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Journal of Computing Research and Innovation 9(2) 2024

Journal of Computing Research and Innovation

Railway Safety Education via Interactive Gamification Learning

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ARTICLE INFO

Article history:
Received 01 July 2024
Revised 29 August 2024
Accepted 30 August 2024
Online first
Published 1 September 2024

Keywords:
Gamifies Learning Activities
Railway Safety Education
Railway Safety

DOI:
10.24191/jcrinn.v9i2.483

ABSTRACT

Gamification in education uses gaming mechanics to make traditional learning environments more engaging and interactive. This approach enhances student engagement and promotes active participation by incorporating rewards, competition, achievements, and progress tracking. Hazard hunts are instrumental in pre-emptively managing workplace safety by ensuring hazards are promptly recognized, assessed, and mitigated. The Safety Railway Game provides high levels of enjoyment and engagement compared to traditional teaching methods, with mean agreement and importance ratings for having fun and enjoying the lesson/game session being both 4.9 out of 5. Studies provide further support for using gamification to enhance learning sessions and increase student enjoyment.

1. INTRODUCTION

Gamification in education uses gaming mechanics to make traditional learning environments more engaging and interactive (Deterding et al., 2011). This approach enhances student engagement and promotes active participation by incorporating rewards, competition, achievements, and progress tracking, which tap into students' natural desire for accomplishment and recognition (Connolly et al., 2006). Specifically, in railway safety education, gamified activities can effectively teach individuals, particularly children, about the dangers of railway environments and the risks of trespassing or being near tracks (Colvin et al., 2009).

Gamification in education has emerged as a powerful tool for enhancing student engagement and collaboration by integrating game elements into learning environments. This approach increases motivation and participation among students (Legaki et al., 2020). It has been successfully implemented across various educational contexts, including online forums, group projects, and traditional classroom activities, fostering collaborative creativity, critical thinking, and problem-solving skills.

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https://dx.doi.org/10.24191/jcrinn.v9i2.483

In contrast to traditional textbooks, which are widely used but slow to update, game-based learning offers high adaptability and flexibility (Öztürk et al., 2019). This adaptability allows for quick updates and modifications to content, ensuring relevance and currency in educational materials.

1.1 Benefit of gamification in safety training

Game-based learning is a powerful approach that enhances student engagement, creativity, critical thinking, and problem-solving skills. Integrating gamified learning activities into railway safety education can revolutionize training methods by boosting engagement and knowledge retention. Gamification in safety training offers several benefits, including:

i. Increased Awareness:

   Gamification raises awareness about safety issues by presenting information engagingly and memorably.

ii. Safety-Conscious Culture:

   It helps in creating and reinforcing a safety-conscious culture among learners.

iii. Realistic Scenario Practice:

   Learners can practice safety procedures in realistic, simulated environments, enhancing their ability to respond to real-world situations.

iv. Instant Feedback:

   The use of feedback loops allows learners to immediately see the results of their actions, reinforcing correct behaviors and correcting mistakes promptly.

v. Immersive Learning:

   Serious games and gamification elements provide an immersive and safe environment for practicing skills, leading to effective behavioral changes.

In the context of railway safety education, gamification can involve increasing awareness about hazards at railway stations and other critical areas. By actively engaging learners through interactive and dynamic methods, gamification promotes compliance with safety protocols and enhances the overall safety culture within the railway industry.

2. BACKGROUND TO DEVELOPING SERIOUS GAMES AND GAMIFICATION

The study of designing 'serious games' is a relatively new field that combines learning design principles with game mechanics and logic (Lameras, 2021). 'Serious games' represent a significant convergence of games, e-learning technologies, and pedagogical models, offering rich, immersive virtual environments. By integrating sophisticated education theories with new technology, serious games address a wide range of needs, from corporate training and education to emergency medical response (Petridis, 2021). Educational computer games founded on pedagogical goals and appropriate game mechanics can effectively teach players by engaging, motivating, and influencing their behaviors. Specifically, the use of serious games through storytelling, quests, rewards, and competitions creates an environment conducive to serious learning.

2.1 Historical Context

The development of serious games and gamification has roots in both educational theory and the evolution of digital gaming. The idea of using games for educational purposes can be traced back to the

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early 20th century when educators began recognizing the potential of play in learning. However, the integration of digital technology has exponentially expanded the possibilities.

2.2 Emergence of Serious Games

Serious games, a term coined in the early 2000s, represent a significant shift in how games are perceived and utilized. Unlike traditional games that focus primarily on entertainment, serious games are designed with the primary purpose of education, training, or other practical applications. The convergence of games, e-learning technologies, and pedagogical models has led to the creation of rich, immersive virtual environments. These environments leverage sophisticated educational theories and advanced technologies to address diverse needs, from corporate training and education to emergency medical response (Lameras, 2021; Petridis, 2021).

