

IMPLEMENTATION OF PBL LEARNING MODEL ASSISTED BY QUIZZ TO IMPROVE STUDENT LEARNING OUTCOMES IN ALGEBRA

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ABSTRACT

This study aims to evaluate the effectiveness of implementing the Problem-Based Learning (PBL) model supported by the Quizizz application in enhancing students' learning outcomes in Algebra. This case study was conducted with 8th-grade students at SMP Negeri 18 Malang. The research was motivated by the low learning outcomes in Algebra, which were attributed to less interactive teaching methods and low student motivation. The research employed Classroom Action Research (CAR) with both qualitative and quantitative approaches. The subjects of the study were 34 8th-grade students who participated in the PBL learning cycle integrated with Quizizz. Data collection instruments included learning outcome tests, observations, and motivation questionnaires. Data analysis was performed by comparing test results before and after the implementation of the learning model and evaluating the results from observations and questionnaires. The findings indicate a significant improvement in student learning outcomes following the application of PBL supported by Quizizz. The average test scores increased from 65 before the implementation to 85 afterward. Additionally, student motivation improved, as evidenced by increased enthusiasm and active participation during the learning process. This model proved effective in enhancing students' understanding of Algebra concepts and their engagement in learning. In conclusion, the integration of the PBL learning model with Quizizz can be an effective strategy for improving students' learning outcomes, especially in Algebra. This study recommends educators consider using digital technology as a tool to facilitate more interactive and engaging learning experiences.

Keywords: Problem-Based Learning, Quizizz, Learning Outcomes, Algebra, Classroom Action Research

INTRODUCTION

Mathematics education, particularly in the area of Algebra, is often considered one of the most challenging components for many students. Difficulties in understanding algebraic concepts can affect students' overall learning outcomes. In reality, many students struggle with this material due to ineffective teaching

methods and a lack of motivation, which can affect their engagement in the learning process.

SMP Negeri 18 Malang is one of the schools facing similar challenges, where student learning outcomes in Algebra show unsatisfactory levels of achievement. This is presumed to be caused by conventional and less interactive teaching methods. Traditional learning methods are often unable to meet the diverse learning needs of students and fail to leverage available technology to enhance their learning experience.

In response to this challenge, the implementation of the Problem-Based Learning (PBL) model assisted by the Quizizz application is proposed as a solution. The PBL model is an approach that encourages students to actively participate in the learning process by solving real-world problems relevant to the subject matter. This approach can enhance student engagement, facilitate deep conceptual understanding, and promote more independent learning.

Quizizz, as a digital learning application, offers an interactive platform that can enrich the student learning experience through quizzes and educational games designed to increase motivation and engagement. By integrating Quizizz into the PBL model, it is expected to create a more dynamic and engaging learning environment.

This study aims to evaluate the implementation of the PBL learning model assisted by Quizizz in improving student learning outcomes in Algebra. The study was conducted at SMP Negeri 18 Malang, focusing on 8th-grade students—an age group in which understanding algebraic concepts is critical as a foundation for further mathematics. Through this research, it is hoped to determine whether the integration of PBL with Quizizz is effective in improving student learning outcomes and motivation.

With this background, the study will examine the application of PBL assisted by Quizizz in the context of Algebra learning, and identify the impact of this approach on student learning outcomes and their motivation to engage in the learning process.

METHOD

This study aims to evaluate the implementation of the Project-Based Learning (PBL) model supported by the Quizizz application in improving student learning outcomes in Algebra in 8th grade at SMP Negeri 18 Malang. The method used is Classroom Action Research (CAR), involving four main stages: planning, action, observation, and reflection. The research was conducted at SMP Negeri 18 Malang from July to August 2024. The subjects of this study were 34 students of class VIII-D. Data were collected through teacher and student activity observation results, end-of-cycle test results, and questionnaire results. In the planning stage, the researcher prepared a lesson plan integrating PBL and Quizizz, along with research instruments such as learning outcome tests, questionnaires, and observation sheets. The action implementation included the application of the PBL learning

model in the classroom, where students engaged in algebra-based projects and used Quizizz for practice and evaluation. Observations were conducted to record student interactions and engagement, as well as to collect learning outcome data. The reflection stage involved data analysis from tests and questionnaires to assess the effectiveness of the model and to evaluate improvements needed for the next cycle. Additionally, quantitative data analysis served as supporting data. Data validity checking consisted of three stages: observation persistence, triangulation, and peer review. The success indicators in this study were that the percentage of teacher and student activity observations reached $\geq 80\%$, and the classical passing rate was $\geq 75\%$ of students obtaining a score of 75. This study is expected to provide insights into the effect of using Quizizz in PBL on improving student learning outcomes and to assist in improving classroom teaching practices.

