

A Gamified Escape Room to Reduce Math Anxiety Among Elementary School Students

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ABSTRACT

Mathematics anxiety is a prevalent affective barrier that hinders elementary school students' ability to engage with and succeed in mathematics, particularly in topics such as standard units of water volume measurement. This condition often leads to passive behavior, reduced confidence, and avoidance of mathematical tasks. This study aimed to determine the effectiveness of the Gamified Escape Room method in reducing mathematics anxiety among fourth-grade students at SD Negeri Ciherang 1. A quantitative approach using a pre-experimental one-group pretest-posttest design was employed, involving 35 participants selected through total sampling. The instrument used was the Modified Abbreviated Math Anxiety Scale (mAMAS), consisting of nine statements measured on a five-point Likert scale. The intervention integrated challenge-based educational games, group collaboration, and sequential problem-solving activities. The findings showed that the mean mathematics anxiety score decreased from 22.23 to 19.57, representing a reduction of 2.66 points. The paired-samples t-test revealed a significance value of 0.000 ($p < 0.05$) and a t-value of 5.968 with 34 degrees of freedom, confirming a statistically significant difference between pretest and posttest scores. These findings suggest that gamification-based learning is effective in creating a more positive and enjoyable learning experience, reducing students' mathematics anxiety, and supporting the development of numeracy literacy through interactive and collaborative problem-solving activities. The study implies that teachers may consider the Gamified Escape Room method as an alternative instructional strategy to foster a more comfortable and engaging mathematics learning environment.

INTRODUCTION

Mathematics is one of the subjects that plays an important role in developing logical, analytical, and problem-solving skills. However, in practice, many elementary school students perceive mathematics as a difficult and stressful subject, leading to mathematics anxiety, also known as math anxiety. Math anxiety is an emotional condition characterized by feelings of fear, nervousness, and worry when individuals encounter mathematical activities (Beilock & Maloney, 2015; Luttenberger et al., 2018; Mammarella et al., 2023).

Research on math anxiety has developed extensively over the past few decades. Dowker et al. (2016) explained that math anxiety is an affective factor that influences students'

ability to understand mathematical concepts, solve problems, and achieve academic success. Furthermore, through a meta-analysis, Namkung et al. (2019) found that math anxiety has a consistent negative relationship with students' mathematics performance across various educational levels. These findings indicate that reducing math anxiety is an important aspect of improving the quality of mathematics learning (Klee et al., 2022; Passolunghi et al., 2020; Pizzie & Kraemer, 2023; Ramirez et al., 2018).

As learning innovations continue to develop, various studies have begun to utilize gamification approaches as strategies to increase student engagement and motivation. Agustin et al. (2025) reported that gamification implementation improved elementary school students' mathematics learning outcomes through more interactive learning experiences. Safitri et al. (2025) also explained that gamification approaches can develop critical thinking skills and increase students' active participation during the learning process. In addition, Kamalodeen et al. (2021) demonstrated that escape-room-based learning designs provide collaborative and challenging learning experiences that can increase motivation to learn mathematics.

In addition to its impact on learning motivation, several studies have shown an association between math anxiety and numeracy literacy. Rakhmawati and Mustadi (2022) explained that numeracy literacy skills are influenced not only by mastery of mathematical concepts but also by affective factors, such as self-confidence and anxiety toward mathematics. Nur (2024) found that higher levels of math anxiety were associated with lower numeracy literacy skills among elementary school students. Therefore, a learning strategy is needed that not only improves understanding of mathematical concepts but also creates an enjoyable learning experience to minimize mathematics anxiety.

Various studies have shown that gamification approaches can increase student motivation and engagement in mathematics learning. However, most studies have focused on general educational games or digital-based applications, while the implementation of Gamified Escape Room approaches as mathematics learning strategies in elementary schools remains relatively limited (Kurniawan et al., 2025; Kusumawardani et al., 2025; Kusumawardani & Widhanarto, 2026; Makri et al., 2021; Rasidi, 2026). In addition, research on math anxiety in Indonesia has been conducted more frequently at the junior and senior high school levels; therefore, studies specifically investigating strategies to reduce mathematics anxiety among elementary school students require further development.

