

Developing An Adventure Game Prototype As A Gamification Model Design In Learning Algebraic Structures, As Seen In The Gams Of Students' Interests And Learning Outcomes

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Abstract

The purpose of this research is to develop a prototype design for an adventure game using a gamification model applied to an algebraic structure course. This was done because student interest in games, particularly serious games, is very high. Meanwhile, student interest in algebraic structure courses remains low. This research is a Research and Development (R&D) study using the ADDIE development model, which includes five stages: analysis, design, development, implementation, and evaluation. This study focused on student interest and learning outcomes after learning with an adventure-based Android game-based gamification model. The results showed a 24.87% increase in interest and 21.30% increase in learning outcomes compared to before the gamification model.

Therefore, the gamification learning model design based on an adventure game (algebra searcher) in an algebraic structure course is effective in increasing student interest and learning outcomes.

Keywords: Gamification model, Adventure game, Interest in learning, Learning outcomes

1 INTRODUCTION

Among the various types of games closely related to gamification are war games, simulation games, serious games, and alternate reality games (Kim et al., 2018). The challenge across all these types of games lies in understanding the consumers or users of gamified products designed based on these game types. This understanding is necessary to ensure that the gamification design aligns with the characteristics of the users. Furthermore, they define gamification as follows:

Gamification is not a single activity but a series of relevant activities and systematic processes. Gamification must have a goal of solving specific problems.

Merely using game mechanisms, such as badges and points, should not be considered gamification. Gamification must be based on the characteristics of game elements.

Meanwhile, in the context of education and instruction, gamification is defined as: "Gamification in learning and education is a set of activities and processes to solve problems related to learning and education by using or applying game mechanisms."

The internet, with all the facilities it offers, provides greater benefits when utilized properly. Currently, the intensity of internet usage is very high; therefore, it would be beneficial if internet use, especially among students, could be better directed toward academic purposes. "Computer use among students includes a range of online entertainment activities such as browsing for fun, instant messaging, and online chatting" (Feng et al., 2019). Hence, it is necessary to design engaging games related to learning in schools and universities, so that students are encouraged to spend more time learning academic material rather than merely using the internet for other purposes. In this regard,

gamification is expected to improve motivation, achievement, and learning interest without eliminating games, which are a source of enjoyment for students. "As part of online learning together with gamification, it has been used as a framework to investigate student motivation and engagement" (Bovermann et al., 2018).

A group is a set equipped with a binary operation (usually addition or multiplication) that satisfies several fundamental properties. Group theory is one of the important concepts in algebraic structure courses. Group theory studies the properties and structures of sets with binary operations that meet certain conditions. In this paper, we explain the concept of group theory, the properties of groups, and examples of groups commonly used in mathematics.

In the current era, understanding various games has become easier because students are generally accustomed to games, particularly computer-based and online games. It is therefore reasonable to assume that students' perceptions of new assessment methods related to digital innovation will always be positive (Moore, 2018). Moreover, online learning facilitates more flexible interaction between students and teachers, without constraints of time and place, as long as both parties agree. "Online learning environments provide students and teachers with different approaches to interact, share, and offer them the ability to collaborate and ask questions in real time through available learning technologies" (Islam et al., 2017). Thus, incorporating games into learning, whether online or offline, can make the learning process more enjoyable.

Recent research on gamification has shown a significant increase, indicating that researchers see considerable opportunities to explore, particularly in the fields of teaching and learning. "Games, gamification, simulations, or virtual reality related to emotional and entertainment environments that can contribute to improved learning rarely appear" (Ferrés, Masanet, & Mateus, 2018), suggesting that both virtual and non-virtual game simulations in learning contexts are still not widely implemented. This is supported by the fact that "gamification can be useful for learning and teaching because it can increase student engagement" (Kim et al., 2018). Other studies support this view, showing that the application of games, gamification, simulations, or virtual games in learning leads to positive outcomes in student learning motivation. Mekler, Brühlmann, Tuch, and Opwis (2017) examined the effects of gamification elements on individual intrinsic motivation and learning performance, while Feng, Ye, Yu, Yang, and Cui (2018) found that individual intrinsic motivation positively regulates the impact of gamification artifacts on participation (Zhang & Liu, 2019). At the university level, Hanus and Fox (2015) also investigated the effects of gamification in classrooms by measuring academic performance at a large university in the United States, using convenient samples to assess other educational aspects such as attendance, design, and affective elements (Lai & Bower, 2019).

Gamification in computer technology, both online and offline, must be designed in a way that facilitates ease of use in the learning process. Both the interface and the game commands should be user-friendly. "Progress visualization is common in human-computer interface systems and is a key feature of computer games and gamified learning systems" (AlJarrah, Thomas, & Shehab, 2018). With applications designed for simplicity, students are more likely to enjoy the games presented, which in turn is expected to increase their willingness to engage with assigned tasks. "Students' use of applications and their engagement, retention, and academic achievement in subjects show that all these measures are positively correlated with application use" (Juan, Loch, Daradoumis, & Ventura, 2017). Research by Orhan Göksün and Gürsoy (2019) found that "quantitative study findings indicate that gamification affects students' academic achievement and engagement in scientific research methods courses." Ebner and Holzinger (2007) also stated that "gamification as an original and comprehensive framework is more effective in education, as several studies have shown the positive effects of educational games" (Yildirim, 2017). Other research demonstrating the advantages of gamified games in learning processes or student responses was presented by Koivisto and Hamari (2014), who stated that "overall, it can be said that they show better performance compared to

participants who were not given any game elements, further indicating the potential effectiveness of gamification in encouraging certain behaviors” (Mekler et al., 2017). Nevertheless, the conditions of students as users still need to be studied more deeply to obtain further insights so that the designed gamification can be developed more effectively in accordance with users’ cognitive development needs.

