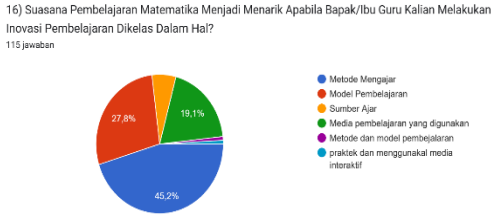


Figure 5. The learning atmosphere becomes interesting


Figure 6. Quizalize gamification media use

Quizalize is a quiz-based learning platform that provides instant feedback, real-time learning outcome analysis, and can be used for practice exercises, quizzes, or formative assessments, which strongly support the stages of learning evaluation [21], [22]. The use of Quizalize creates an engaging, non-monotonous learning environment, encouraging students to participate more actively and motivating them to learn [23]. Based on the results of the instructional media questionnaire above and the benefits of Quizalize, the gamified instructional media platform Quizalize is therefore needed in the learning process and can serve as an alternative solution.

From an affective perspective, the Empathy phase showed that 33.6% of students correctly solved the problems presented in the questions, viewing them as important and meaningful. When learning mathematics, 87.9% of students feared receiving a poor grade if the questions contained lengthy text, such as in word problems.

Meanwhile, the results of a teacher survey from three different schools showed a rate of 66.7%. Most of my students are still unable to solve numerical literacy problems. This is due to students' difficulty analyzing the problems, the excessive amount of text, not knowing the solution steps, and forgetting the solution formulas. To address the above issues, 100% of teachers agreed to use an engaging problem-based learning model, and 66.7% use interactive and innovative learning media; additionally, 66.7% provide numerical problems as often as possible (Figure 7). The strategies students can use to improve their numerical problem-solving skills are shown in Figure 8.


Figure 7. Students' efforts to increase numerical literacy

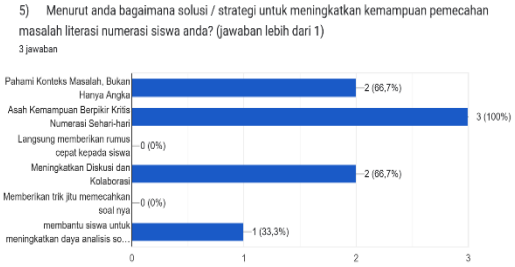


Figure 8. Strategies to improve Litnum

Based on the survey results, the researcher then analyzed the problems arising in mathematics learning through empathy maps from students and teachers. Empathy mapping is divided into four quadrants: says, thinks, feels, and does. The following is the empathy map based on the analysis of the survey and interviews:


Figure 9. Student's empathy map

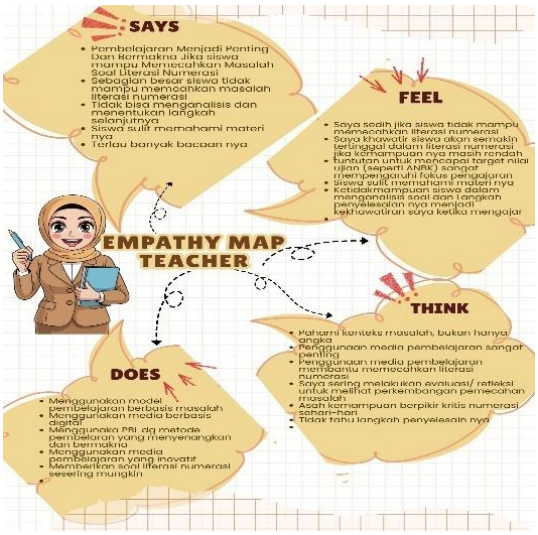


Figure 10. Teacher's Empathy Map

## Define Phase

In this stage, the researcher defines the problems identified in the previous stage. This stage helps the researcher generate ideas that will enable the resolution of existing problems by analyzing and understanding the results from the empathize stage [24]. The researcher uses an empathetic approach focused on specific user problems, grounded in user insights and needs, employing the "Point of View" technique [25] and the "How Might We" framework to determine which problems to address with solutions.

