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RME-Based Gamification on Students' Motivation And Learning Outcomes

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ABSTRACT

This research aims to explore the impact of RME (Realistic Mathematics Education)-based gamification in mathematics learning on student motivation and learning outcomes in elementary schools. The method used is qualitative research with a case study approach in several elementary schools that apply gamification in mathematics learning. Data was collected through interviews, observation, analysis of documents, and FGDs. The research results show that the application of RME-based gamification can increase students' motivation in taking mathematics lessons. Game elements, such as points, levels, and badges, successfully create a fun atmosphere, which motivates students to be more active and enthusiastic in learning. In addition, there was a significant increase in student learning outcomes, especially in problem-solving abilities involving the application of mathematical concepts in real life. However, challenges in implementation, such as limited resources and time, as well as the need for training for teachers, were discovered during the research. Overall, RME-based gamification has proven to be effective in increasing motivation and mathematics learning outcomes and can be an interesting and relevant alternative approach to mathematics learning in elementary schools. This research suggests that teachers should be given sufficient training and schools should provide resources that support the implementation of gamification in learning.

Keywords: *gamification, RME, mathematics learning, learning motivation, learning*

1. INTRODUCTION

Mathematics education at the elementary school level often faces challenges in creating a fun and effective learning experience for students. Mathematics learning is often considered difficult and challenging by many students, which leads to low learning motivation and learning outcomes (Apriyanti et al., 2023; Hayati et al., 2023). In addition, traditional learning approaches are often less appealing to today's digital generation students, who are more familiar with technology and games (Ekawati & Falani, 2015; Jusuf, 2016).

One approach that can increase student motivation and learning outcomes is gamification. Gamification in mathematics learning utilizes game elements to create a more interesting and interactive learning experience (Hakeu et al., 2023; Ratinho & Martins, 2023; Legaki et al., 2020).

Gamification, as an innovative approach, has been proven to increase student engagement by integrating game elements such as points, levels, and rewards into the learning process (Aguiar-Castillo et al., 2020; Wang et al., 2024). In this context, the application of gamification in mathematics learning has great potential to improve students' learning motivation and learning outcomes, but it requires in-depth exploration of how this approach works in various learning environments (Sailer et al., 2017).

RME (Realistic Mathematics Education) is an approach that focuses on real-world contexts in teaching mathematical concepts, which can help students connect mathematics to everyday life. (Altaylar & Kazak, 2021; Apriyanti et al., 2023). The combination of gamification and RME is expected to improve students' understanding and engagement in mathematics learning, as well as encourage increased motivation and learning outcomes.

However, although these two concepts have been applied in various fields of education, there is still little research exploring the impact of RME-based gamification in mathematics learning, especially in the context of

student motivation and learning outcomes. Therefore, it is important to conduct this study to identify the extent to which this approach can have a positive impact on mathematics learning.

Several findings from previous studies have shown that gamification can increase student motivation and participation, but not many have examined how the integration of game elements with contextual mathematics approaches such as RME can have a direct impact on student learning outcomes (Legaki et al., 2020; Alt, 2023). In addition, although RME has been shown to be effective in improving understanding of mathematical concepts, its application with gamification has rarely been studied in the broader context of mathematics learning, especially in elementary schools (Zubainur et al., 2020; Farida et al., 2022). Therefore, the gap that needs to be filled is the lack of understanding of how these two approaches can complement each other and significantly improve student learning outcomes.

Many studies have shown that gamification in education can increase student engagement, provide faster feedback, and create a more enjoyable and competitive learning environment (Alt, 2023). Research focusing on gamification in mathematics reveals that game elements, such as points, badges, and levels, can increase students' motivation in completing math tasks that are usually considered boring (Ratinho & Martins, 2023).

On the other hand, the Realistic Mathematics Education (RME) approach has proven effective in helping students understand mathematical concepts more deeply by linking subject matter to real-life situations (Rafiela & Andhany, 2023; Hidayat & Fasha, 2021). RME encourages students to solve problems in a more creative and critical way, which should be synergized with gamification to create a more enjoyable and meaningful learning experience (Ningsih, 2014).