Recently, online learning has been widely developed at the university, secondary, and even primary school levels. Online learning is conducted using various methods and media, such as images, videos, audio, audiovisual materials, or, in its simplest form, the distribution of learning modules and assignments that must be completed. Imagine if all these elements were accommodated and designed in the form of games with simple instructions that guide students to study and complete tasks through certain levels or stages, thereby encouraging curiosity and sustained motivation to find correct answers.

In this study, the researchers focus on developing a gamification model for teaching algebraic structures, specifically group theory, based on an Android adventure game, by measuring its effectiveness in terms of students’ learning interest and learning outcomes.

2 RESEARCH METHODS

The research we conducted involved 23 students from the Mathematics Education study program at Nggusu Waru University, Bima City, in the Algebraic Structures course, specifically on group theory material. This type of research is Research and Development (R&D) using the ADDIE model, which includes:

a. Analysis

This stage involves analyzing students’ learning difficulties in group theory in the Algebraic Structures course. Difficulties often arise when students incorrectly apply theorems, axioms, and lemmas during problem-solving. This generally occurs because students feel they have forgotten the material. In addition, this stage examines the types of games that students commonly use in their daily lives.

b. Design

Determining gamification elements, types of games, levels, points, rewards, and game flow that are suitable for students’ gaming characteristics.

c. Development

This stage involves creating an Android game design by selecting an available game development studio/generator.

d. Implementation

Conducting trials with students from the Mathematics Education study program at Nggusu Waru University.

e. Evaluation

Expert validation to provide assessments of the developed product.

The evaluation in this study was carried out by comparing the results before and after using the gamified learning model with the Android game “Algebra Researcher.” Learning outcomes were analyzed based on pre-test and post-test questions, while learning interest was analyzed using questionnaire results with a Likert scale (1–5).

3 RESULT AND DISCUSSION

3.1 RESULT

This study employed a Pre-Experimental Design, specifically the One-Group Pretest-Posttest Design. The results of the analysis indicate an increase in students’ interest and learning outcomes after learning through the Android game-based gamification model “Algebra Researcher.” This improvement can be seen in the following table.

Tabel 1. Student Learning Outcomes and Learning Interest

Aspect	Pre-test	Post-Test	improvement	(%)
Learning Outcomes	68,20	82,72	14,52	21,30%
Learning Interest	65,14	81,40	16,26	24,87%

Referring to the table, there was an increase in students' learning outcomes of 21.30%, with the average score rising from 68.20 (pre-test) to 82.72 (post-test). Meanwhile, students' interest increased by 24.87%, where after using the "Algebra Research" game in the gamification learning model, the average score was 81.40, compared to the previous average of 65.14.

3.2 DISCUSSION

In gamified learning, the provision of rewards or prizes in the game for each student's success is very meaningful. However, for university students who have above-average abilities, rewards or prizes in the game are not something special for them, although they still enjoy the gameplay presented. This indicates that gamification has a positive impact on students with average academic abilities.

"Improvements in efficiency, effectiveness, motivation, and student engagement in online learning can be achieved through gamification. Gamification applies elements associated with video games (game mechanics and game dynamics) to non-game applications" (Urh et al., 2015). According to Lee and Hammer (2011), "Educational gamification leverages rule-based systems such as games, player experiences, and cultural roles to shape learners' behavior" (Aldemir et al., 2018). This demonstrates that learning through gamification can encourage the formation of positive learning behaviors. Similarly, the findings of Huang and Hew (2018) show the positive value of implementing gamification in out-of-class learning, stating that "Overall, this study shows that gamification has positive effects on motivating participants to complete more out-of-class activities and to produce higher-quality out-of-class artifacts compared to non-gamified courses."

It is also important to observe and consider students' attitudes toward games themselves. "Participants with positive attitudes and high levels of gaming experience expect greater benefits from gamification, whereas participants with negative attitudes and little gaming experience expect greater benefits from traditional instruction" (Nacke & Deterding, 2017). Those who enjoy games can take better advantage of gamification, while those who dislike games tend to experience fewer or even negative benefits. In this context, the role of the lecturer in managing the game and enhancing motivation is crucial. Therefore, lecturers are required to regulate and understand learning situations, appropriate task characteristics, learning environments, students' psychological conditions, levels of intelligence, and interests, so that gamification is not merely about designing an attractive game. Ultimately, "Improvements in efficiency, effectiveness, motivation, and student engagement in e-learning can be achieved through gamification" (Urh et al., 2015). Gamification is highly dependent on the game's interface, including clear step-by-step instructions and command buttons that can be easily understood by students. Game-based learning makes it easier to encourage students to be more interactive during the learning process, as supported by research findings stating that "Game-based learning environments have significant potential to challenge and engage students in active learning processes" (Estriegana et al., 2019).

3 CONCLUSION

- a. Learning outcomes shown after the learning process using gamification indicate an improvement or are better compared to conventional learning methods.

b. Students enjoy learning through gamification, because the world of games is their world. As a result, learning is not merely an activity that must always be carried out seriously, but can also be conducted in a more relaxed way by involving their favorite game

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