1) Defining the Problem Using the Point of View

The "Point of View" is a method for gathering user information to generate solution design ideas aligned with the user's perspective. This technique captures the problem statements articulated by users, which will serve as the basis for developing solution design ideas later [26]. Below are the results of the "Point of View" analysis for students and teachers:

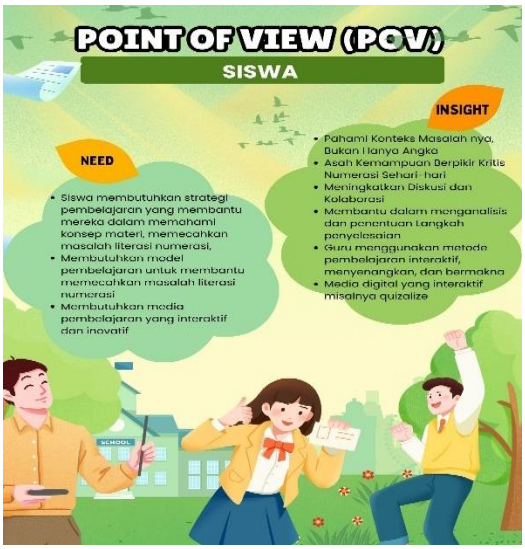


Figure 11. Point of View from a Student

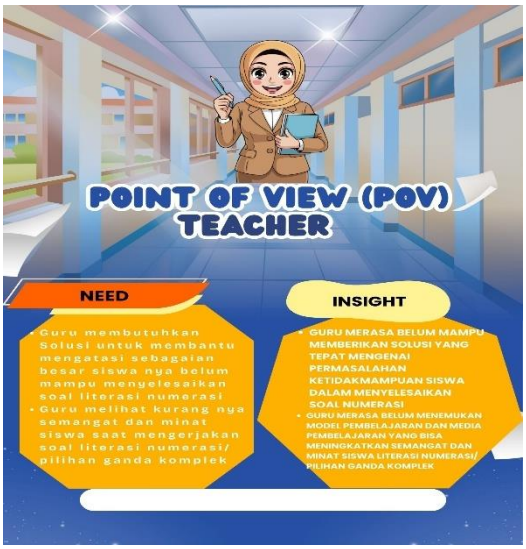


Figure 12. Point of View from Teachers

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In the students' point of view above, the researcher defined the problem based on 115 high school students in the Merdeka Curriculum through a student empathy map. Students consider the most important aspects of learning mathematics to be the ability to relate mathematics to daily life and to solve numerical literacy problems. Numerical literacy problems are challenging for students. This is due to students forgetting the solution formulas, not knowing the steps to solve them, struggling to understand the material, and being reluctant to read. One potential solution is to provide interactive and innovative digital learning media, as well as enjoyable, interactive, and meaningful learning methods, such as the gamified platform Quizalize.

As for the learning model, a problem-based learning model can be used. This aligns with research by [27], which explains that when learning uses technology-based media, it can foster enthusiasm and motivation in students during classroom instruction, help them recall lessons more easily, and make them more active in responding to and providing feedback during learning activities.

From the teachers' perspective, the researcher identified issues reported by three mathematics teachers in the Merdeka Curriculum through a teacher empathy map: teachers felt that the material they taught was difficult for students to understand, leading students to adopt a passive attitude and to lack motivation in learning. Mathematics lessons are perceived as uninteresting. The primary need is for mathematics instruction that incorporates motivation or a drive to learn by presenting material accessible on their own devices, allowing discussion of problem-solving strategies and hands-on practice, thereby making mathematics easier to understand and less tedious.

This aligns with research by [24], which explains that when learning uses technology-based educational media, it can foster enthusiasm and motivation in students during classroom instruction, enabling them to recall lessons more easily, be more active in responding, and provide feedback during ongoing learning activities.

