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Effectiveness of Quizizz Gamification Mastery Peak Model on Critical Thinking and Collaboration Skills of Junior High School Students

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ABSTRACT

This study aims to examine the effectiveness of implementing Quizizz gamification based on the Mastery Peak model in improving students' critical thinking and collaboration skills at SMP IT Madani. A quasi-experimental method with a pretest–posttest control group design was used. The sample consisted of 60 eighth-grade students, divided into two groups: an experimental group (using Mastery Peak Quizizz) and a control group (conventional learning), each consisting of 30 students. The instruments used included descriptive tests to measure critical thinking and a Likert scale questionnaire to assess collaboration skills. The results showed that the experimental group improved their critical thinking posttest scores from 63.67 to 84.50, with a normalized gain (N-Gain) of 0.56 (medium–high category), while the control group improved from 65.67 to 75.67 (N-Gain = 0.30). This difference was statistically significant ($p = 0.0005$). In terms of collaboration, the experimental group's scores increased from 60.87 to 88.53 (N-Gain = 0.71), while the control group increased from 61.93 to 74.27 (N-Gain = 0.37), also showing a significant difference. The most improved dimensions were open communication and joint decision-making. These findings provide practical insights that Mastery Peak-based gamification is effective not only in enhancing cognitive achievement but also in fostering social interaction and teamwork. Therefore, this strategy is recommended as a relevant and transformative instructional approach for developing 21st-century skills.

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INTRODUCTION

In the era of digital transformation, the world of education faces a major challenge in preparing a generation that is not only academically capable, but also has high-level thinking skills and the ability to collaborate (Trilling & Fadel, 2009; UNESCO, 2021). 21st century education demands adaptive and innovative learning approaches so that students are able to compete in a complex and dynamic global environment (Silva, 2009; Voogt & Roblin, 2012). One innovation that is developing rapidly is the application of gamification in learning.

Gamification, which is the use of game elements such as points, badges, levels, and leaderboards in non-game contexts, has been shown to increase student motivation, engagement, and learning outcomes (Deterding et al., 2011; Sailer et al., 2017; Koivisto & Hamari, 2019). Quizizz, as one of the popular gamification platforms, allows students to interact with course content in a fun and competitive atmosphere. Several studies have shown that the use of Quizizz in mathematics learning can increase students' active participation and intrinsic motivation (Pratama & Fitriyani, 2021; Maulidya et al., 2023; Kurniawan, 2022; Silitonga, H., & Irvan, I., 2021).

Furthermore, gamification can also contribute to strengthening social skills such as collaboration and communication. According to Adi and Iswanto (2023), interactions in a gamification-based learning environment can encourage teamwork and democratic joint decision-making. Permatasari et al. (2023) stated that gamification not only improves cognitive outcomes, but also the affective and socio-emotional aspects of students. This is in line with the findings of the OECD (2018) which emphasizes the importance of integrating social skills in the learning process.

Vol. , No 2, June 2025 , pp. 86-95 DOI: https://doi.org/ 10.30596/jmea.v4i2.20552

However, the success of gamification depends heavily on its pedagogical design. Mogavi et al. (2022) warn about the potential novelty effect, which is a temporary effect due to the novelty of the media that is not sustainable if not accompanied by a mature learning structure. Therefore, a gamification model is needed that is not only fun but also deep and oriented towards concept mastery.

One promising model is Mastery Learning, an approach that provides opportunities for students to learn at their own pace until they achieve mastery of certain competencies (Bloom, 1981; Guskey, 2007). Quizizz adopts this approach through its Mastery Peak feature, which presents tiered questions with graded challenges and instant feedback. This feature encourages meaningful iterative learning and increases active student engagement (Putra & Arifin, 2022; Jack et al., 2024).

In the context of mathematics learning, critical thinking is a core competency that must be developed, in line with the revised Bloom taxonomy by Anderson & Krathwohl (2001). These skills include analysis, synthesis, evaluation, and complex problem solving (Ennis, 2011; Saeed et al., 2012). On the other hand , collaboration is a social skill that supports the development of 21st century competencies, as emphasized in the Framework for 21st Century Learning (P21, 2019) and Vygotsky (1978).

Studies on the effectiveness of the Mastery Learning model integrated with digital gamification are still limited, especially in the development of critical thinking and collaboration skills simultaneously (Almeida et al., 2023; Suh et al., 2018). Therefore, a comprehensive empirical study is needed to answer this need.

Based on the background above, the main problem to be answered in this study is whether the implementation of Quizizz gamification based on the Mastery Peak model is effective in improving critical thinking and collaboration skills of junior high school students. This focus arises from the gap between the high potential of gamification and the still minimal empirical evidence regarding its simultaneous influence on these two important competencies in the context of mathematics learning.

