PCMJ

Progress in Computer and Mathematics Journal (PCMJ)
volume 3 [November, 2025]
e-ISSN: 3030-6728
Website: fskmjebat.uitm.edu.my/pcmj

LIFE WITH MATHS: GAME-BASED LEARNING ON HOW TO USE MATHEMATICS IN DAILY LIFE

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Article Info

Received: March 2025
Accepted: September 2025
Available Online: November 2025

Abstract

Mathematics is a crucial skill in daily life; however, many students find it uninteresting and difficult to apply outside of the classroom. This project, Life With Maths: Game-Based Learning on How to Use Mathematics in Daily Life, addresses the issue by creating an interactive visual novel that teaches students in primary school's practical mathematical applications in an enjoyable way. The project uses a game-based learning (GBL) strategy that combines storytelling and interactive problem-solving to reinforce fundamental mathematical concepts including addition, subtraction, multiplication, and division. The development follows the Game Development Life Cycle (GDLC) methodology, ensuring an organized process from concept to implementation. Unity was used as the major development platform, and game mechanics were created using the EGameFlow model, which emphasizes concentration, goal clarity, feedback, challenge, autonomy, knowledge improvement, and immersion to improve the learning experience. User evaluation was done through gameplay testing, in which participants judged the game's ability to make mathematics interesting and applicable to real-world settings. The results showed a high engagement rate, with an overall enjoyment score of 85.6% and a total mean score of 4.28, showing that game-based learning can greatly improve students' mathematical knowledge and a sense of excitement. However, feedback recommended potential enhancements, such as adding a dual-language feature to increase accessibility. This research emphasizes the potential of interactive learning tools in education, opening the path for future developments in game-based educational applications.

Keywords: Game-Based Learning, Game Development Life Cycle, EGameFlow model, enjoyable

INTRODUCTION

Mathematics is important in daily life, but many students find it difficult to connect what they learn in class with real-world situations. Teachers often try to show how math can be useful, but the examples given may not always relate to every student. Most of the time, math is linked to careers in engineering and science, even though it is used in many other areas like sports. For example, in football, players might think kicking the ball at 60° is best, when in reality, 45° is the most effective angle (Dahiya, 2014). Mathematics also plays a key role in physics and problem-solving (Dahiya, 2014). Carl Gauss even referred to math as "the queen of the sciences" (Dahiya, 2014).

Even though math is used every day, many students struggle to apply what they learn in school to real-life situations. Kenedi et al. (2019) found that primary school students have a low ability to make mathematical connections through traditional learning methods. Many students have trouble solving basic math-related problems, such as calculating discounts or managing money (Putranto & Ratnasari, 2022). Jansen et al. (2016) also found that students often lack confidence in solving math problems outside the classroom. Another issue is that teachers sometimes struggle to provide real-life examples that make math more meaningful, relying too much on textbooks (Dahiya, 2014).

To solve this issue, Game-Based Learning (GBL) is a great way to make learning math more fun and engaging. By combining storytelling, problem-solving, and interactive challenges, students can see how math is used in real life. GBL also helps students develop important 21st-century skills, like creativity and critical thinking (Liu et al., 2020). With GBL, learning math can be more interesting and enjoyable, making it easier for students to understand and apply their knowledge.

LITERATURE REVIEW

Important of Mathematics

Mathematics is not just about numbers and calculations; it also involves logical thinking, problem-solving, and creativity (Khan, 2015). The subject has been essential for centuries, dating back to Al-Khawarizmi, the father of algebra, who contributed significantly to mathematical principles (Brentjes, 2007). It has been shown that strong mathematical skills help develop students' critical thinking and reasoning abilities (Jeyaraj et al., 2023).

Mathematics in Daily Life

Mathematics is widely used in everyday activities such as managing finances, time, and measurements. It plays a vital role in various industries, including technology, engineering, and business (Deepika, 2021). Research suggests that learning mathematics with real-world applications enhances students' understanding and appreciation of the subject (Van den Heuvel-Panhuizen & Drijvers, 2020). Despite its importance, many students find mathematics challenging and struggle to apply it in real-life situations (Putranto & Ratnasari, 2022).

Project Development

Mathematics-based educational games require careful platform selection and game design to maximize learning outcomes. Game platforms can include PC, mobile, and console gaming, each with unique advantages for engagement and accessibility. Studies suggest that PC games are preferred for structured learning, while mobile platforms offer flexibility for learning on the go (Murti et al., 2019).

In terms of game genres, research indicates that visual novel, puzzle, and adventure genres are particularly effective for game-based learning (Hu et al., 2023). These genres provide interactive storytelling and problem-solving mechanics, which enhance students' cognitive engagement (Park et al., 2019). This project adopts a visual novel approach combined with mathematical problem-solving to make learning more interactive and enjoyable.

Game-Based Learning

Game-Based Learning (GBL) is an innovative approach that incorporates gaming elements into education to improve engagement and retention. Studies indicate that students are more motivated to learn when mathematical concepts are presented in an interactive and enjoyable way (Liu et al., 2020). GBL offers various advantages, such as improved problem-solving skills, increased engagement, and better knowledge retention (Rondına & Roble, 2019).

Existing Applications

Several math-based educational games, such as Algebra Ridge and Mr. Rumble Tumble's Math Jumble, have successfully used gamification to improve learning. These games provide engaging experiences, but most lack localization for specific student groups, such as Malaysian primary school students. This study builds upon previous research by developing a visual

novel-based GBL approach, designed to make mathematics more engaging and accessible through storytelling and interactive gameplay. By applying the EGameFlow Model, this research aims to evaluate how effectively students engage with and learn mathematical concepts in an interactive game environment.

