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Mobile Game-Based Learning on Sustainable Development Goals

Wan Abdul Rahim Wan Mohd Isa[*1], Ahmad Iqbal Hakim Suhaimi[2], Nurulhuda Noordin[3], Muhammad Anwar Zakwan Mohd Rozi[4]

[1,2,3,4]Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia

*Corresponding Author Email: wrahim2@uitm.edu.my

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Abstract

This study explores the development and implementation of a Mobile Game-Based Learning (MGBL) application designed to promote awareness and understanding of the United Nations Sustainable Development Goals (SDGs). Leveraging the structural and motivational affordances of gamification, the application integrates elements such as storytelling, rewards, timers, scoring systems, and challenges to foster learner engagement and drive behavior change. Grounded in a Design-Based Research (DBR) framework and guided by an adapted Digital Educational Game (DEG) Life Cycle methodology, the research emphasizes accessibility, interactivity, and pedagogical relevance within diverse learning environments. The resulting high-fidelity prototype includes interactive gameplay, quiz-based learning on SDGs and feedback mechanisms to enhance user motivation and retention. MGBL applications can be powerful educational tools, particularly in reaching underserved communities and supporting global educational initiatives. Future research should investigate long-term learning outcomes, cultural adaptability and the effectiveness of specific mobile game-based learning application in promoting behavioral changes.

Keywords Digital Educational Game (DEG) Life Cycle methodology, Mobile Game-Based Learning (MGBL) application, Gamification, Mobile Learning and Technology, Sustainable Development Goals (SDGs)

Introduction

Mobile Game-Based Learning (MGBL) application has emerged as a promising pedagogical tool, offering interactive, learner-centered experiences that may foster knowledge acquisition, critical thinking, and behavioral change. Mobile games, with their ability to transcend traditional classroom boundaries and appeal to a wide demographic, offer unique opportunities for education on sustainability.

Recent studies have demonstrated a growing interest in Mobile Game-Based Learning (MGBL), particularly in contexts involving cultural and scientific education for indigenous communities. For instance, Isa et al. (2022) developed a mobile game-based learning

application centered on the Semai people, highlighting its potential for preserving indigenous knowledge and promoting cultural awareness. Similarly, Isa et al. (2023) designed an MGBL application to teach science concepts to indigenous learners, illustrating the adaptability of gamified learning to diverse educational needs. Further work by Wan Mohd Isa et al. (2025) evaluated user experience in the "Kenali Semai" MGBL application, offering valuable insights into user experience for further improvement. Collectively, these studies underscore the potential of mobile game-based platforms to enhance learning experiences across culturally and contextually specific domains.

By incorporating game mechanics such as storytelling, challenges, rewards, and feedback loops, the digital environment of Mobile Game-Based Learning application can promote active learning, reflection, and motivation. Furthermore, mobile platforms provide accessibility, scalability, and adaptability across diverse cultural and socioeconomic contexts, making them especially suitable for global initiatives like the Sustainable Development Goals.

Literature Review

Structural Gamification

Structural gamification refers to a systematic approach to integrating game elements into educational and engagement contexts, enhancing motivation and participation without altering core content. In higher education, structural gamification can address engagement issues, particularly among at-risk students. For instance, role-playing game elements were successfully integrated into a computer game development curriculum, leading to increased attendance and participation (Ntokos, 2019).

Gamification Elements

Gamification incorporates various elements to enhance user engagement and motivation across different contexts. Key elements include storytelling, scoring systems, timers, rewards, and challenges, each contributing uniquely to the gamified experience.

- Storytelling

Storytelling creates a narrative that users can connect with, enhancing emotional engagement and making tasks more relatable (Christopoulos & Mystakidis, 2023). It can transform mundane activities into compelling experiences, fostering a deeper connection with the content.

- Scoring

Scoring systems provide measurable feedback, allowing users to track their progress and achievements (Cechetti et al., 2017). This element encourages competition and self-improvement, motivating users to strive for higher scores.

- Timer

Timers introduce urgency, prompting users to complete tasks within a set timeframe, which can enhance focus and productivity (Kapp, 2016). This element can be particularly effective in educational settings, where time constraints can drive engagement.

