The effect of blooket-assisted RADEC learning model on students' metacognitive ability

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Abstract

The purpose of this research was to investigate the influence of the RADEC learning model by implementing games in learning, specifically Blooket, on students' metacognitive capacities. This study utilized a quasi-experimental design featuring a non-equivalent control group, involving 62 tenth-grade students from high schools in Jakarta during the 2025/2026 academic year. A posttest instrument intended to evaluate students' metacognitive skills was utilized as the principal assessment tool. The data were analyzed using descriptive statistics and an independent samples t-test. The findings showed that the experimental class achieved a higher mean score compared to the control class. The hypothesis testing results also indicated a statistically significant difference between the two groups. The results demonstrate that the application of the Blooket-supported RADEC learning paradigm positively influenced students' metacognitive skills. The efficacy of the RADEC learning paradigm is linked to its organized learning phases, which promote student engagement in planning, monitoring, and assessing their cognitive processes during mathematics activities. Moreover, the incorporation of Blooket as a technology-driven educational platform fosters a more participatory and stimulating learning atmosphere through gamification and prompt feedback. Consequently, the Blooket-supported RADEC learning paradigm can function as an innovative and successful option to enhance students' metacognitive skills in mathematics education.

Keywords: blooket; game-based learning; mathematics learning; metacognitive ability; RADEC learning model.

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INTRODUCTION

Mathematics plays a crucial role as a subject at every level of education, particularly in building students' knowledge foundation. Structured mathematics instruction not only teaches math skills but also fosters the development of logical thinking abilities. A solid understanding of mathematical concepts is essential for students to effectively progress to higher levels of learning. Indah et al. (2021) state that in learning mathematics, since success is determined by the level of students' understanding not merely the amount of material they have studied, a deep understanding is essential for students to be able to learn subsequent material. Mathematics education also plays a crucial role in developing students' analytical and problem-solving skills. Through mathematics education, students are encouraged to think systematically, critically, and logically when facing various problems in daily life.

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Students who can manage and evaluate their learning processes tend to be better able to achieve a deeper understanding, a skill known as metacognition. Metacognition refers to the ability to independently identify and control one's own thinking, including knowledge of cognitive strengths and shortcomings, as well as the capacity to oversee, monitor, and assess the learning process. Lestari et al. (2019) state that metacognition involves the ability to understand how one learns, estimates the difficulty level of tasks, and assesses learning progress independently. This statement aligns with Zulfikar (2019) perspective, which highlights that metacognition relates to an individual's ability to observe and evaluate themselves. The stages of planning, monitoring, and assessment are crucial to the success of the learning process. This perspective is reinforced by Saputra et al. (2018), who explicitly emphasize the significance of these three aspects. The study's conclusions support the claims made. Metacognitive skills support students to grasp mathematical concepts as well as to select the appropriate strategies to solve problems. Students who can monitor and evaluate their own thinking processes are likely to be more independent and self-confident during learning activities. In the learning process, a deeper understanding of mathematical topics is made possible by metacognitive skills, which are crucial in helping students become aware of and control their thinking processes. Rizqiani et al. (2020) state that metacognitive skills play a role in organizing and monitoring thinking and learning processes in a systematic and focused manner. Zakiah (2017) also argues that the development of mathematical thinking skills is facilitated by metacognitive abilities. The findings of Taufik et al. (2023) Reinforce this statement by revealing that students with high metacognitive capacity tend to achieve a deeper conceptual understanding.

Based on empirical evidence, students' metacognitive abilities remain inadequate. Earlier research confirms this finding by Suryaningtyas et al. (2020), which revealed that 46% of students fall into the low metacognitive ability category, while the remainder are distributed across the moderate and high categories. Similarly, Fauziana et al. (2020) concluded that the majority of students are still at a low level, with only a small proportion demonstrating high metacognitive abilities. Effective teaching approaches must support students' active participation in the learning process. Such mechanisms are a prerequisite for students to experience optimal self-awareness and self-regulation. Therefore, the development of metacognitive abilities requires an appropriate learning model. Poor metacognitive skills can make it difficult for students to fully grasp mathematical concepts. As a result, students often rely more on rote memorization than on understanding the reasoning process when solving math problems. This condition suggests that pupils require educational activities that promote the cultivation of a sense of self- during the learning process. Thus, educators must adopt instructional practices that promote student engagement in self-directed learning.