METHODOLOGY

This project adopts the Game Development Life Cycle (GDLC) as its development methodology, which provides a structured framework suitable for game-based learning projects. GDLC follows an iterative process consisting of six phases which is initiation, pre-production, production, alpha testing, beta testing, and release. The Initiation phase involves researching and defining project objectives, while the pre-production phase focuses on designing game elements such as storyboarding and character development. The production phase includes game creation using Unity, followed by testing and beta testing, where gameplay mechanics and user experience are refined based on player feedback. Finally, the release phase ensures all components function properly before deployment.

To evaluate the game's effectiveness, this project applies the EGameFlow Model, a framework used to measure engagement in educational games. The model assesses eight key factors which is concentration, goal clarity, feedback, challenge, autonomy, knowledge improvement, immersion, and social interaction (Fu et al., 2009). By integrating these elements except social interaction, the game ensures an engaging learning experience, keeping students motivated while reinforcing mathematical concepts. The iterative nature of GDLC allows continuous refinement based on EGameFlow assessments, ensuring that Life With Maths: Game-Based Learning on How To Use Mathematics in Daily Life is both interactive and educationally effective. The phases of the GDLC model can be seen in Figure 1.

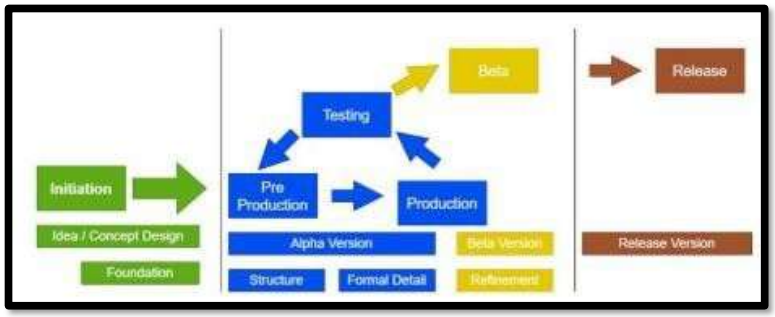

Figure 1: Phases of GDLC

RESULT AND DISCUSSION

Enjoyment Evaluation

User feedback is crucial in determining whether the game meets its objectives, particularly in terms of enjoyment. The EGameFlow questionnaire was used to evaluate key factors such as concentration, goal clarity, feedback, challenge, autonomy, immersion, and knowledge improvement. Social interaction was excluded as Life With Maths is a single-player game. Only relevant questions were selected to ensure an accurate assessment of the game's engagement and effectiveness.

Demography respondents

According to the questionnaire results, the majority of the participants testing the game project are male, with 8 students (59.4%), while the remaining students are female, with 4 (40.6%). The results also suggest that the majority of the participants are students in primary school aged 7 to 12, accounting for 43.8% of the total, with those aged 18 to 29 accounting for 40.6%. While the minority of the participants are from the group of age 13-17 years old, which is secondary school students, and the range of age 30 and above, both have small total number of participants, which is 12.5% and 3.1%.

Table 1: Demography of participants

Question	Range	Frequency	Percentage (%)
Gender	Male	19	59.4
	Female	13	40.6
Age	7-12	14	43.8
	13-17	4	12.5
	18-29	13	40.6
	30 and above	1	3.1

Findings

After players finished playing Life With Maths: Game-Based Learning on How to Use Mathematics in Daily Life on their PCs, their input data was collected using a Google Form. Google Form featured the game's different factors, each with its own set of values. To assess

the level of enjoyment with the game, the overall mean of each factor was computed. The questionnaire employed a score system of 1 to 5, with 1 representing "Strongly Disagree," 2 as "Disagree," 3 as "Neutral," 4 as "Agree," and 5 as "Strongly Agree." Table 5.10 shows the total mean and percentage of the overall total mean for the enjoyment obtained from the game.

According to the table above, the total mean for all factors is 4.28. Based on the data collected, it can be stated that Life With Maths: Game-Based Learning on How to Use Mathematics in Daily Life is a delightful and enjoyable game, with an overall percentage of 85.6%. As a result, this study successfully meets the third objective, which is to evaluate the enjoyment of game-based learning in mathematics implemented in daily life for primary school.

Table 2: Overall total mean and percentage of enjoyment

Factor	Total Mean
Concentration	4.35
Goal Clarity	4.23
Feedback	4.40
Challenge	4.34
Autonomy	4.00
Immersion	4.28
Knowledge Improvement	4.36
Total Average Mean	4.28
% of Overall Total Mean	85.6%

CONCLUSION

Mathematics is widely regarded as one of the most difficult and complex topics to study in school. A lot of students are frightened of math and dislike learning it. As a result, many students were unable to apply basic mathematical skills in real-world circumstances. This is because they believe that the subject of mathematics is difficult to learn, and the delivery technique is not exciting and uninteresting.

The goal of this game was to attract the interest of primary school students, particularly those in grade 5 mathematics. Game-based learning, such as Life With Maths: Game-Based Learning on How To Use Mathematics in Daily Life, can indirectly become one of the more fun learning mediums while also attracting students to learn mathematics.

This project was developed using a variety of software applications, including Canva and Unity. The goal of this study is to assess the enjoyment of game-based mathematics learning implemented in everyday life for students in primary schools. This is because the study discovered difficulties in solving everyday mathematical problems. This study intends to clarify the effects of the game on the level of student enjoyment by using assessment tools like EGameFlow. Despite using a 2D perspective in the project's design, a level of enjoyment was still achieved. This was supported by user input acquired via a questionnaire. Therefore, based on the questionnaire's findings, it appears that the project has achieved all of its objectives.

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