Based on observations at SD Negeri Ciherang 1, fourth-grade students tended to lack confidence and feel anxious when solving mathematics problems, particularly related to standard units of water volume measurement. This condition caused students to become passive and less engaged in the learning process. As a solution, this study applied the Gamified Escape Room method, which integrates educational game elements, group collaboration, and mathematical problem-solving activities. Through this approach, students were expected to learn in a more relaxed and enjoyable environment, thereby reducing their level of mathematics anxiety. The purpose of this study was to determine the effectiveness of applying the Gamified Escape Room method in reducing math anxiety among fourth-grade students at SD Negeri Ciherang 1.

The urgency of this research was further supported by observations at SD Negeri Ciherang 1, where fourth-grade students exhibited a tendency to lack confidence and feel anxious when facing mathematics problems, particularly regarding standard units of water

volume measurement. This condition caused students to become passive and less engaged in the learning process, creating a cycle of anxiety and avoidance that could hinder mathematical development. Previous research on working memory and mathematics anxiety has explained that anxiety can consume part of working memory capacity, thereby disrupting mathematical problem-solving processes. Therefore, interventions that redirect students' attention from fear toward engagement and challenge are needed to break this cycle and create more positive learning experiences (Felver & Singh, 2020; Gregory & Kaufeldt, 2015; Macklem, 2015; Souers & Hall, 2016; Willis & Willis, 2020).

The novelty of this study lies in its direct application of the Gamified Escape Room method to teaching standard units of water volume measurement for elementary school students. Through problem-solving activities presented as tiered challenges, this research not only evaluated the effectiveness of gamification in reducing mathematics anxiety but also provided an overview of contextual and collaborative learning implementation within an Indonesian elementary school environment. Unlike previous studies that have examined gamification in general contexts, this research integrated escape room mechanics with specific curriculum content, offering a practical model that teachers can adapt and implement in their classrooms (Amorim & da Silva Lopes, 2026; Damaševičius & Sidekerskienė, 2026; Lim, 2026; Veldkamp et al., 2020; Vorderobermeier et al., 2024).

The purpose of this study was to determine the effectiveness of applying the Gamified Escape Room method in reducing mathematics anxiety among fourth-grade students at SD Negeri Ciherang 1. By employing a quantitative approach with a one-group pretest–posttest design and utilizing the Modified Abbreviated Math Anxiety Scale (mAMAS), a valid and reliable instrument for measuring mathematics anxiety in children, this research aimed to provide empirical evidence regarding the potential of gamified escape room interventions in the Indonesian elementary school context. The findings were expected to contribute theoretically by expanding knowledge regarding gamification and mathematics anxiety in early education and practically by providing teachers with an alternative instructional strategy for creating a more enjoyable mathematics learning environment with reduced anxiety. Ultimately, this study aimed to support the development of numeracy literacy among Indonesian elementary school students by addressing affective barriers that hinder mathematical learning and engagement.

METHOD

This study employed a quantitative approach with a pre-experimental one-group pretest–posttest design. The study was conducted at SD Negeri Ciherang 1, Cianjur Regency, West Java, on April 22–23, 2026.

The research subjects consisted of 35 fourth-grade students who participated in all research activities. Total sampling was applied because all students in the class were included as research respondents.

The Gamified Escape Room activity was organized into groups. Each group received a series of mathematics challenges related to water volume measurement that had to be completed sequentially. Each correct answer provided a clue to access the next challenge until the final stage of the game was completed. During the activity, students received points and

simple rewards as motivational reinforcement. The teacher acted as a facilitator who provided guidance, monitored group discussions, and led reflection activities after the intervention.

The research procedure consisted of five stages:

1. Administering a pretest using the mAMAS instrument.
2. Implementing mathematics learning using the Gamified Escape Room method.
3. Conducting discussion and reflection activities.
4. Administering a posttest using the same instrument.
5. Analyzing the data and drawing conclusions.