To raise the caliber of educational activities and make them more interesting and pertinent, effective instructional models must fundamentally integrate interactive media. Through their learning experiences with digital games, they are able to understand mathematics learning materials and develop their skills (Kuo et al., 2025). In practice, game-based media such as Blooket have proven effective in increasing student engagement and motivation (Maulana & Arini, 2024; Sinaga et al., 2025). By using technology in learning, students don't just passively participate in it but also engage in deepening their cognitive abilities (Wood & Moss, 2024). The advancement of educational technologies provides an experience and opportunity for learning that is accessible anywhere and anytime, facilitated by immediate on-demand access to a tailored array of tools and materials (Ofori & Lockee, 2021). Technology-based learning can facilitate immersive and interactive experiences for students in learning, particularly mathematics (Rozo & Ramírez-Montoya, 2025). In addition, international studies have shown that technology-supported learning environments can enhance students' metacognitive awareness by encouraging them to monitor, regulate, and reflect on their learning processes (Bal, 2022). Likewise, gamification in education appears to improve involvement of students and foster the development of higher-order thinking skills via active participation and prompt feedback (Li et al., 2023). The RADEC model, as proposed by Sopandi (2017), is an appropriate teaching strategy to implement in classroom learning activities. The model's design is tailored to the characteristics of Indonesia's education system. Furthermore, the systematically organized phases within the RADEC model support students' active participation in the learning process. This technique is highly effective in fostering the development of higher-order cognitive skills (Suryana et al., 2021). The integration of interactive learning media with learner-centered instructional paradigms can enhance the significance of the learning experience. Students are urged to engage actively in learning activities, collaborate with others, and assume greater responsibility for their own educational process.

In previous studies, some learning models have been applied to enhance metacognitive skills, such as the POE-type Discovery Learning approach, which has been associated with improved development of these skills (Susanti et al., 2020). Although the RADEC model's methodical processes are intended to motivate students to actively engage in thinking activities, most previous studies have tended to examine instructional models and learning media separately (Bush, 2021). Therefore, a research gap remains regarding the integration of the RADEC learning model with game-based interactive learning media such as Blooket, particularly in enhancing students' metacognitive abilities. Research specifically investigating the effect of combining RADEC and Blooket on students' metacognitive abilities remains relatively limited.

This study intends to examine how students' development of metacognitive skills is affected when the RADEC learning paradigm is integrated with Blooket. Based on this gap, the present study aims to analyze the effect of integrating the RADEC learning model supported by Blooket on students' metacognitive abilities in mathematics learning. The results of the study are expected to significantly strengthen the evidence behind new learning methods. This study introduces a fresh approach by combining the RADEC learning paradigm with Blooket, a gamified educational platform, aimed at improving students' metacognitive skills. This project seeks to make a meaningful contribution to the development of technology-assisted methods for learning mathematics, focusing on enhancing students' metacognitive engagement and fostering self-regulated learning.

METHODS

To evaluate how effective the intervention was, this study employed a quasi-experimental design combined with a quantitative approach. (Sugiyono, 2019) emphasizes that this strategy focuses on gathering quantitative data. The analysis of the collected data later revealed how the intervention impacted the situation. This study used a design with a control group that was not the same as the experimental group. (Zulfikar & Fadilah, 2024) chose this design to enable a comparison of learning outcomes across groups that experienced different interventions.