2) How Might We (HMW)

HMW is a method for transforming statements into questions. The purpose of HMW is to shift the mindset that every problem has a solution. HMW data is derived from student and teacher questionnaires and interviews conducted during the empathize Phase. "How" is a question derived from the user's problem, while "might" is the answer to the question posed. The results are as follows:


Figure 13. How Might We (HMW)

**Ideate Phase**

The ideate phase involves brainstorming, a technique for gathering diverse ideas from others to solve problems [28]. Below is a mind map of the brainstorming results, which illustrates all the ideas incorporated into Figure 13 below:

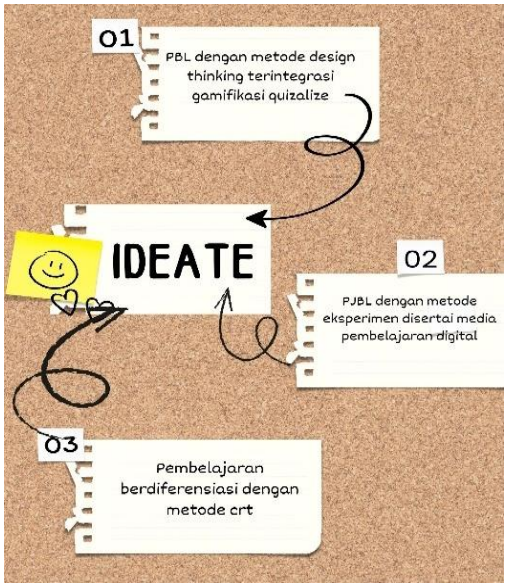


Figure 14. Tahap Ideate

From the analysis of the Empathy to Define phases, an initial conclusion was drawn that "A learner-centered, problem-based learning strategy is needed, featuring an engaging and meaningful learning process. This includes the use of learning media that can assist in understanding concepts, solving problems, and analyzing issues, accessible anytime and anywhere." After the researchers conducted a literature review of previous studies, Quizalize was examined as a gamification-based learning platform that integrates game elements such

as points, badges, leaderboards, and challenges to enhance student engagement and motivation. This platform is also positioned as a digital formative assessment tool that enables teachers to track student progress in real time and adjust teaching methods to individual needs. The research findings [29] concluded that the Quizalize platform is effective and suitable for use in Arabic language learning, capable of creating a more interactive and enjoyable learning environment, and encouraging student motivation to achieve more optimal learning outcomes. Therefore, in this context, the researchers propose the use of PBL (Problem-Based Learning) design combined with design thinking and the Quizalize platform as a revolution in learning.

**Prototipe Phase**

The foundation for developing media that centers the resulting product on user needs lies in the prototype phase of the Design Thinking Framework [30]. From the ideation stage onward, the PBL model was identified and integrated with Design Thinking, aided by Quizalize's gamification. The challenge lies in developing an integrated PBL learning design framework using the Design Thinking method supported by Quizalize gamification. The research involved a Forum Group Discussion with 10 participants, comprising 3 faculty members specializing in mathematics education and seven graduate students. The PBL learning design integrated with the Design Thinking method supported by Quizalize gamification produced the following prototype model: (1) the syntax in the PBL model was adapted by incorporating contextual problems; (2) Quizalize was used for sequences and series material; (3) the learning design was applied to sequences and series instruction; (4) student worksheets present problem-solving steps; (5) presenting problems involving sequences and series related to problem-solving. The PBL steps are integrated with the design thinking method supported by Quizalize gamification, as shown in the figure below:

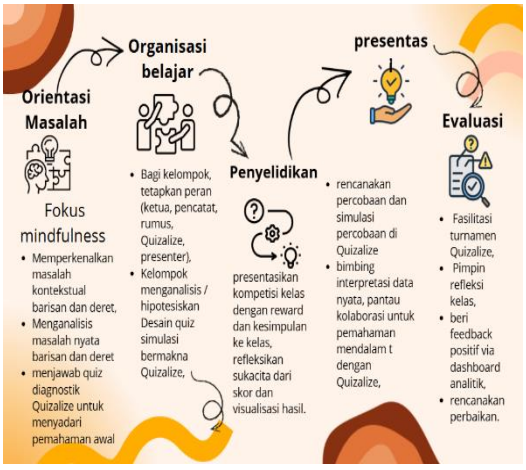


Figure 15. PBL, which is integrated with Quizalize's Gamification-Assisted Design Thinking Method