The research instrument used was the Modified Abbreviated Math Anxiety Scale (mAMAS) developed by Carey et al. (2017). The instrument consisted of nine statements measuring students' mathematics anxiety using a five-point Likert scale. To accommodate the characteristics of fourth-grade elementary school students, the instrument was translated into Indonesian using age-appropriate language while maintaining the conceptual meaning of each item. The adapted instrument was used to assess students' anxiety levels during mathematics learning activities.

Table 1. Translation of the Modified Abbreviated Math Anxiety Scale

No	Item
1	Having to complete a worksheet by yourself
2	Thinking about a math test the day before you take it
3	Watching the teacher work on a math problem on the board
4	Taking a math test
5	Doing math homework with many difficult problems that must be turned in the next day
6	Listening to the teacher talk for a long time in math class
7	Listening to a classmate explain a math problem
8	Finding out that you will have a surprise math quiz at the start of class
9	Starting a new topic in math

Source: Adapted from Carey et al. (2017).

Data were analyzed using the Paired Samples T-Test with the help of statistical software to determine differences in students' mathematics anxiety levels before and after treatment.

RESULTS AND DISCUSSION

The study involved 35 fourth-grade students at SD Negeri Ciherang 1 who completed both the pretest and posttest in full. The overall results of the study are presented in Figure 1.

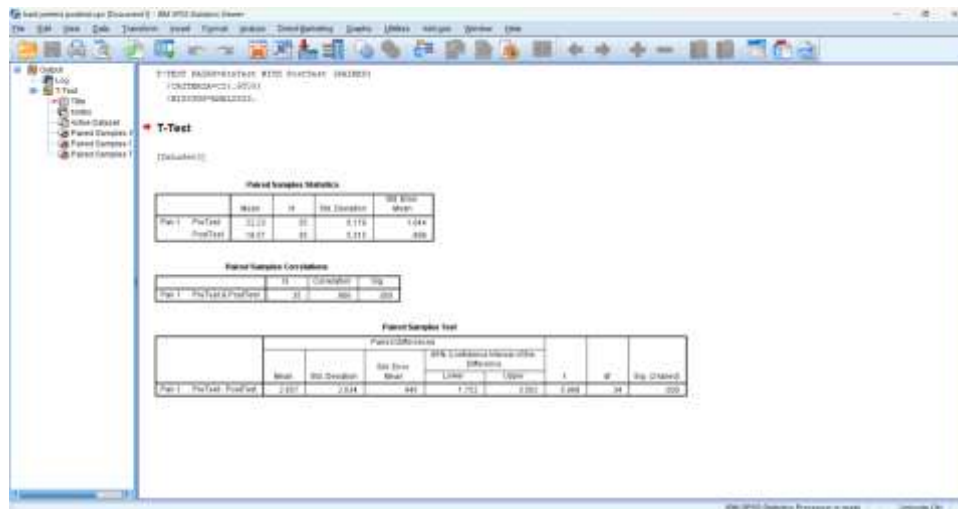


Figure 1. Paired Samples T-Test Results

Source: Primary data processed by the authors using statistical software (2026).

In Figure 2, it can be seen that the average mathematics anxiety score of students decreased from 22.23 to 19.57. This decrease of 2.66 points indicates a change.