The participants in this study were tenth-grade students from a high school in Jakarta during the 2025/2026 academic year. Sampling was carried out using a cluster random sampling method. Two classes, comprising a total of 62 students, were chosen based on the application of this technique. Class X-1 was chosen to be the experimental group, and Class X-2 acted as the control group. The experimental group was introduced to the RADEC model, which is supported by Blooket. On the other hand, the control group did not receive any instructions that utilized the Blooket-supported RADEC learning model.

The learning material centered around the System of Linear Equations involving three variables. The RADEC learning model was put into action through five stages, where students took the initiative to explore the learning material on their own before coming to class for instruction. During the Answer phase, students engaged with questions related to the topic they had explored. During the Discussion phase, students shared their thoughts and engaged in meaningful conversations with their classmates. The Explain stage required students to express and clarify their understanding of the concepts being studied. In the Create phase, students came up with answers or educational materials that were relevant to the mathematical content. Blooket was integrated into two instructional sessions at the beginning of the lesson to strengthen previously learned concepts and boost student engagement in the learning experience.

This research employed an essay-format assessment for the posttest to accurately assess students' metacognitive skills. The assessment consisted of five essay questions. The test items were developed in alignment with the principles of accepted metacognitive theory. by Flavell (1979), encompassing planning, monitoring, and evaluation. Prior to utilization, the instrument underwent testing for validity and reliability to ensure measurement quality. The correctness of the test items was confirmed by validity analysis utilizing Pearson's Product-Moment correlation. The results of the validity test indicated that all five items were valid and suitable for use as research instruments. Meanwhile, Cronbach's Alpha was used to assess the reliability of the measurement results (Hajaraoh & Raehanah, 2022). The reliability test yielded a Cronbach’s Alpha coefficient of 0.679, indicating that the instrument had acceptable reliability and was suitable for data collection.

However, a number of analytical requirements must be fulfilled before moving on to the hypothesis testing phase. The data distribution's normality was initially assessed using the Shapiro-Wilk test, as the sample size in this study was comparatively small (Quraisy, 2020). Subsequently, Levene's test is employed to verify the equality of variances among groups. The data is classified as homogeneous if the significance value (p) exceeds 0.05; conversely, if p is below 0.05, the data is classified as non-homogeneous. The hypothesis was evaluated by an independent samples t-test once the prerequisites were satisfied. The objective of this test was to evaluate whether the experimental group that underwent the Blooket-assisted RADEC model intervention exhibited different metacognitive abilities compared to the control group that did not receive the intervention (Nuryadi & Dewi Astuti, 2017).

RESULTS AND DISCUSSION

The experimental and control groups were formed using different methods to establish an objective basis for comparison. The final test results from both courses were further examined to assess the impact of the RADEC learning paradigm, supported by Blooket, on students' metacognitive abilities. Different treatments were applied to the two classes to create a neutral basis for comparison. Consequently, an empirical analysis of the utilization of this learning model by the two groups may be conducted. Subsequently, descriptive statistics, prerequisite tests, and hypothesis testing were performed. The research sample included two classes with a total of 62 students. The findings of the descriptive analysis of the posttest scores are summarized as follows.

This makes it easier to confidently link any differences in outcomes to the use of the RADEC model, which is backed by Blooket. The comparison between these two treatments shows how the learning model can shape students' metacognitive abilities. The descriptive statistical data provides us a clear picture of how the data is spread out, highlighting things like the average score and the differences within each group. This initial analysis holds significance as it provides valuable insights into the overall characteristics of the data, paving the way for more complex statistical tests to follow.