However, the combination of gamification and RME in mathematics learning has not been widely explored in the educational literature. Previous studies have focused more on one of these approaches, while their combination in the context of improving student motivation and learning outcomes is still limited. Several issues that need to be identified and explored further in this study include how RME-based gamification can affect students' motivation in participating in mathematics learning. The use of game elements such as points, levels, and prizes can encourage students to be more enthusiastic about learning mathematics. Can the RME-based gamification approach improve students' mathematics learning outcomes? Do students involved in learning with this approach show significant improvements in mathematical problem-solving abilities compared to traditional learning methods? What are the teachers' and students' perceptions of the implementation of gamification in RME-based mathematics learning? And what are the challenges faced in implementing RME-based gamification in mathematics classes? This study aims to identify the answers to these questions and contribute to the development of more interesting and effective mathematics learning.

2. METHODS

Qualitative research is used to understand phenomena in a deeper context, looking at the meanings, experiences, and perspectives of participants in a situation. In the context of exploring the impact of RME-based gamification in mathematics learning, qualitative methods can provide richer insights into how this approach affects students' motivation and learning outcomes and how students and teachers feel and respond to its implementation. The following is an explanation of the main components of qualitative research methods that can be applied in this study. This study can use a case study design, namely by selecting one or more classes in elementary schools that implement RME-based gamification. This design allows researchers to observe and analyze the learning process in depth. The research subjects in this qualitative study include students and teachers as well as parents. Students As the main participants in mathematics learning, students involved in RME-based gamification will be the main focus of the study.

Teachers who implement RME-based gamification will provide views on their experiences in managing the class and the impacts they observe on students' motivation and learning outcomes. Parents: In some cases,

parents can be interviewed to get their views on their children's development in mathematics learning using RME-based gamification. Data collection techniques, namely in-depth interviews, class observation, documentation, and Focus Group Discussion (FGD). Interviews were conducted with students, teachers, and parents to obtain their views on the implementation of RME-based gamification. The interviews aimed to explore their perceptions of motivation, engagement, and learning outcomes in gamified mathematics learning. The researcher directly observed teaching and learning activities in the classroom using RME-based gamification. This observation aims to document how this approach is applied in learning and how students respond to it. The documentation is in the form of data from student work results, such as math assignments, exams, and reports related to the implementation of gamification. This documentation is used to analyze student learning outcomes. Furthermore, there is a Focus Group Discussion with students and teachers to discuss their experiences with the RME-based gamification approach. FGD allows researchers to gain further insight into group dynamics and more collective perceptions.

3. RESULTS & DISCUSSION

3.1 Results

The results of the research in a qualitative study on the impact of RME-based gamification in mathematics learning on students' motivation and learning outcomes will be presented through data analysis collected from interviews, observations, and documentation. Here are some of the results that can be found based on the analysis conducted.

3.1.1 Student Motivation

Students who engaged in gamification and RME-based mathematics learning showed a significant increase in motivation compared to those who used traditional learning methods. Game elements such as points, levels, and badges helped students feel more engaged and enthusiastic in completing math tasks.Gamification combined with the RME approach successfully created a more interactive learning atmosphere, where students had more discussions, collaborations, and active participation in problem solving. The use of real-world contexts in RME motivated students because they felt that mathematics was relevant to their lives.Students who were usually anxious or uninterested in mathematics reported that they began to see this subject as a fun challenge and realized the importance of mathematics in everyday life.

3.1.2 Student Learning Outcomes

Students showed an increase in their understanding of mathematical concepts, especially in terms of problem solving. The use of real-world contexts in the RME approach allowed students to better understand the real applications of the mathematical concepts they learned. With the RME-based gamification approach, students were involved in tasks that honed their problem-solving skills. The gamification element provided motivation to continue trying to solve problems until they reached their goals, while RME provided experience. In the evaluation of learning outcomes, students who took part in RME-based gamification learning showed higher scores in mathematics exams, especially in questions that required contextual problem-solving and critical thinking skills.