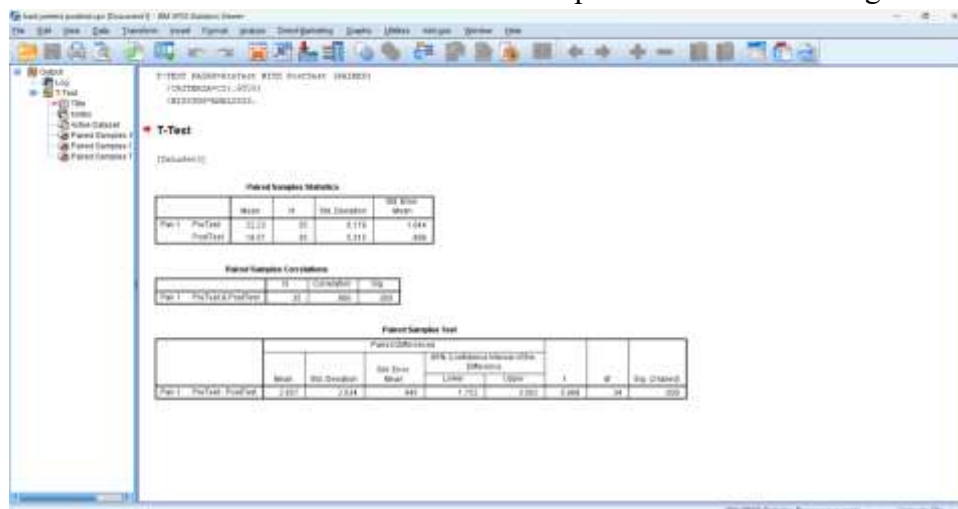


Figure 2. Paired Samples Statistics Results

Source: Primary data processed by the authors using statistical software (2026).

The results of the Paired Samples T-Test showed a Sig. (2-tailed) value of 0.000, which is smaller than 0.05. In addition, a t-value of 5.968 was obtained with 34 degrees of freedom (df). These results can be seen in Table 2, which shows that there is a significant difference in mathematics anxiety levels before and after the intervention.

Table 2. Paired Samples Test Results

t	df	Sig.
5.968	34	.000

Source: Primary data processed by the authors using statistical software (2026).

These findings indicate that the Gamified Escape Room method is effective in reducing math anxiety among elementary school students. The use of educational games made students focus more on completing challenges rather than on their fear of mathematics. Collaborative group activities also helped students obtain social support from peers, thereby reducing feelings of anxiety.

These results are consistent with the study by Nabillah and Nurhayati (2024), which stated that interactive learning can reduce students' mathematics anxiety. In addition, gamification theory explains that elements of challenge, reward, and cooperation can increase students' intrinsic motivation, making learning more enjoyable.

The reduction in math anxiety levels can be explained through the perspective of working memory. According to Ashcraft and Krause (2007), mathematics anxiety consumes part of working memory capacity, thereby disrupting the process of solving mathematical problems. Through the Gamified Escape Room activity, students' attention was more focused on completing challenges and group cooperation rather than on fear of mathematics. This condition allowed cognitive resources to be used more optimally to understand and complete the given tasks.

In addition, the challenge element in the Gamified Escape Room has the potential to change students' perception of mathematics from a threatening activity into a challenging and enjoyable one. This change in perception is important because one of the main characteristics of math anxiety is a tendency to avoid mathematical activities (avoidance behavior). When students are actively involved in the game, this tendency can be reduced, making the learning experience more positive.

The advantage of the Gamified Escape Room method lies in its ability to create an active and contextual learning experience. Students not only learn mathematical concepts but also develop logical thinking, communication, and cooperation skills. However, this study still has limitations because it used a single group without a control group, so the effectiveness of the method cannot yet be compared with other learning models.

CONCLUSION

This study showed that the application of the Gamified Escape Room method was effective in reducing mathematics anxiety among elementary school students. Learning activities that integrated challenge, collaboration, and educational game elements created a more positive learning experience, enabling students to feel more comfortable and confident when participating in mathematics learning. These findings indicated that gamification could serve as an alternative instructional strategy to support a more enjoyable mathematics learning environment with reduced anxiety.

Based on the research findings, teachers may consider implementing the Gamified Escape Room method as an alternative mathematics learning strategy to create more interactive learning experiences and reduce students' anxiety toward mathematics. For schools, this method can be further developed and applied to other learning materials and grade levels to improve instructional quality. Future research should incorporate control groups, larger sample sizes, and longer intervention periods to evaluate the effectiveness of the Gamified Escape Room method more comprehensively and generate more generalizable findings. Further studies are also recommended to examine additional variables, such as learning motivation, mathematics self-efficacy, and numeracy literacy, to provide a more comprehensive understanding of the impact of the Gamified Escape Room method on mathematics learning.

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