Table 1. Summary of Descriptive Statistics for Posttest Scores

Class	N	Min. Value	Max. Value	Mean	Std. Deviation
Experiment	32	45	90	66.47	10.314
Control	30	38	82	59.47	12.085

Table 1 presents a summary of the descriptive statistics regarding students' metacognitive abilities. The experimental group showed better results than the control group. The mean scores achieved by the two classes were 66.47 and 59.47, respectively. The experimental group reached a high score of 90, while the control group scored 82. The results indicate that students in the experimental group showed enhanced metacognitive skills after being taught with the RADEC learning model, along with the use of Blooket. The higher maximum scores in the experimental class suggest that some students experienced better learning results after the intervention. The higher average scores in the experimental class indicate that students showed improved skills in organizing and handling their thinking during math learning activities. Students in the experimental group showed a higher level of involvement in understanding concepts, discussing ideas, and evaluating problem-solving solutions than those in the control group. Before conducting hypothesis testing, we first used tests for homogeneity and normality to ensure that the study's criteria were met. The results of the normality test can be found in Table 2.

Table 2. Normality test results

	Shapiro-Wilk		
Class	Statistic	df	Sig.
Experiment	.973	32	.588
Control	.971	30	.555

To ensure that the use of parametric statistics is appropriate, before assessing the hypothesis, a normality assumption test was carried out. Table 2 test results indicate that the experimental group's significant value (p) is 0.588. Conversely, the control group's significance value is 0.555. The data values in both groups have a normal distribution, as both satisfy the condition of $p > 0.05$. Consequently, the assumption of normality is intact. The results demonstrate that the prerequisites for parametric analysis have been satisfied, allowing for the subsequent application of parametric statistical methods to the data. The fulfilment of the normality assumption indicates that the data distributions in both groups are stable and suitable for further statistical analysis. Therefore, the results obtained in this study can provide a more accurate picture of the effect of the Blooket-assisted RADEC learning model on students' metacognitive abilities.

Table 3. Results of the Data Homogenity Test

	Levene Statistic	df1	df2	Sig.
Based on Mean	1.236	1	60	.271

Following the normality test, to make sure that the data distribution was equal across groups, the next step was to look for homogeneity in variances. The p-value for this test was 0.271, which is higher than the significance level of 0.05. Thus, it can be said that the criteria for statistical significance ($p > 0.05$) have been met. This indicates that the differences in the data between the experimental and control groups are relatively stable. Therefore, the variance and distribution of the data show no notable differences between the two groups. The variance of each group can be considered similar. This meets the requirement for consistent variance. This condition creates a strong base for performing data analysis using parametric testing methods. The results of the homogeneity test show that the two groups share similar characteristics before the medication is given. As a result, the learning interventions carried out during the study probably played a significant role in influencing the differences in the outcomes.

Table 4. The Result of Hypothesis

	t	df	Sig. (2-tailed)
Assumed	2.459	60	.017

Upon the successful completion of all precondition tests, including those for normality and homogeneity, the study advanced to the primary hypothesis testing phase. An independent samples t-test was employed to compare the metacognitive abilities of the treatment group with those of the control group. The analysis shown in Table 4 indicates statistically significant findings, since the significance value (Sig. 2-tailed) is 0.017, which is less than $\alpha = 0.05$. This illustrates the significant disparities between the experimental and control groups, which is the main aim of this study. The results demonstrate that the application of the RADEC learning paradigm, augmented by Blooket, significantly enhances students' metacognitive abilities. The results demonstrate that learning activities conducted via the RADEC phases effectively enhance students' metacognitive skills. Students are urged to comprehend mathematical concepts and to oversee, assess, and evaluate their learning processes during educational activities.

The basic characteristics of the RADEC learning model strongly influence its success. The RADEC learning approach prioritizes the active engagement of students in the learning process. This methodology is highly effective in improving metacognitive skills through several systematic processes. Accordingly, metacognitive skills in learning enable students to organize the knowledge they receive to make informed decisions in problem-solving (Fisher & Al-Tamar, 2024). These stages enable pupils to develop systematic thinking processes particularly in the planning, monitoring and evaluation of their cognitive activities according to Flavell's theory. Besides that, the use of Blooket can enhance enthusiasm and motivate students in their learning (Christianto et al., 2024).