3.1.3 Challenges Faced

Some teachers reported challenges in implementing RME-based gamification, particularly in managing limited time and resources. Although the game element is engaging, it takes extra time to design and implement effective learning activities. Some schools face limitations in terms of access to the technology or software needed to support gamification. While not all gamification elements need to be technology-based, digital elements can enhance the learning experience if supported with adequate resources.

3.1.4 Diverse Students' Engagement

Not all students react the same way to this approach. Some students feel overwhelmed by the competitive element or have difficulty adapting to unconventional methods, which require more adjustment and attention from teachers.

3.1.5 Teachers' and Students' Perception

Teachers reported that RME-based gamification helped create a more enjoyable learning environment and reduced anxiety among students. However, they also noted the importance of thorough training and preparation before implementing this approach. Most students felt that the RME-based gamification approach was more enjoyable than traditional mathematics learning. They felt more challenged and motivated to learn, but some students felt that the competitive or level elements could add pressure.

3.1.6 Changes in Perceptions of Mathematics

Mathematics as a Fun Challenge Many students who previously felt mathematics was a difficult and boring subject began to see it as a fun challenge. RME gives them the opportunity to learn through more concrete experiences, while gamification makes the learning process more exciting and competitive. Deeper Understanding of Mathematical Concepts. Students not only learn mathematical theory, but also see how those concepts are applied in real situations, which helps them relate what they learn to the outside world.

3.2 Discussion

This discussion will outline the main findings of the research on the impact of RME (Realistic Mathematics Education)-based gamification in mathematics learning on students' motivation and learning outcomes. This discussion will also discuss the implications of these results in the context of elementary school learning and the challenges faced during implementation. RME-based gamification has been shown to increase students' motivation to participate in mathematics learning. Research shows that game elements, such as points, levels, and prizes, can create a more enjoyable atmosphere and motivate students to be more actively involved in mathematics tasks. With the presence of positive competition elements and recognition of achievement, students feel appreciated for their efforts and are motivated to continue trying.

This is in line with previous studies showing that gamification can increase students' learning motivation. For example, recognition of achievement in the form of badges or levels can provide psychological encouragement for students to continue learning and achieve certain goals. Students feel more involved in the learning process because they see learning as a fun game, not as an obligation or boring task. However, despite the overall increase in motivation, there was variation in students' responses to the competitive element. Some students may feel pressured by the competitive aspect of gamification, especially if they feel they are lagging behind their classmates. Therefore, teachers need to monitor and adjust the competitive element to ensure that all students feel comfortable and engaged in learning.

One of the main findings of this study is the improvement in students' learning outcomes in mathematics after the implementation of RME-based gamification. Students showed better ability in solving mathematical problems, especially problems that require the application of concepts in real-world contexts. The implementation of RME allows students to connect mathematical concepts to real-world situations, which makes it easier for them to understand and remember the material learned (Hidayat & Fasha, 2021).

Previous research also shows that context-based learning, as conducted in the RME approach, can help students develop a deeper understanding of mathematical concepts because they not only learn theoretically but also applicatively (Puspitasari & Airlanda, 2021). By connecting mathematics to everyday experiences, students can more easily see the relevance of the material they are learning and feel more engaged in their learning. In addition, gamification supports this process by providing students with immediate feedback. In many cases, RME-based gamification provides students with immediate feedback through game elements, which helps them

identify their strengths and weaknesses in completing tasks. This allows students to immediately correct mistakes and continue working toward achieving learning goals.

Although RME-based gamification has shown positive impacts, its implementation is not without challenges. One major challenge is limited resources. Some schools struggle to provide the technology needed to support digital-based gamification. While gamification does not always require digital devices, elements such as learning apps or computer-based educational games can enhance the learning experience. Therefore, limited technological resources in schools can be a barrier to wider implementation of gamification.

