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Game-based Paragogy in Virtual Learning Space: Mathematics World of Fun (WoF)

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ABSTRACT

Mathematics World of Fun (WoF) is a mathematics game-based assessment designed to create an exciting learning assessment for Centre for Pre-University Studies, UNIMAS students. WoF combines the Roblox game and some topics taught in the class. Roblox's popularity renders it an ideal medium for enriching education, offering interactive experiences that resonate with modern learners. This approach aligns with paragogy, a peer-driven learning model wherein students collaborate, share knowledge and collectively shape their educational journey. WoF harnesses the engaging nature of video games to deliver educational content, making learning enjoyable and immersive. In WoF, Roblox serves as a dynamic environment where educators craft engaging educational games and simulations, fostering experiential learning. By integrating curriculum into Roblox, WoF promotes diverse subjects in an enjoyable format, nurturing critical skills like problem-solving and collaboration. WoF also can be a platform for evaluating students' understanding and skills development. Moreover, WoF facilitates holistic assessments, evaluating students' comprehension, critical thinking, and creativity. This approach aligns with current educational trends, emphasizing a holistic evaluation of student performance beyond traditional tests. By embracing WoF, educators respond to contemporary demands for interactive, student-centric learning tools, enhancing education's effectiveness and relevance in today's dynamic landscape. Therefore, the idea of using the Roblox games concept enables students to be resilient in solving mathematical problems.

Keywords: Mathematics, Game-Based Assessment, Paragogy, Problem-Solving, Roblox Platform

INTRODUCTION

Transitioning to e-learning in pre-university level courses has proven to be a huge leap during the pandemic era, especially in STEM-based subjects (Kamal et al., 2020). To support this, the Department of Mathematics in the Centre for Pre-University Studies at Universiti Malaysia Sarawak agreed on implementing Mathematics World of Fun (WoF), a game-based activity based on the popular Roblox games concept (Otemaier et al., 2020). The trends of using Roblox games have been shown to enhance the mathematics teaching-learning delivery (Glavas & Stascik, 2017). Mathematics is frequently regarded as tough, and many students drop out of science, technology, engineering, and mathematics programmes (STEM).

Mathematics World of Fun (WoF) is a continuous assessment based on Roblox genre games. WoF is conducted in groups and implemented online at set times.

WoF is designed on the Roblox platform, an online game platform and game creation system developed by Roblox Corporation that allows users to program games and play games created by other users. WoF is deployed to assess the Mathematics Course Learning Outcomes (CLO) related to communication skills, ethics and professionalism.

Gamification appeals to teaching-learning as it takes the fun and engaging elements when playing, to be applied in serious, real-world situations. Game-based learning encourages students to solve problems and learn on their own, allowing them to grasp a mathematical concept without even recognising it. Chou (2019) derived the gamification framework called octalysis, which focuses on the eight core drives to help educators design game-based learning content to fully enhance learners' motivation and experience. According to Chou (2019), the eight core drives are; (i) epic meaning, the player

believes that the player is chosen to do something greater than the player self, (ii) accomplishment, an internal drive to make progress by overcoming challenges, (iii) empowerment, players are engaged in a creative process to create solutions, (iv) ownership, motivation of feeling to own something better or more, (v) social influence, the social elements that drive a player, (vi) scarcity, the drive of wanting to own a thing because not all players can have it, (vii) unpredictability, the curiosity of wanting to know what will happen next, and (viii) loss and avoidance, a drive to avoid a negative element or penalty from happening. Naturally, WoF is designed to apply six core drives: epic meaning, empowerment, accomplishment, unpredictability, social influence, loss, and avoidance.

Therefore, the idea of using the Roblox games concept enables students to be resilient in solving mathematical problems (Stohlmann, 2020). With the current state of the art in tertiary education, the flexibility of Roblox games allows for face-to-face, online meetings or hybrid (Rosillo & Montes, 2021). Roblox provides a unique environment where users can create, share, and play games meetings created by other users Roblox's collaborative features enable students to work together on game projects. They can divide tasks, share ideas, and provide feedback to each other, fostering teamwork and communication skills.

RESULTS AND DISCUSSION

A Holistic Approach in Mathematics World of Fun (WoF)

The Mathematics World of Fun (WoF) assessment is a holistic evaluation that goes beyond measuring mathematical knowledge. It assesses students' ability to apply knowledge, think critically, solve problems, and work collaboratively while integrating math, science, and communication skills in real-world tasks. WoF uses a rubric-based system to evaluate a wide range of skills and behaviours, incorporating self, peer, and teacher assessments. It supports continuous learning by identifying strengths and areas for improvement and also evaluates students' attitudes, values, teamwork, leadership, and ethical reasoning, providing a comprehensive understanding of their overall development.