The 'read' stage allows students to make sense of the learning material on their own before doing any class activities. Students strengthen their reasoning and critical thinking abilities by analyzing contextual problems while reading (Pratama et al., 2019). At this stage pupils find crucial information and establish first methods to solve arithmetic problems. In this activity, students read a passage from the textbook and view an educational film. Subsequently, students are presented with challenges via prompting questions with Blooket and respond based on their comprehension and interpretation of the material. Previous study indicates that the implementation of educational games engaging students can boost their conceptual comprehension abilities (Assegaf & Bonyah, 2024). Such exercises promote the development of planning skills, which are an important part of metacognitive capabilities. Furthermore, students are more prepared to participate in class discussions because they have a fundamental comprehension of the material to be learned. This can allow pupils to feel more confident in sharing their ideas and opinions during learning sessions.

Next is the "answer" stage where students get to use their initial comprehension by answering questions relevant to the topic they have learned. This phase matters since it assesses the students' mastery of the content covered in the preceding stage (Yohana et al., 2022). According to previous research findings, to achieve good critical thinking skills, it is necessary to use effective questioning techniques to facilitate students in processing their thinking (Satria & Sopandi, 2019). At this stage, children are encouraged to organize their cognitive processes and identify the proper solutions for solving arithmetic problems on their own. Consequently, students are more actively engaged in the process of developing their own comprehension.

The phases of "discuss" and "explain" are crucial for the enhancement of pupils' metacognitive abilities. Discussion exercises empower students to share ideas, test responses, and monitor the effectiveness of their approach. When learning prioritizes discussion thru group assignments, students are able to elaborate on the problems they face to discuss them together (Novianti et al., 2025). When students discuss, they are actually developing their critical thinking and reasoning skills in finding solutions to the given problems (Widodo et al., 2024). Meanwhile, the explain stage teaches students to articulate their thinking clearly and systematically. Such activities enhance students' awareness of their cognitive processes and assist them in identifying errors in problem-solving.

Furthermore, during the "create" phase, students can develop learning products pertinent to the mathematical curriculum they have engaged with. These activities allow students to categorize topics, highlight vital information, and show their knowledge in innovative ways. The assignment is designed to develop students' creativity in creating products from learning materials (Salim et al., 2026). At this stage, students explore and devise multiple solutions to the assigned challenges (Khaerunnisah et al., 2023). This phase allows students to assess how well the tactics worked and to think about their own thought processes throughout the learning journey. Students are guided not just to arrive at the right answer, but also to comprehend and evaluate the thought processes involved in tackling mathematical problems.

As a result, when looking at the experimental class, it appears that the control group, which did not undergo a similar intervention, generally showed poorer metacognitive skills. This discovery resonates with the metacognitive idea put forward. by Flavell (1979), which highlights the importance of awareness and management of thinking processes. Furthermore, using Blooket as a game-based tool increases student engagement in their learning journey. The RADEC learning approach is interactive and encourages active participation, which greatly supports the growth of metacognitive abilities and other advanced thinking skills. This positively influences students' metacognitive skills. On the other hand, the control group, which did not take part in the RADEC model intervention, had fewer chances to actively engage in cognitive processes when compared to the experimental group.

Metacognitive skills might be connected to how well instructional design matches with students' cognitive engagement. Metacognitive ability provides awareness of one's own knowledge in thinking and processing information (Pintrich, 2002). People who struggle with self-awareness may discover it challenging to express possible solutions to their challenges (Wang et al., 2024). Students with metacognitive abilities understand their actions and have developed learning strategies, which help them grasp the tasks they need to accomplish (Marantika, 2021). The organized stages in the RADEC model offer a straightforward learning journey, guiding students as they slowly become more aware of their own thought processes. Students are invited to take an active role in their learning by planning, monitoring, and evaluating their understanding during mathematics activities. Additionally, incorporating Blooket brings in aspects of engagement and instant feedback through interactive responses. This combination enables students to engage more actively and reflect on their understanding in real time as the learning process progresses. Moreover, the utilization of technology-based media can facilitate the accommodation of diverse student learning styles, so rendering the educational experience more inclusive and adaptable. Consequently, the amalgamation of the RADEC learning model and Blooket can function as an efficacious strategy to enhance students' metacognitive skills in mathematics education.