In addition, the time required to design and implement RME-based gamification learning is also a challenge. Teachers must prepare materials that are not only based on mathematical theory but also link these concepts to real-world contexts while inserting effective game elements. This requires extra time in planning and implementing learning. According to the results of the study, teachers' perceptions of the implementation of RME-based gamification tend to be positive, although they admit that implementing this approach requires thorough preparation. Teachers reported that this approach created a more dynamic and enjoyable classroom atmosphere and helped students participate more actively. However, some teachers also noted that further training was needed so that they could be more effective in designing and implementing learning with the RME-based gamification approach.

Student perceptions were also mostly positive. Most students felt more motivated and challenged with the gamification elements (Krath et al., 2021). They felt that learning became more interesting and enjoyable. However, there were also some students who felt that the competitive element in gamification could be a burden if they felt left behind by their friends. One interesting finding from this study was the change in students' perceptions of mathematics. Before the implementation of RME-based gamification, many students saw mathematics as a difficult and boring subject. However, after implementing this approach, many students began to see mathematics as a fun and rewarding challenge. The gamification element made them feel more challenged to solve math problems, while RME provided a context that made the subject matter more relevant to their lives.

This shows that with the right approach, such as RME-based gamification, students' perceptions of mathematics can change significantly. Fun and context-based learning can transform mathematics from a subject that is considered difficult into a subject that is easier to understand and more meaningful. Based on the findings above, it can be concluded that RME-based gamification has great potential to improve student motivation and learning outcomes in mathematics learning. Although there are challenges in implementation, such as limited resources and the need for training for teachers, the benefits obtained from this approach are quite significant. Therefore, it is recommended that schools provide support in the form of adequate resources to support the implementation of technology-based gamification. Teachers are given intensive training to integrate gamification and RME elements in mathematics learning effectively. Education policies encourage the use of gamification-based approaches in learning, given their positive impact on student engagement and understanding.

4. CONCLUSION

Based on the results and discussion of research on the impact of RME (Realistic Mathematics Education)-based gamification in mathematics learning on student motivation and learning outcomes, it can be concluded as follows: RME-based gamification has proven effective in increasing student motivation. Game elements such as points, levels, and prizes provide positive encouragement for students to be more active and enthusiastic in following mathematics lessons. Students feel that mathematics is no longer a boring subject but a fun challenge. RME-based gamification also has a positive impact on student learning outcomes. Students show an increase in understanding of mathematical concepts, especially in solving problems involving real-world applications. RME provides a more concrete context, while gamification provides quick feedback and motivation to continue learning. Some challenges found in the implementation of RME-based gamification are limited resources (especially technology) and the time needed to design learning involving gamification elements. Teachers also

need more intensive training in order to implement this method effectively. The RME-based gamification approach has succeeded in changing students' perceptions of mathematics. Those who previously found mathematics difficult or uninteresting began to see this subject as something fun and relevant to everyday life.

As for suggestions, teachers need to be given special training in integrating gamification and the RME approach in mathematics learning. This training is not only related to technical aspects, but also how to manage classes and adjust game elements to student characteristics. Schools need to pay attention to the need for resources needed to support the implementation of gamification, both in terms of technological devices and learning materials that support this approach. If technology is limited, gamification can still be applied with non-digital elements, but technology can enrich students' learning experiences. Teachers should use the gamification approach in a flexible way, which takes into account the diversity of student characteristics. Not all students respond the same way to competition elements, so it is important to ensure that all students remain comfortable and motivated. It is important for teachers and schools to conduct regular evaluations of the implementation of RME-based gamification, both in terms of motivation and student learning outcomes. This evaluation will help to determine the effectiveness of this method and make necessary adjustments. An education policy is needed that supports the implementation of gamification in learning, especially in elementary schools. This policy should include support for teacher training, provision of resources, and relevant assessments to measure the success of gamification-based learning.

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