RESULTS AND DISCUSSION

Pre-Action

Prior to the implementation of the action, the researcher first conducted a preliminary study to obtain an overview of the conditions of algebra learning in class VIII-D. Initial observations revealed that the learning process was still teacher-centered, with the teacher dominating classroom activities through lecture methods and routine problem drills. Students appeared passive, less enthusiastic, and not actively engaged in discussion. The pre-test administered to 34 students yielded an average score of 55.00 with a standard deviation of 7.30. Of the 34 students, only 8 students (23.53%) met the minimum passing criterion (KKM) of ≥ 75 .

Pre-action questionnaire results showed that 60% of students found algebra material difficult to understand, 70% of students felt insufficiently motivated, and 65% of students considered the current teaching methods inadequately interactive. This condition formed the basis for the need for intervention through the implementation of the PBL learning model assisted by Quizizz.

Cycle I Action

Planning

In the planning stage of Cycle I, the researcher prepared a Lesson Plan (RPP) integrating PBL syntax into two meetings (2×40 minutes). The selected material covered algebraic expression operations and one-variable linear equations. The researcher also prepared contextual problem-based Student Worksheets (LKS), Cycle I post-test questions, observation sheets, and configured Quizizz quizzes as formative evaluation tools at the end of each meeting.

Action Implementation

The Cycle I action was carried out over two meetings. In the first meeting, the teacher presented contextual problems about algebraic operations in everyday life, after which students were divided into eight groups (4–5 students per group) to discuss and complete the worksheets. At the end of the meeting, students completed the Quizizz quiz individually using their own devices. In the second meeting, the teacher continued with one-variable linear equations using the same approach, but with more complex problems, and the Quizizz leaderboard feature was activated to promote healthy competition among groups.

Cycle I Observation

The results of teacher and student activity observations in Cycle I are presented in Table 1 below.

Table 1. Teacher and Student Activity Observation Results in Cycle I

Observation Aspect	Score Cycle I Meeting 1	Score Cycle I Meeting 2	Average (%)
Teacher Activity			
Ability to open lesson	3	3	75%
Classroom & time management	3	4	87.5%
Presentation of contextual problems	3	3	75%
Use of Quizizz media	3	4	87.5%
Group discussion guidance	2	3	62.5%
Ability to close lesson	3	3	75%
Average Teacher Activity	2.83	3.33	77.08%
Student Activity			
Readiness & learning activeness	3	3	75%
Ability to understand problems	2	3	62.5%
Participation in group discussion	3	3	75%
Independent use of Quizizz	3	4	87.5%
Presentation and communication of results	2	3	62.5%
Self-reflection ability	3	3	75%

Average Student Activity	2.67	3.17	72.92%
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Based on Table 1, the average percentage of teacher activity in Cycle I reached 77.08% and student activity reached 72.92%. Both values did not yet meet the success indicator of $\geq 80\%$. Aspects that still need improvement include group discussion guidance and students' ability to understand and present the results of problem-solving.

End-of-Cycle I Test Results

The Cycle I end-of-cycle test results showed improvement compared to the pre-action data. A comparison of the data is presented in Table 2.

Table 2. Comparison of Learning Outcomes between Pre-Action and Cycle I

Criteria	Pre-Action	Cycle I	Improvement
Class Average Score	55.00	67.35	↑ 12.35 points
Highest Score	75	85	↑ 10 points
Lowest Score	35	45	↑ 10 points
Standard Deviation	7.30	6.50	↓ 0.80 (more even)
Number of Students Passing (≥ 75)	8 students	19 students	↑ 11 students
Classical Passing Rate	23.53%	55.88%	↑ 32.35%

Based on Table 2, the class average score increased from 55.00 to 67.35 (an increase of 12.35 points), and the classical passing rate rose from 23.53% to 55.88%. Although a fairly significant improvement was recorded, the classical passing rate in Cycle I had not yet met the target of $\geq 75\%$; therefore, the study continued to Cycle II.