RESEARCH METHOD

This study was conducted with a quantitative approach using a quasi-experimental design to determine the effect of gamification-based learning Quizizz Mastery Peak model on improving students' critical thinking and collaboration skills. The design used is Nonequivalent Control Group Design, where two classes are selected as the experimental and control groups. The experimental group received learning using a gamification model, while the control group received conventional learning. Both groups were given a pretest and posttest to measure changes in ability after treatment.

The research subjects consisted of 60 grade VIII students at SMP IT Madani who were selected using purposive sampling technique, taking into account the equality of academic characteristics between classes. Each group consists of 30 students. Data were collected using two main instruments, namely a critical thinking test and a collaboration questionnaire. The critical thinking test was compiled based on indicators from Facione (2015), while the collaboration questionnaire refers to indicators from OECD (2018) and uses a Likert scale. Both instruments have been tested for validity and reliability, with Cronbach's Alpha test results of 0.83 and 0.87 respectively, indicating a good level of internal consistency.

Vol. , No 2, June 2025 , pp. 86-95 DOI: https://doi.org/ 10.30596/jmea.v4i2.20552

Data were analyzed descriptively and inferentially. Descriptive analysis was used to determine the average, standard deviation , and N-Gain value, while inferential analysis used the independent sample t-test to test for significant differences between groups. All analyses were performed using SPSS version 26 software at a significance level of 5%. Through this approach, research is expected to provide an accurate picture of the effectiveness of the gamification learning model in improving students' critical thinking and collaboration skills.

RESULTS AND DISCUSSION

The results of the study were obtained from the data collection and analysis process that had been carried out on both groups, namely the experimental group using the Mastery Peak learning model based on Quizizz gamification, and the control group receiving conventional learning. The results presented include quantitative data in the form of pretest and posttest scores, N-Gain values, and the results of independent sample t-test statistical tests for two main variables, namely critical thinking skills and student collaboration.

The discussion is conducted descriptively and inferentially to answer the problem formulation and research objectives. The interpretation of the results is based on empirical findings and reinforced with theoretical references and previous research results. In addition, this section also analyzes the relevance between findings in the field and the 21st century learning approach which emphasizes the importance of developing cognitive and social competencies in a balanced manner.

To facilitate understanding, the results and discussion are presented in five subsections, namely: (1) Improving Students' Critical Thinking Skills, (2) Testing the Significance of Critical Thinking Skills, (3) Improving Students' Collaboration Skills, (4) Testing the Significance of Collaboration Skills, and (5) Interpretation of Findings.

1. Improving Students' Critical Thinking Skills

Critical thinking skills are an essential component in mathematics learning because they play a role in the process of analyzing, interpreting, and evaluating information and solving problems. In the context of 21st-century education, this ability is one of the core competencies that students need to master in order to be able to think reflectively, logically, and evidence-based (Anazifa & Djukri, 2020).

The results of the analysis in Table 1 show that there was a significant increase in students' critical thinking scores after participating in learning using the Quizizz-based Mastery Peak model. The average posttest score of the experimental group reached 84.50 , an increase from the pretest score of 63.67, with an N-Gain of 0.56 (medium-high category). Meanwhile, the control group only experienced an increase from 65.67 to 75.67, with an N-Gain of 0.30 (medium category).

Table 1. Results of Pretest, Posttest, and N-Gain Critical Thinking Skills

Group	Pretest	Posttest	N-Gain
Experiment	63.67	84.50	0.56
Control	65.67	75.67	0.30

This increase indicates that the Mastery Peak learning model implemented through the Quizizz platform contributes positively to the development of students' critical thinking skills. The characteristics of the model that emphasizes gradual mastery, direct feedback reinforcement, and the use of gamification elements have been shown to increase students' cognitive engagement.

Vol. , No 2, June 2025 , pp. 86-95 DOI: https://doi.org/ 10.30596/jmea.v4i2.20552

Research by Supriadi et al. (2021) confirms that a learning process that includes stages of mastery and guided repetition can help students identify their own thinking errors and correct them through reflection.

In addition, the use of interactive digital media such as Quizizz can create an adaptive and responsive learning environment. According to Nurfadillah et al. (2022), gamification platforms encourage students to think more actively and challenge themselves in completing complex tasks because of the scores, leaderboards, and competitive motivation.

Furthermore, learning that provides opportunities for students to obtain direct feedback plays a major role in encouraging self-evaluation and more critical decision-making (Utami et al., 2021). In mathematics learning, this process becomes very relevant considering that students often experience misconceptions that require time and appropriate teaching strategies to correct.