2.3 Key principles

i. Learning Design Principles:

   Serious games are built on robust learning design principles. These principles ensure that the educational content is effectively integrated into the game mechanics, making the learning experience engaging and meaningful.

ii. Game Mechanics and Logic:

   The use of game mechanics such as points, levels, challenges, and feedback loops helps in maintaining learner engagement and motivation. Game logic ensures that the progression through the game aligns with the learning objectives.

iii. Pedagogical Models:

   Incorporating established pedagogical models ensures that serious games are educationally sound. These models guide the structuring of content and the assessment of learning outcomes.

2.4 Gamification in education

Gamification involves applying game-design elements in non-game contexts to enhance user engagement, motivation, and participation. In education, gamification leverages elements like rewards, competition, achievements, and progress tracking to boost student motivation. By tapping into students' natural desire for accomplishment and recognition, gamification enhances learning experiences and outcomes (Connolly et al., 2006).

Well-designed serious games aim to blend entertaining gameplay with effective pedagogical elements, creating experiences that are both enjoyable and educational (Zyda, 2005). This approach requires seamless integration of engaging game characteristics and educational content into the mechanics of play. As a result, formal design methodologies for serious games are being developed to achieve this balance (Zyda, 2005).

However, one of the ongoing challenges is the need to gather evidence and experiences that validate specific approaches across diverse contexts. What works well in one context or for certain demographics may not be as effective in others, given the wide range of subjects, industry sectors, and user characteristics involved in serious games. Therefore, more empirical research is essential to understand how to tailor serious games effectively to different needs and audiences.

In the UK rail sector, for example, this need for specific evidence led to projects focused on training frontline staff using serious games. These initiatives aim to demonstrate the effectiveness of serious games in enhancing training outcomes and improving safety practices.

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Moreover, traditional e-learning development methodologies have often struggled to effectively incorporate gamification into learning experiences. They typically prioritize content delivery over engagement and interaction. Future advancements in serious game and e-learning pedagogy should focus on attracting, engaging, and retaining users through innovative gamification strategies that align with educational goals and learning outcomes. This evolution is crucial to maximizing the potential of serious games as impactful tools in education and training.

3. METHODOLOGY

Real-life games immerse participants in scenarios that closely resemble real-world situations, making them highly immersive and engaging. These games leverage realistic scenarios to motivate participants, encouraging active participation and learning. However, the intensity of these scenarios can sometimes lead to stress, as participants are required to make quick decisions and apply their knowledge under pressure.

Real-life games, as the name suggests, are based on scenarios based on reality. These games have proven to be highly motivating but can also cause stress in some situations. students are required to make body movements and use their brains. These games engage the learners in almost every aspect of their education.

This Hazard Hunt game for Quantity Surveying students at UiTM Seri Iskandar, Perak, focusing on railway studies, here's how the methods can be adapted. Firstly create 5 groups. Each group has 6 members. Hazard Hunt is a proactive process aimed at identifying and mitigating potential hazards in different work environments. It involves a systematic approach to ensure workplace safety by identifying, assessing, and controlling hazards to prevent accidents and incidents. Hazard hunts utilize various techniques and activities, such as walkthroughs, inspections, campaigns, competitions, and active monitoring.

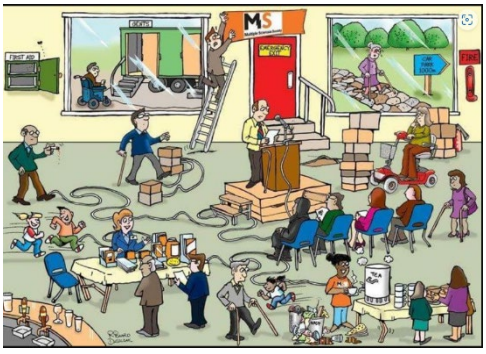

Fig. 1. Hazard hunt

3.1 Key steps in a hazard hunt

i. Identification:

Participants systematically scan the environment to identify potential hazards, such as unsafe conditions or practices.

ii. Assessment:

Once hazards are identified, they are assessed to determine their severity and the likelihood of causing harm. This step helps prioritize actions to mitigate risks effectively.

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iii. Control:

Measures are implemented to control or eliminate identified hazards. This may involve immediate corrective actions or long-term preventive measures.