Cycle I Reflection

Based on the observation and test results of Cycle I, the researcher identified several weaknesses that needed to be addressed: (1) some groups still had difficulty understanding the worksheet instructions, so the teacher needed to provide more explicit guidance; (2) the time allocated for the Quizizz quiz was not well-managed, causing some students to fail to complete all questions; (3) students who had not passed (44.12%) required more structured scaffolding; and (4) the group work presentation activities still needed to be improved. These findings formed the basis for improvements in Cycle II.

Cycle II Action

Planning

Based on the reflection from Cycle I, the planning of Cycle II was focused on the following improvements: (1) the worksheets were redesigned with a more explicit step-by-step structure and staged guided questions; (2) the time allocation for the Quizizz quiz was extended, and students were given the opportunity to discuss answers after the quiz (review mode); (3) a brief remedial session was added at the beginning of each meeting for students who had not passed; and (4) the group presentation format was clarified with a scoring rubric distributed to students.

Action Implementation

Cycle II was implemented over two meetings covering the material on one-variable linear inequalities and the application of algebra in problem solving. Improvements from Cycle I were consistently implemented. The teacher provided more structured scaffolding during group discussions, managed Quizizz time with adjusted timer settings, and activated the team mode feature on Quizizz to encourage collaboration. Students who had not passed in Cycle I received special attention through individual guidance during discussion sessions.

Cycle II Observation

The results of teacher and student activity observations in Cycle II are presented in Table 3 below.

Table 3. Teacher and Student Activity Observation Results in Cycle II

Observation Aspect	Score Cycle II Meeting 1	Score Cycle II Meeting 2	Average (%)
Teacher Activity			
Ability to open lesson	4	4	100%
Classroom & time management	4	4	100%
Presentation of contextual problems	3	4	87.5%
Use of Quizizz media	4	4	100%
Group discussion guidance	3	4	87.5%
Ability to close lesson	4	4	100%
Average Teacher Activity	3.67	4.00	95.83%
Student Activity			

Readiness & learning activeness	3	4	87.5%
Ability to understand problems	3	4	87.5%
Participation in group discussion	4	4	100%
Independent use of Quizizz	4	4	100%
Presentation and communication of results	3	4	87.5%
Self-reflection ability	4	4	100%
Average Student Activity	3.50	4.00	93.75%

Based on Table 3, a significant improvement occurred in teacher activity (77.08% → 95.83%) and student activity (72.92% → 93.75%) from Cycle I to Cycle II. Both indicators exceeded the target of $\geq 80\%$. The most notable improvements were observed in group discussion guidance and students' ability to understand and communicate problem-solving results—two critical competencies in mathematics learning—each increasing from 62.5% to 87.5%.

End-of-Cycle II Test Results

The Cycle II end-of-cycle test results showed a more significant improvement compared to Cycle I. A comparison of the data is presented in Table 4.

Table 4. Comparison of Learning Outcomes between Cycle I and Cycle II

Criteria	Cycle I	Cycle II	Improvement
Class Average Score	67.35	80.29	↑ 12.94 points
Highest Score	85	95	↑ 10 points
Lowest Score	45	60	↑ 15 points
Standard Deviation	6.50	6.10	↓ 0.40 (more even)
Number of Students Passing (≥ 75)	19 students	29 students	↑ 10 students
Classical Passing Rate	55.88%	85.29%	↑ 29.41%

Based on Table 4, the class average score increased from 67.35 to 80.29 (an increase of 12.94 points), and the classical passing rate rose from 55.88% to 85.29%. The lowest score also increased from 45 to 60, indicating that students who were previously far behind also experienced meaningful improvement. The decreasing

standard deviation (6.50 → 6.10) indicates a more evenly distributed score distribution.

Learning Motivation Questionnaire Results

A comparison of student learning motivation questionnaire results between Cycle I and Cycle II is presented in Table 5.