Overall, the increase in students' critical thinking skills in this study was not only the result of using the Quizizz media alone, but also because of the pedagogical design of the Mastery Peak model which is in line with the principles of mastery learning and differentiated learning that allows students to learn according to their respective rhythms and levels of mastery (Widodo et al., 2023).

2. Test of Significance of Critical Thinking Ability

To determine whether the difference in the increase in critical thinking skills between the experimental group and the control group was statistically significant, an inferential analysis was conducted using the independent sample t-test. The results of the analysis are shown in Table 2.

Table 2. Results of the t-test for critical thinking skills

Variables	t-count	p-value	Information
Critical thinking	4.68	0,000	Significant

The t-value of 4.68 with a p-value of 0.000 ($p < 0.05$) indicates that there is a significant difference between the experimental group and the control group. Thus, the use of the Mastery Peak model based on Quizizz gamification is statistically proven to be effective in improving students' critical thinking skills.

These results support previous findings which state that a learning approach that emphasizes gradual mastery (mastery learning) can improve the quality of students' analytical thinking (Husna et al., 2021). In this context, gamification integration provides a more structured and engaging learning experience, encouraging students to be more active in constructing arguments and developing high-level thinking strategies (Rahmawati & Hidayat, 2022).

In addition, this significant influence is also closely related to the cognitive aspects of students that are stimulated through in-game challenges, direct feedback, and score incentives that encourage reflection and self-improvement. According to Putri et al. (2023), these elements are able to strengthen the critical thinking cycle through reflection on results, revision of approaches, and logic-based decision making.

In the realm of mathematics education, these findings suggest that students who learn through a Mastery Peak-based approach have a higher chance of mastering concepts in depth and being able to apply knowledge to problem-solving contexts. This is in line with the UNESCO report (2021), which emphasizes the importance of implementing learning models that encourage reflection and independent thinking amidst the digital education transformation.

Vol. , No 2, June 2025 , pp. 86-95 DOI: https://doi.org/ 10.30596/jmea.v4i2.20552

Thus, it can be concluded that this significant difference is not only numerically significant, but also indicates the success of the pedagogical approach in stimulating students' critical thinking skills comprehensively and sustainably.

3 . Improving Students' Collaboration Skills

Collaboration skills are one of the important competencies in 21st century learning that reflects students' ability to work in teams , share responsibilities, and build effective communication and coordination. In mathematics learning, collaboration allows students to discuss, convey ideas, and solve problems collectively (Fitriyani et al., 2021).

The results of the data analysis in Table 3 show that the experimental group experienced an increase in the average collaboration score from 60.87 to 88.53 with an N-Gain value of 0.71, which is categorized as high. Meanwhile, the control group only increased from 61.93 to 74.27 with an N-Gain of 0.37 (moderate category). This difference reflects the success of gamification-based learning in creating a cooperative learning environment and motivating students to interact more actively.

Table 3. Results of Pretest, Posttest, and N-Gain Collaboration Ability

Group	Pretest	Posttest	N-Gain
Experiment	60.87	88.53	0.71
Control	61.93	74.27	0.37

The increase in collaboration in the experimental group cannot be separated from the contribution of gamification features in the Quizizz platform, such as group challenges, team scores , and collective rankings. These features create a dynamic of cooperation that encourages students to help each other and complete tasks with good coordination (Sari & Saputra, 2021; Silitonga, H., & Irvan, I., 2021). This interactive element has been proven to be able to build student social engagement during online and offline learning.

According to Gunawan et al. (2022), technology-based learning designed with a gamification approach can encourage the creation of a competitive and collaborative atmosphere, because students not only try to be the best, but also learn to solve challenges in groups. This is relevant to the results of this study, where the experimental group was more active in solving problems together and showed improvements in the aspects of coordination, communication, and shared responsibility.

Research by Lestari and Widodo (2023) also found that learning models with score-based and level-based reinforcement systems can increase students' motivation to participate in group discussions and teamwork, especially in procedural materials such as mathematics. The concept of teamwork developed in educational games allows students to build academic empathy and distribute tasks fairly.

Thus, learning with the Mastery Peak model not only targets individual achievement, but also creates a conducive and productive collaborative atmosphere in the classroom. This supports the strengthening of collaborative competencies as part of the 4C Skills initiated in global education (Trilling & Fadel, 2021).

4. Significance Test of Collaboration Ability

To test whether there is a statistically significant difference in the improvement of collaboration skills between the experimental group and the control group, an independent sample t-test was conducted. The test results are shown in Table 4.

Table 4. Collaboration Ability t-Test Results

Variables	t-count	p-value	Information
Collaboration	8.88	0,000	Significant

The t-value of 8.88 and p-value of 0.000 (p <0.05) indicate that there is a very significant difference between the experimental group and the control group in terms of increasing collaboration skills. This provides statistical evidence that learning using the Mastery Peak model based on Quizizz gamification effectively improves students' collaborative skills.