Figure 1 shows the workflow of the Mathematics WoF assessment. It starts with the process of distributing subgroups followed by signing up for Roblox using the provided link. Then, they must declare their Roblox username via eLEAP and log in to Roblox. This step is critical for ensuring that students are correctly identified and can participate in the game. In this situation, students demonstrate critical thinking by organizing themselves to ensure they are correctly signed up for Roblox and have declared their usernames accurately. This step requires them to follow instructions carefully and manage their participation in the process. Collaboration is evident as students join their subgroups and begin to communicate with their peers about setting up their accounts and

preparing for the game. The subgroup distribution phase is crucial for fostering initial teamwork. Communication skills are tested as students need to accurately communicate their usernames and other necessary details to ensure they are correctly identified for participation in WoF. They must also clearly communicate with their peers during the setup phase to ensure everyone is ready to participate.

Playing WoF via Roblox is the main body of this assessment. Students can proceed to play the WoF game on the platform once their usernames are declared. During the gameplay, students apply critical thinking by solving mathematical problems and overcoming in-game challenges. This involves analyzing situations, making strategic decisions, and applying learned concepts in a dynamic environment. WoF requires effective teamwork as students collaborate to solve problems, share insights, and navigate the game's challenges. Collaboration is key in ensuring the group can progress through the stages of the game successfully. In-game coordination and communication are essential, as students need to coordinate with each other, share information quickly, and make collective decisions. Effective communication ensures that the group works as a cohesive unit, especially under time constraints.

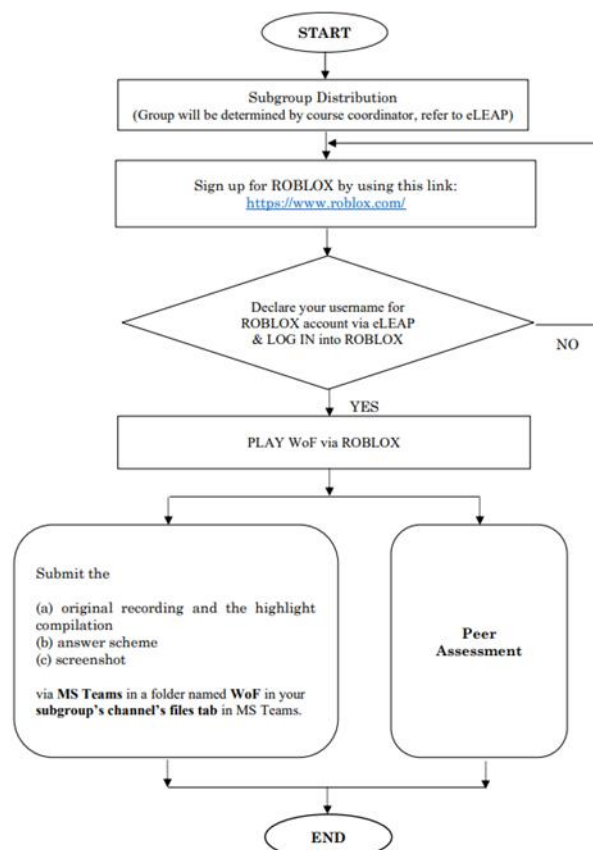


Fig. 1 Mathematics World of Fun (WoF) Flow Chart

After completing the WoF assessment, students are required to submit several materials which are original recordings and a highlight compilation of their gameplay, The answer scheme or portfolio of students' works for the

mathematics questions they tackled and A screenshot as evidence of their success in the game. All the materials will be the evidence for instructor evaluation. In addition to the submissions, a peer assessment includes a self-evaluation component. Students will be assessed by their peers, which contributes to the overall evaluation. Through these steps, students engage in reflective thinking as they compile their recordings, highlight their gameplay, and prepare their answer schemes. They critically evaluate their performance, identifying key moments and strategies that contributed to their success. The submission phase requires collaboration as students work together to compile their recordings and other materials. They must decide as a group what highlights to include, ensuring that the submission accurately reflects their collective effort. Communication is further emphasized during the peer assessment phase, where students provide constructive feedback to their peers. They must communicate their evaluations clearly and respectfully, helping others understand their strengths and areas for improvement.

The Design of Game-Based Learning in Mathematics WoF

WoF implements a game-based learning project to assess mathematics content and skills. This is a teaching and learning approach that involves the usage of serious games for academic delivery purposes. This dynamic method helps educators in evaluating learning outcomes differently. The learning process happens when students are thrown into a fictional scenario, overcoming challenges in multiple stages by applying classroom knowledge.