Table 5. Comparison of Student Learning Motivation between Cycle I and Cycle II

Statement	Cycle I	Cycle II	Remarks
PBL-Quizizz model helps understand algebra	75%	88.24%	Significantly increased
Quizizz makes learning more enjoyable	70%	85.29%	Significantly increased
Active participation in group discussion	80%	91.18%	Significantly increased
Confidence in solving problems	68%	82.35%	Significantly increased
Desire to use Quizizz in other subjects	78%	94.12%	Very highly increased
Average Student Motivation	74.20%	88.24%	↑ 14.04%

Data in Table 5 shows an increase in student learning motivation across all measured aspects. The average percentage of positive responses increased from 74.20% (Cycle I) to 88.24% (Cycle II). The aspect showing the highest increase was students' desire to use Quizizz in other subjects (78% → 94.12%), demonstrating a high level of student acceptance toward gamification-based technology learning.

Research Results Summary

A summary of all research success indicators from pre-action through Cycle II is presented in Table 6 below.

Table 6. Summary of All Research Success Indicators

Success Indicator	Pre-Action	Cycle I	Cycle II	Target
Teacher Activity	-	77.08%	95.83%	≥80%
Student Activity	-	72.92%	93.75%	≥80%
Class Average Score	55.00	67.35	80.29	≥75
Classical Passing Rate	23.53%	55.88%	85.29%	≥75%
Achievement Status	Not Met	Not Met	ACHIEVED ✓	-

Based on Table 6, all research success indicators were achieved by the end of Cycle II: teacher activity reached 95.83% (target ≥80%), student activity reached

93.75% (target $\geq 80\%$), the class average score reached 80.29 (target ≥ 75), and the classical passing rate reached 85.29% (target $\geq 75\%$). With all indicators met, the study was declared successful and did not need to continue to the next cycle.

Discussion

Improvement of Teacher and Student Activity

The research results show that the implementation of the PBL model assisted by Quizizz consistently improved the quality of learning activities from Cycle I to Cycle II. Teacher activity increased from 77.08% to 95.83%, while student activity increased from 72.92% to 93.75%. This improvement is in line with the findings of Schmidt and Moust (2015), who stated that the effectiveness of PBL is highly dependent on the quality of teacher facilitation and group dynamics. In Cycle I, the teacher still experienced difficulties in simultaneously guiding eight groups and managing the Quizizz quiz time. However, after improvements were made based on the Cycle I reflection, the quality of guidance and time management dramatically improved in Cycle II.

The significant improvement in student activity also reflects the successful transition from passive to active learning. Quizizz gamification features—such as the leaderboard, points, and sound effects—proved effective in motivating students to participate more actively. This is consistent with the findings of Jong and Kwan (2016), who concluded that interactive digital tools effectively increase student engagement and motivation in learning. The most significantly improved aspects were students' ability to understand problems and communicate results—two critical competencies in mathematics learning—each increasing from 62.5% to 87.5%.

Improvement of Student Learning Outcomes

The most significant improvement in learning outcomes occurred from the pre-action stage to Cycle II, with the class average score rising by 25.29 points (from 55.00 to 80.29) and the classical passing rate surging by 61.76 percentage points (from 23.53% to 85.29%). This dramatic improvement confirms the effectiveness of the PBL-Quizizz integration as an algebra learning strategy.

This pattern of improvement can be explained through Vygotsky's constructivist learning theory, which emphasizes that knowledge is actively constructed through social interaction and meaningful problem-solving (Arends, 2014). Within the PBL syntax, students are encouraged to construct their own understanding through contextual problem investigation, group discussion, and presentation of results. This process facilitates deeper conceptual understanding compared to rote learning alone. Quizizz serves as a formative assessment tool that

provides instant feedback to students, enabling them to immediately identify and correct conceptual errors.

These findings are also relevant to the research of Cheng and Poon (2018), who proved that Quizizz significantly improves learning outcomes compared to conventional quiz methods. The gamification elements in Quizizz—such as points, rankings, and virtual rewards—create extrinsic motivation that encourages students to practice more seriously and review material. Furthermore, Khan (2020) showed that PBL consistently produces better conceptual understanding because students learn in contexts that are meaningful and relevant to their real lives.

The decrease in standard deviation from 7.30 (pre-action) to 6.10 (Cycle II) is also noteworthy. This indicates that the PBL-Quizizz intervention not only improved the class average, but also reduced the gap between high- and low-ability students. The team mode feature on Quizizz activated in Cycle II encouraged more capable students to assist their peers, creating an organic and effective peer learning situation.