3.2 Effective methods for executing hazard hunts

Teams typically compete to identify the highest number of hazards within a specified time frame, often around 1 minute per station in educational scenarios. This competitive aspect encourages thoroughness and quick thinking in hazard recognition.

i. Walkthroughs:

Structured inspections of the workplace to identify hazards.

ii. Inspections:

Detailed examinations of equipment, processes, and surroundings for safety vulnerabilities.

iii. Campaigns:

Educational initiatives to raise awareness and promote safety practices among employees.

iv. Competitions:

Engaging teams in competitive activities to spot hazards and foster a safety-conscious culture.

v. Active Monitoring: Continuous surveillance and feedback mechanisms to promptly address emerging hazards.

Hazard hunts are instrumental in pre-emptively managing workplace safety by ensuring hazards are promptly recognized, assessed, and mitigated. This proactive approach not only enhances safety protocols but also fosters a culture of vigilance and responsibility among participants.

4. FINDINGS

After the game, students are given a questionnaire to test students who agree that games will stimulate their understanding and knowledge transfer criteria. A questionnaire to test was conducted by using a survey among 30 students for students joining this game learning. This survey uses Google Forms where 5 groups of 30 students. The result of feedback from students agreed that games will stimulate their understanding and knowledge transfer criteria (n = 30) (Table 1).

Table 1. Result of feedback from students agreed that games will stimulate their understanding and knowledge transfer criteria

Question	Mean Agreement	Mean Importance
This game involves competition	4.9	4.7
The objectives of the game are well-defined.	4.8	4.8
The rules of the game are clearly specified.	4.9	5.0
The game rules are straightforward to implement.	4.8	4.8
The game accurately portrays the spectrum of choices typical of disruption.	4.5	4.8
The challenges (questions) are realistic and vary in difficulty.	4.7	4.9
The students found the lesson and game session enjoyable and engaging.	4.9	4.9

Student feedback on the Safety Railway Game indicates high levels of enjoyment and engagement compared to traditional teaching methods. The mean agreement and importance ratings for having fun and

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enjoying the lesson/game session are both 4.9 out of 5. Additionally, 95% of students reported positive engagement with joining these games. Studies by Inocencio (2018), Öztürk and Korkmaz (2019), and Legaki et al. (2020) provide further support for using gamification to enhance learning sessions and increase student enjoyment.

This feedback highlights the effectiveness of gamification in creating engaging and enjoyable learning experiences that surpass traditional teaching methods.

5. CONCLUSION

Gamification is indeed a versatile and powerful tool for enhancing student engagement and collaboration in educational settings. By integrating game elements and mechanics into learning activities, educators can create dynamic and participatory environments that stimulate critical thinking, creativity, and problem-solving skills among students. This approach not only makes learning more enjoyable but also encourages active participation and motivation.

While gamification offers significant benefits for student engagement and collaboration, its implementation should be purposeful and aligned with educational goals. By addressing potential challenges and designing inclusive and motivating experiences, educators can leverage gamification effectively to enhance learning experience.

Railway safety education is a crucial component in fostering a safe and secure environment for everyone interacting with the railway system. Through structured educational programs, practical training, and innovative approaches like gamification, individuals can develop a strong understanding of the risks associated with railways and the best practices to mitigate them. By prioritizing safety awareness and promoting responsible behaviors, we can significantly reduce accidents and incidents on the railways. The continuous emphasis on railway safety education ensures that all individuals, from students to professionals, are equipped with the knowledge and skills necessary to navigate the railway environment safely, contributing to a culture of safety that benefits society as a whole.

In conclusion, the students actively participated in the fun and enjoyful learning activities and simultaneously gained more understanding of the related topic, as shown in their reflective feedback. In overall, the objectives of this game are successfully achieved and hopefully will be conducted in other learning games railway safety education as well.

6. ACKNOWLEDGEMENTS/FUNDING

The authors would like to acknowledge the support Department of Quantity Surveying, Faculty of Built Environment and Surveying (FABU), Universiti Teknologi Malaysia and Department of Quantity Surveying at Universiti Teknologi Mara Kampus Seri Iskandar, Perak for providing the facilities and financial support on this research.

7. CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

https://dx.doi.org/10.24191/jcrinn.v9i2.483

8. AUTHORS' CONTRIBUTIONS

Mohd Amir Rashdan Mat Kashim: Conceptualisation, methodology, investigation and writing-original draft. **Mohd Saidin Misnan**: formal analysis, supervision. **Norsyazwana Jenuwa:** Conceptualisation, methodology, and formal analysis and validation; **Abdul Muhaimin Ab.Wahid**: Conceptualisation, methodology, and formal analysis; **Siti Nur Faizah Ab Malek** : Conceptualisation writing- review and editing, and validation.

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