**Testing Phase**

In this Phase, the prototype testing phase was conducted using nine steps: (1) preparation of learning materials and assessment instruments, (2) validation of learning materials and assessment instruments, (3) preparation of learning media, (4) validation by

experts regarding the learning media, (5) implementation of learning activities, (6) assessment of problem-solving ability using problem-solving indicators aligned with the questions posed, (7) participant reflection questionnaires, (8) analysis of problem-solving ability results. Considering its strengths, weaknesses, and effectiveness in learning, prototype testing is conducted at least twice, with each iteration subsequently evaluated.

Pada saat pengujian prototipe PBL berbantuan gamifikasi Quizalize, aspek afektif siswa lebih terlihat seperti siswa lebih antusias dalam proses pembelajaran, partispasi siswa menjadi lebih hidup dan aktif, siswa mulai berani bertanya jika ada kendala saat penyelesaian soal litnum

During testing of the PBL prototype assisted by the gamification tool Quizalize, students' affective aspects were more evident: students were more enthusiastic in the learning process, student participation became more lively and active, and students began to feel confident asking questions when they encountered difficulties while solving litnum problems.

Research on the implementation of PBL in the learning process has shown that in effectively improves students' mathematical literacy and problem-solving skills [31]. However, some studies also highlight significant challenges in implementing PBL, including time constraints, teachers' difficulty in designing authentic problems, and a lack of timely and personalized feedback for students [32].

Some studies have also integrated PBL by using mathematical software, such as GeoGebra, to improve literacy and numerical skills [18]. The findings show that in developing students' abilities, the influence of technology-assisted PBL implementation is greater than the influence of PBL implementation alone. However, the use of GeoGebra is still limited to cultivating understanding of mathematical concepts and has not focused on monitoring students' litnums. Therefore, to overcome these limitations, it is necessary to integrate Quizalize, which will enable mathematics learning to provide feedback, analyze learning outcomes in real time, and be used for practice, tests, and formative assessments [21], [22].

In addition, another study that uses the design thinking approach found that, during the exploration of the five stages of design thinking, students and teachers in mathematics learning need cooperative learning using interactive media accessible via the internet/Google Sites [14]. Thus, this study explicitly designed a learning design that integrates three elements at once: (1) PBL, (2) Design Thinking, and (3) Quizalize gamification, with a special focus on improving students' litmus skills.

### 3.2. Discussion

The results of this study indicate that students face significant affective and cognitive barriers in mathematical problem-solving, particularly related to anxiety, low self-confidence, and difficulties in analyzing and selecting appropriate problem-solving strategies, especially when solving numerical literacy (litnum) problems. These findings align with previous research showing that math anxiety significantly impairs students' performance and strategic reasoning processes [33]. Similarly, previous studies on numerical literacy reported that many students tend to rely on memorization and procedural approaches

rather than conceptual understanding when solving contextual mathematical problems [2], [3]. This condition suggests that mathematics learning should not only emphasize procedural fluency but also support conceptual understanding, reasoning, and students' confidence in problem-solving.

During the empathy phase, this study identified that many teachers still rely heavily on textbook-oriented instruction and conventional learning approaches. As a result, students demonstrated low engagement and limited opportunities to explore contextual mathematical reasoning. These findings strengthen previous studies emphasizing the importance of student-centered and problem-based learning environments in improving numerical literacy skills [4], [7], [8]. In this context, the integration of interactive digital media becomes increasingly relevant because visualization and immediate feedback can help students bridge abstract mathematical concepts with real learning experiences [32].

Previous studies on gamified learning environments also indicate that technology-supported mathematics instruction can increase students' motivation, participation, and conceptual engagement [23]. Likewise, the implementation of Quizalize across several learning contexts has shown positive impacts on student interest, classroom interaction, and participation in learning [27], [29]. While previous studies primarily highlighted the role of gamification in increasing motivation and classroom participation, this study further demonstrates that integrating Quizalize into a Design Thinking-oriented PBL framework can also support contextual reasoning and reflective problem-solving during numerical literacy activities. However, this study extends previous research by positioning Quizalize not merely as a digital gamification tool, but as part of a broader human-centered instructional design process integrated with Problem-Based Learning and Design Thinking.