The outcomes correspond with those presented by Eka et al. (2025) who discovered that metacognition-based learning strategies might enhance students' awareness of their cognitive processes. This study reinforces these findings by illustrating that the amalgamation of the RADEC learning model and Blooket enhances students' capacity to plan, monitor, and assess their learning processes in mathematics education. Moreover, Dockendorff et al. (2025) highlighted the transformative capacity of significant technological integration in improving students' comprehension of mathematical topics. (Mirriahi et al., 2025) contended that technology enhances students' comprehension solely when learners are actively engaged in the educational process. This study substantiates the premise that Blooket was not only utilized as a digital tool but was also included into the systematic phases of the RADEC model, facilitating active student engagement in learning activities. This discovery aligns with Abbassyakhrin et al. (2024) who suggested that gamification has the potential to enhance higher-order thinking skills and boost student engagement? As a result, combining the RADEC learning approach with Blooket could create a more engaging, thoughtful, and meaningful educational experience that helps students improve their metacognitive skills.

An extra viewpoint that enhances these findings is the importance of structured reflection integrated within the RADEC framework. The stages of the RADEC model guide students in slowly becoming more aware of their thinking processes through engaging activities. This process aligns with Flavell's theory of metacognition, highlighting the importance of planning, monitoring, and evaluating as key elements of metacognitive skills. Using the RADEC model in learning boosts student involvement in educational activities, which in turn enhances their understanding, critical thinking, and creativity (Novianti et al., 2025). Additionally, incorporating Blooket brings in engaging feedback and fun game-like features that motivate students to get involved and contemplate what they're learning throughout the process. The use of technology-based media also supports different student learning styles, creating a more inclusive and adaptable learning environment. Blooket has the potential to enhance how students learn and boost their interest in educational activities. (Amalia & Sujarwati, 2025).

The findings of this study offer several important insights for teaching mathematics. Mathematics educators can explore the RADEC learning model, complemented by Blooket, as a different teaching approach to help students strengthen their metacognitive skills. Students work together in groups to tackle questions using Blooket, creating a fun and engaging learning experience. The friendly competition between groups helps reinforce the material and makes the process more enjoyable.(Wongsaming et al., 2023).These findings underscore the necessity for learning media developers to create digital learning resources that facilitate students' reflective thinking processes. The findings indicate that technology-driven and student-focused learning methodologies should be enhanced in mathematics education. Integrating games into educational content might facilitate improved comprehension among students, consequently augmenting their cognitive and emotional capacities (Pebrianti, 2025). Furthermore, future studies are recommended to explore RADEC learning model especially when implemented with gamification in different educational levels, subjects, or learning environments. Overall, the findings imply that integrating gamified learning platforms into structured pedagogical models may strengthen students' self-regulated learning and metacognitive engagement during the learning process.

CONCLUSION

The combination of the RADEC learning model with the Blooket platform has greatly enhanced students' metacognitive skills. The students in the experimental group showed improved metacognitive skills compared to those in the control group, highlighting how effective the intervention was in fostering metacognitive growth during their mathematics learning journey. These findings indicate that combining structured learning models with technology-based media can be a valuable way to boost students' metacognitive skills and encourage them to actively participate in their learning journey. This study plays a significant role in advancing technology-assisted mathematics learning by offering concrete evidence on how the combination of the RADEC learning model and Blooket can enhance students' metacognitive growth. The findings also have practical implications for mathematics teachers in implementing interactive and student-centered learning approaches, as well as for learning media developers in designing digital learning environments that encourage reflective thinking. Future research is recommended to investigate the implementation of the RADEC learning model supported by Blooket at different educational levels, mathematical topics, or learning environments and to examine its long-term effects on students' metacognitive abilities and other higher-order thinking skills.

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