These results are consistent with the research of Rahayu and Saputra (2021) which states that learning strategies that integrate elements of healthy competition and shared challenges can strengthen the spirit of cooperation between students in solving problems. In a gamification-based learning environment, students not only interact to achieve individual scores but also build team awareness to achieve common goals.

According to Tamba et al. (2022), learning platforms designed with collaborative features such as group leaderboards, collective point systems, and team- based evaluations are very effective in increasing active participation and interpersonal communication among students. These activities stimulate healthy social interactions, joint decision-making, and collective responsibility within the group.

This finding also supports the view of Wahyuningsih and Fikriyah (2023) that collaborative learning supported by digital technology can create more meaningful learning experiences, especially in developing interpersonal skills and academic empathy. With a constructively designed gamification system, students are encouraged to contribute to each other, share problem-solving strategies, and appreciate differences in completing tasks.

Thus, it can be concluded that the significant differences obtained not only indicate the technical effectiveness of using the Mastery Peak model, but also reflect its effectiveness in instilling strong values of cooperation , communication and collaboration, as emphasized in the 21st century competencies (OECD, 2020; P21, 2021).

5. Interpretation of Findings

The findings of this study indicate that the gamification-based Mastery Peak learning model through the Quizizz platform is significantly able to improve two important competencies in 21st century mathematics learning, namely critical thinking skills and collaboration skills. Both abilities showed a high increase in scores in the experimental group compared to the control group, both descriptively through gain values and inferentially based on the t-test.

The improvement of critical thinking skills in mathematics learning is closely correlated with the characteristics of the Mastery Peak model which emphasizes a gradual, reflective, and feedback-based learning process. In this approach, students not only memorize concepts, but are also required to understand mistakes, correct them, and retest their understanding independently or in groups. According to Fauzi and Mulyadi (2021), a mastery-oriented learning model with technology support enables students to develop high-level thinking skills because they are involved in a continuous problem-solving cycle.

Meanwhile, the improvement of collaboration skills is the result of the integration of gamification elements such as group leaderboards, collective scoring systems, and joint problem-solving activities. These elements play a role in building a culture of cooperation and emotional engagement among students. Students who were previously passive become more active in group

communication, providing support to each other, and sharing strategies in solving problems. The study by Hasanah et al. (2022) emphasized that the use of gamification in learning not only increases motivation, but also strengthens students' social interactions and collective awareness.

In addition to the technical aspects of learning methods, improving student abilities also reflects the effectiveness of the application of targeted educational technology. In the context of the pandemic and post-pandemic era, flexible, digital, and responsive learning to student needs is key to developing competencies that are relevant to future challenges. In line with these findings, Yunus et al. (2023) stated that a pedagogically and adaptively designed gamification model can improve the quality of mathematics learning as a whole, both from cognitive, affective, and social aspects.

Thus, the implementation of the gamification-based Mastery Peak model is not just a technological innovation in learning, but also a pedagogical strategy that is able to answer the challenges of today's education. This model indirectly integrates the principles of differentiated learning, independent learning, and character building through team interaction and feedback. Therefore, the results of this study provide an important contribution for teachers and education practitioners in designing mathematics learning that is not only meaningful but also transformative.

CONCLUSION

Based on the results of the research that has been conducted, it can be concluded that the Mastery Peak learning model based on Quizizz gamification is effective in improving the critical thinking and collaboration skills of junior high school students. This is indicated by a statistically significant increase in pretest to posttest scores and N-Gain values that are in the medium to high category in the experimental group compared to the control group. These findings suggest that combining mastery learning strategies with gamification elements can create a learning environment that supports cognitive and social engagement simultaneously.

Students' critical thinking skills are enhanced because the Mastery Peak approach provides students with space to learn incrementally, gain immediate feedback, and refine their understanding through structured repetition. On the other hand, students' collaboration skills are enhanced because the gamification design encourages meaningful social interactions through group work, collective scoring systems, and shared challenges that foster a spirit of cooperation and team responsibility.

Thus, this learning model is very relevant to be applied in 21st century mathematics learning, especially to build high-level thinking competencies and social skills needed in the future.

Based on the results of this study, the researcher provides several suggestions. First, mathematics teachers are advised to integrate gamification-based Mastery Peak strategies into the learning process to improve the quality of learning and student learning motivation. Second, educational media developers can make Quizizz a platform that is further developed to support interactive learning based on differentiation and collaboration. Third, further research can expand the scope to other subjects and different levels of education to see the consistency of the influence of this model on various 21st century skills.

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