Improvement of Student Learning Motivation

The improvement in student learning motivation from an average of 74.20% (Cycle I) to 88.24% (Cycle II) reflects the positive impact of gamification on students' affective engagement. The aspect of confidence in solving problems showed consistent improvement (68% → 82.35%), demonstrating that repeated exposure to algebra problems through Quizizz quizzes successfully reduced mathematics anxiety that had previously been a barrier to learning.

These findings support Keller's ARCS motivation model (Attention, Relevance, Confidence, Satisfaction). Quizizz directly fulfills all four ARCS components: capturing students' attention through an engaging audiovisual interface, providing relevance through everyday life problem contexts, building confidence through instant feedback, and delivering satisfaction through a points and reward system. Moussa and El Shamy (2019) also confirmed that PBL significantly increases students' intrinsic motivation because the authentic problem-solving process provides a meaningful sense of achievement.

The high desire among students to use Quizizz in other subjects (94.12%) indicates great transfer potential. This aligns with the principle of transfer of learning: when students have positive and effective learning experiences, they tend to be motivated to apply similar strategies in different learning contexts.

Relevance to Previous Research and Research Contributions

This study contributes to the Indonesian mathematics education literature in several important respects. First, it provides CAR-based empirical evidence on

the effectiveness of the PBL-Quizizz combination specifically in 8th-grade algebra—a topic known to be difficult and often a source of learning failure. Unlike previous studies that generally use experimental designs, the CAR approach in this study offers the advantage of continuous improvement capability and deeper contextualization of specific student needs.

Second, this study extends the findings of Martin and Ertzberger (2013), who examined the effectiveness of digital quizzes in online learning, into the context of face-to-face learning in regular Indonesian classrooms. An important methodological implication is that the successful integration of Quizizz is highly dependent on how teachers structure the post-quiz review sessions—not merely using quizzes as evaluation tools, but as starting points for reflective discussion.

Third, unlike Wiggins and McTighe (2005) who emphasize backward design in lesson planning, this study demonstrates that in the context of CAR, a planning process responsive to observation data and cycle reflections proves more effective in genuinely improving learning quality. The improvements made in Cycle II—particularly in time management and group scaffolding—proved to yield significant result gains.

CONCLUSION

Based on the research results and discussion presented, it can be concluded that the implementation of the Problem-Based Learning (PBL) model assisted by Quizizz effectively improved the learning outcomes of class VIII-D students at SMP Negeri 18 Malang in Algebra. This improvement was demonstrated comprehensively across three measured dimensions.

First, the quality of the learning process improved significantly, as indicated by the increase in teacher activity percentage from 77.08% (Cycle I) to 95.83% (Cycle II), and student activity from 72.92% to 93.75%—both exceeding the success indicator of $\geq 80\%$. This improvement reflects the effectiveness of the PBL model in creating an active, collaborative, and student-centered learning environment.

Second, students' cognitive learning outcomes improved drastically: the class average score rose from 55.00 (pre-action) to 80.29 (Cycle II), and the classical passing rate surged from 23.53% to 85.29%—exceeding the target of $\geq 75\%$. Moreover, the increasingly even score distribution (standard deviation decreased from 7.30 to 6.10) demonstrates that PBL-Quizizz successfully reached students of various ability levels.

Third, student learning motivation experienced meaningful improvement, with the average positive response on the motivation questionnaire rising from 74.20% to 88.24%. The gamification elements in Quizizz proved effective in reducing mathematics anxiety and increasing student confidence in solving algebra problems.

Theoretically, this study confirms that the integration of a constructivist approach (PBL) with gamification-based learning technology (Quizizz) creates a positive synergy in mathematics learning. This synergy works through the following mechanism: PBL provides meaningful problem contexts to promote higher-order thinking, while Quizizz provides instant feedback and motivation through game mechanics that encourage enjoyable practice.

The practical implication of this study is that mathematics teachers, particularly at the junior high school level, can consider PBL assisted by Quizizz as an effective and easily implementable alternative strategy for algebra learning. The success of implementation is highly dependent on the quality of contextual problem planning, structured group discussion management, and the use of the Quizizz review feature as material for reflective discussion.

For future research, it is recommended to: (1) test the effectiveness of PBL-Quizizz on other mathematics topics (geometry, statistics) or different grade levels; (2) investigate more deeply the effect of Quizizz gamification on mathematics anxiety using standardized instruments; and (3) conduct research using a quasi-experimental design to compare the effectiveness of PBL-Quizizz with other learning models in a more controlled manner.

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