- Rewards

Studies show that gamified environments with rewards lead to higher student motivation and improved collaboration among peers (Sahli & Spriet, 2024).

- Challenges

Challenges present users with obstacles to overcome, fostering a sense of achievement upon completion (Teotónio & Reis, 2018). They can stimulate critical thinking and problem-solving skills, making the experience more enriching.

While gamification elements can significantly enhance user engagement, some critics argue that over-reliance on these elements may lead to superficial motivation, where users are driven by rewards rather than intrinsic interest in the tasks themselves. This perspective highlights the importance of balancing gamification with meaningful content to sustain long-term engagement.

Advantage of Gamification Elements

Gamification elements in educational contexts offer significant advantages, particularly in enhancing student engagement, motivation, and learning outcomes. By integrating game design features into learning environments, educators can create more interactive and enjoyable experiences that foster deeper comprehension and persistence among students. The following sections outline the key benefits of gamification elements.

- Enhanced Engagement and Motivation

Gamification provides instant feedback through points and badges, allowing students to track their progress effectively (Jun & Lucas, 2024). Elements like badges and avatars help students' express individuality and maintain motivation, significantly influencing their engagement levels (Venter, 2022). Gamified environments encourage students to participate actively, which is crucial for meaningful learning experiences (Vallejo, 2024).

- Improved Learning Outcomes

Gamification creates interactive settings that facilitate better understanding and retention of knowledge (Jun & Lucas, 2024). While gamification has shown promising results in increasing engagement and motivation, some critics argue that it may lead to an overemphasis on numerical assessments, potentially undermining intrinsic learning values (Vallejo, 2024).

Methodology

This study employed a design-based research (DBR) approach, guided by an adapted Digital Educational Game (DEG) Life Cycle methodology (Aslan and Balci, 2015). The DEG Life Cycle, originally conceptualized to provide a systematic framework for the development and implementation of educational games, was tailored in this research to align with the thematic and pedagogical requirements of SDG education within a mobile learning environment. The main objective of this study is to design the Mobile Game-Based Learning application on Sustainable Development Goals. The Digital Educational Game Life Cycle (DEG) methodology was adapted into this study.

Results and Discussions

A. Game Design Using Storyboard

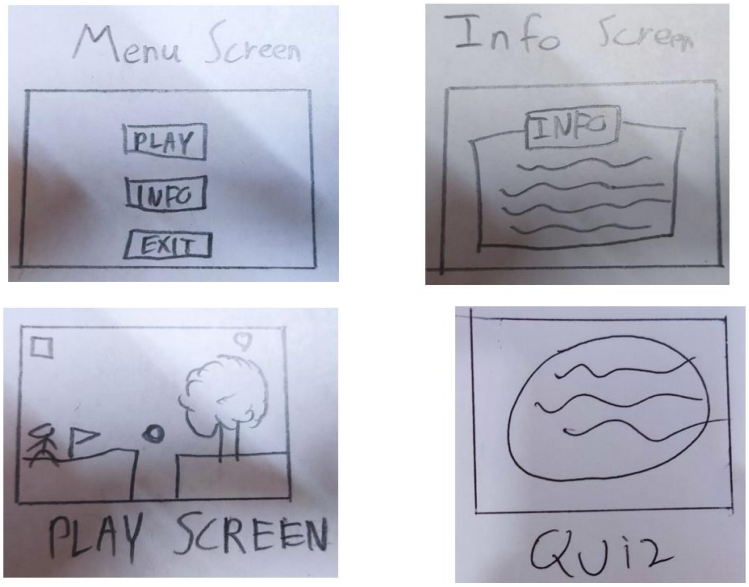

Fig. 1 Storyboard

Fig. 1 depicts the storyboard for the mobile game-based learning application.