WoF is an original approach created by the educators of this course based on the concept of game-based learning. This game is designed on the Roblox platform, which is very popular among teenagers and children. Roblox is a popular online platform and game creation system that can be utilized for game-based learning. The strength of this platform is its robustness in enabling the creation of various distinct and unique games. WoF is a multiplayer game played by a group of five students.

For WoF, the challenges are created based on mathematics questions and riddles. WoF consists of two stages, as illustrated in Figure 2. The first stage is designed as a theme park in which the group members must split to find questions hidden in the stage. The questions are made from one of the learning units in the course, which is matrices and a system of linear equations. For each question answered, clues are rewarded for the group to guess the password needed to unlock the door for the next stage.

The second stage is a maze where each group member will begin from a different location. They must make their way to the centre of the maze to finish the stage. Along the way, each member needs to solve mathematics riddles made from the vector learning unit. As they arrived at the centre of the maze, the group had to take a screenshot as evidence of their success for submission later.

Throughout the game, although students play on their own devices, they are required to communicate and collaborate to tackle WoF challenges as fast as possible. This is due to completion time and teamwork skills are a part of the marking rubric for this assessment. The recording of the group playing together in a location is made and must be submitted as well for evidence and documentation purposes.



Fig. 2 How to play Mathematics World of Fun (WoF)

Learning Experience in Mathematics World of Fun (WoF)

Table 1 presents the mean scores of students' responses to a survey that assessed their learning experiences in the Mathematics World of Fun (WoF) assessment. Each item reflects a different aspect of the learning experience, with higher mean values indicating more positive responses.

Table 1. Students' Survey Analysis of Learning Experience in Mathematics World of Fun (WoF)

Item	Mean
Apply the knowledge	4.34
Apply mathematical-based thinking and skills	4.51
Meaningful learning experience	4.60
Professionalism	4.46
Motivation	4.41

Item 1: Apply the Knowledge (Mean = 4.34) reflects students' perception of their ability to apply the knowledge they have acquired during the WoF assessment. It suggests that students generally felt confident in their ability to apply the knowledge gained from the course, although there is still some room for improvement compared to other items. In Item 2: Apply Mathematical-Based Thinking and Skills (Mean = 4.51), the score indicates students' perception of their ability to apply mathematical thinking and skills within the WoF context. It shows that students found the WoF assessment effective in helping them use their mathematical knowledge in practical, problem-solving scenarios, with a slightly stronger response compared to general knowledge application. The highest mean score (4.60) is for the "Meaningful Learning Experience" item, indicating that students overwhelmingly found the WoF assessment to be a significant and impactful part of their learning. This suggests that the WoF assessment succeeded in providing a deep and engaging learning

experience, making it the most positively rated aspect of the survey. Based on Item 4, students' perception of professionalism is related to the conduct, structure, or organization of the WoF assessment. With a mean of 4.46, it shows that students recognized and appreciated the professional environment and approach of the WoF assessment, contributing positively to their overall experience.

Lastly, the motivation score in Item 5 (mean = 4.41) indicates that students felt motivated by the WoF assessment. This relatively high score suggests that the WoF was effective in engaging students and encouraging them to participate actively, although slightly less so compared to other areas like meaningful learning and mathematical application.

The survey results indicate a highly positive student experience with the WoF assessment, with all items receiving mean scores above 4.0. The highest score for "Meaningful Learning Experience" suggests that students found the WoF assessment particularly engaging and valuable. The consistency of scores across different areas, such as knowledge application, mathematical thinking, professionalism, and motivation, reflects the holistic effectiveness of the WoF in enhancing various aspects of student learning and engagement. While all areas received strong ratings, the slightly lower score in "Apply the Knowledge" suggests an area where further enhancement could potentially increase the overall impact of the assessment.

CONCLUSION

Mathematics World of Fun (WoF) is a noteworthy innovation in education as it effectively combines game-based learning with conventional curriculum content. Through the use of the Roblox platform, this method replaces the emphasis on passive learning with an engaging, student-centered process in which students take charge of their own learning. WoF has significantly wider potential applications than only the immediate field of mathematics education. WoF's versatility allows it to be adapted into other areas, providing a flexible framework for multidisciplinary education. Not only would the expansion of WoF to encompass additional disciplines promote individualized education, but it would also appeal to a variety of learning styles and interests. By offering a variety of subject-specific games and activities, educators could create personalized learning paths that align with individual student strengths, needs, and aspirations. This would make education more inclusive and accessible, ensuring that all students have the opportunity to engage with the material in a way that resonates with them. As a conclusion, the adaptability of WoF positions it as a powerful tool for transforming education across the curriculum.

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