From a theoretical perspective, the integration of Design Thinking into mathematics learning represents one of the key contributions of this study. Design Thinking emphasizes empathy, problem identification, idea generation, prototyping, and iterative testing processes that encourage students to construct solutions in context actively [15], [16]. In mathematics learning, these processes are closely related to the development of numerical literacy because students are encouraged to interpret problems, evaluate alternative strategies, and apply mathematical reasoning in authentic contexts. Moreover, the iterative nature of Design Thinking encourages students to continuously reflect on errors, revise strategies, and evaluate solutions, which are essential components of numerical literacy development. Previous studies also reported that Design Thinking-based learning environments can improve students' problem-solving abilities, creativity, and mathematical thinking skills [18], [30]. Therefore, integrating Design Thinking into PBL creates opportunities for more reflective, collaborative, and human-centered mathematical learning experiences.

This study also supports previous findings that Problem-Based Learning positively contributes to students' numerical literacy and problem-solving skills [9], [31]. However, unlike previous studies that primarily focused on measuring learning effectiveness through experimental approaches, this study applies a user-centered Design Thinking framework before designing the instructional intervention. Through the stages of empathize, define, ideate, prototype, and test, the proposed instructional design was developed based on students' actual learning barriers and teachers' classroom needs. This approach contributes

to a more contextual and adaptive understanding of instructional innovation in mathematics education.

Despite its potential benefits, implementing Quizalize and gamification-based learning also presents several limitations and challenges. The effectiveness of digital learning environments may be constrained by unequal internet access, limited technological infrastructure, and varying levels of teacher digital competence. Previous studies highlighted that successful technology integration depends not only on the availability of digital media but also on teachers' readiness and pedagogical competence in managing technology-supported instruction [12], [22]. In addition, gamification-based learning may risk shifting students' focus away from conceptual understanding toward competition, scores, or game mechanics if not carefully facilitated. This indicates that gamification should function as a pedagogical support tool rather than merely a source of entertainment within mathematics instruction. Therefore, integrating gamification into mathematics learning should remain aligned with instructional objectives and meaningful learning experiences.

Overall, this study enriches the literature on technology-based mathematics learning by integrating Design Thinking, Problem-Based Learning (PBL), and Quizalize within a human-centered instructional framework. The findings emphasize that improving numerical literacy requires not only technological innovation but also a balanced consideration of students' affective needs, teachers' readiness, contextual learning design, and the development of digital literacy.

## 4. CONCLUSION

Based on the findings of the learning revolution exploration conducted to improve problem-solving skills through the Design Thinking method, aided by Quizalize, the processes of empathy, definition, and ideation have yielded the following innovative learning solutions: A learner-centered, problem-based learning strategy is needed, along with a learning process that is enjoyable and meaningful. This involves using learning media that help students understand concepts, comprehend questions, analyze problems, and determine the next steps in solving math problems. This media should be accessible anywhere and anytime. In this context, the researcher proposes an integrated PBL (Problem-Based Learning) design combined with Design Thinking, supported by Quizalize gamification, to drive a learning revolution that enhances students' math skills.

Additionally, the results of the meta-analysis from the ideation phase yielded a p-value of <0.001, which is smaller than the alpha value (0.05). This indicates a significant effect size of 0.900 for the PBL model integrated with Design Thinking and supported by Quizalize gamification in improving problem-solving skills. The application of the Design Thinking method in innovating effective learning models can significantly enhance students' mathematical problem-solving skills.

This study provides implications for the development of Problem-Based Learning (PBL) integrated with Design Thinking and supported by Quizalize. For future researchers, the results of this study can serve as a reference in examining the application of similar learning models in different educational contexts and levels. For teachers, Quizalize can serve as an alternative gamification-based learning platform to increase student engagement

during the learning process. Meanwhile, for students, the implemented learning approach can encourage active engagement and reflection on the learning process as material for evaluation to improve future learning.

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