Use Case Diagram

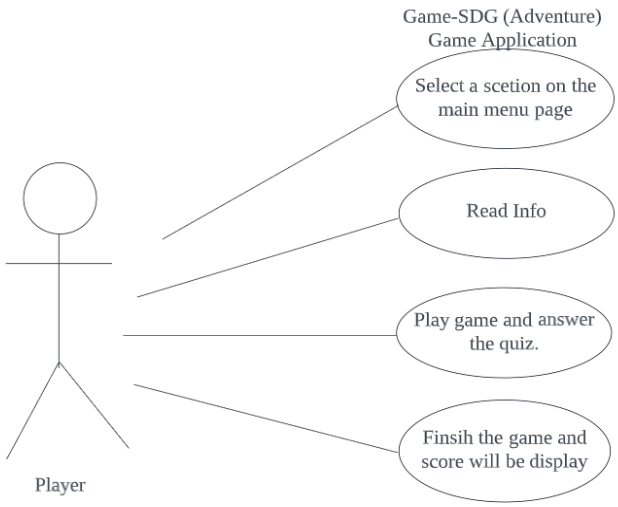

Fig. 2 Use case diagram for the application

Fig. 2 depicts the interaction between the user and the process using a case diagram.

High-fidelity Prototype

Fig. 3 Loading Page

Fig. 3 shows the Loading Page Before progressing on to the main menu page, the Game-SDG (Adventure) page displays a loading progress bar.

Fig. 4 Main Menu Page

Fig. 4 shows the Main Menu Page. The Play, Info, and Exit buttons are the three options available on the main menu page for users to select.

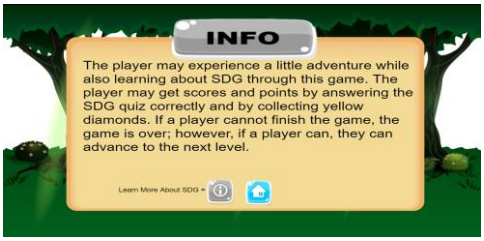

Fig. 5 Info Page

Fig. 5 shows the Info Page. In the Info Page, players can learn how to play and finish the game.

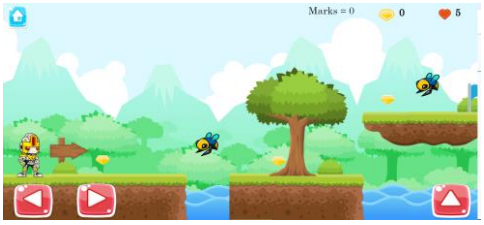

Fig. 6 Gameplay page

Fig. 6 shows the Gameplay Page. This where players can start their adventure and survive the wild while answering the quiz given about SDG.

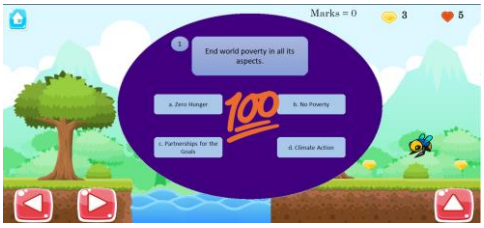

Fig. 7 Question/Quiz Page

Fig. 7 shows the Question/Quiz Page. It is a question or quiz which consists of a question about SDG. If a player answers the question/quiz correctly they will be given 100 marks and if they answer it wrong, they will not get any marks and get X instead.

Fig. 8 Game Over

Fig. 8 shows the Game Over page. The game will be over in the middle of gameplay whenever character player health is equal or below zero. The page will show the marks and diamond points that players have been collecting.

Fig. 9 Finish Page

Fig. 9 shows the Finish Page. If a player finishes the game without having a character health, go down below zero this page will appear. The page will show the marks and diamond points that players have been collecting.

Conclusion

The development of the Mobile Game-Based Learning application on Sustainable Development Goals is important as the flexibility and accessibility of mobile platforms makes it especially valuable for reaching diverse learning populations such as underserved or remote communities. As the global community continues to seek innovative educational tools to promote sustainable development, this mobile game-based learning presents a promising avenue for bridging the gap between awareness and action.

Future research should investigate long-term learning outcomes, cultural adaptability and the effectiveness of specific mobile game-based learning application in promoting behavioral changes aligned with the principles of Sustainable Development Goals. Collaboration among educators, game developers, policymakers and learners themselves will be crucial in scaling and refining this mobile game-based learning application. Ultimately, Mobile Game-Based Learning application on Sustainable Development Goals represents not just as a tool but may possibly be a meaningful strategy in shaping a more informed and create awareness for new generation.

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