

POTENTIAL OF GAMIFICATION FOR ENVIRONMENTAL MANAGEMENT TRAINING IN THE CONSTRUCTION INDUSTRY

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ABSTRACT

Construction activities are a major source of environmental pollution. Environmental Management Systems (EMS) which aim to minimize adverse environmental effects and maximize environmental benefits, have gained attention recently. However, the human capital in EMS is insufficient to realize its full potential in preventing environmental issues. Environmental management training (EMT) is required to provide knowledge and skills regarding good practices in sustainability, a safe and hygienic work environment and reducing environmental risks resulting from construction activities. Gamification approaches for EMT have the potential to empower knowledge and skills effectively for construction players. This study's objectives are (i) to highlight challenges in EMT, (ii) to highlight effective measures in EMT, and (iii) to discuss the potential of gamification for effective EMT. Challenges in EMT include low environmental awareness, saturated training content, lack of hands-on approach, lack of visualization from training with real practice. Effective measures in EMT includes increases environmental awareness, increases motivation with rewards system, employee engagement, and strategy of designing effective training delivery. The potential of gamification can be seen through improving employees' motivation and attractive engagement, meanwhile serious game capacity to transfer skills and knowledge of environmental management innovatively and effectively. The limitation of the study is that it only explored the theoretical integration of EMT and gamification in the construction industry. Future research should focus on the actual application of gamification for EMT in the industry.

KEYWORDS

Environmental Management, Training, Construction Industry, Gamification, Serious Game

1. INTRODUCTION

Development is inevitable and one of the significant effects is pollution (Lau *et al.*, 2016). 67.5% of the ecosystem and 21% of the natural resources in Malaysia are affected by construction activities (Zolfagharian *et al.*, 2012). Currently, environmental management system, a process management system that enables organizations to further reduce their environmental impact (Daud, Yusof and Mokhtar, 2019) is being promoted. Every organization should equip its workers with the skills and knowledge of environmental management (EM). Environmental management training (EMT) is crucial to provide knowledge and skills regarding good practices in sustainability, a safe work environment and minimize environmental risks resulting from construction activities. However, EMT is not well acknowledged in the construction industry. Lack of awareness for environmental factors are obvious (Ojo, Oladinrin and Obi, 2021) as construction companies tend to prioritize time and money over environmental concerns (Abdullah, Madros and Ahmad, 2001). Besides, lack of emphasis on EMT caused low recognition of EM in organizations (Ololade and Rametse, 2018). Despite the scarcity of skilled workers in EM for the construction industry, there are no articles discussed on relevant issues that identify challenges related to human resources (Campos *et al.*, 2016). Among significant human resource aspects is EMT which aims to prepare change agents to encourage the growth of EM in organizations (Jabbour *et al.*, 2010). This study focused issues on a shortage of skilled workers for EM in the construction industry, insufficient training content for construction environmental training, and the potential gamification for EMT in construction. Hence, the objectives of this study are (i) to highlight challenges in EMT, (ii) to highlight effective measures in EMT, and (iii) to discuss the potential of gamification for effective EMT. This paper is structured into an introduction, gamification rationale, challenges and effective measures of EMT, gamifications potentials, and a conclusion.

2. WHY GAMIFICATION AS A STRATEGY?

Gamification is defined as use of game elements in non-gaming contexts to enhance user engagement and experience (Deterding *et al.*, 2011) and promotes behavioral change (Mazur Stommen and Farley, 2016). Also, gamification refers to the mix of game elements' selection, application, implementation, and integration to enhance users' experiences and create engaging gameplay (Werbach, 2014). Common visible game elements are points, badges, leaderboards, performance graphs, meaningful stories, avatars and teammates. Besides, the needs of the players for psychological satisfaction is crucial during the design of gamification tools (Sailer *et al.*, 2017). Gamification can highlight objectives and their applicability, guide users along predetermined paths, provide rapid feedback, reward excellent behavior, and condense complex topics into simple tasks (Krath, Schürmann and von Korflesch, 2021). There are higher preferences for "just-in-time" training due to its ability to tailor programs to the specific and immediate needs of employers and deliver quick training (Gekara and Snell, 2018). This raises the possibility of linking just-in-time training and gamification for EMT in the construction industry, as proven in healthcare education (ONeill *et al.*, 2018).

3. CHALLENGES IN EMT

Factors that discourage construction workers from joining training program are a lack of training environments on site, lack of policies to hire trained workers as permanent employees, a lack of research and development in the training system and a lack of training infrastructure (Johari and Jha, 2019). Moreover, participants perceived neutrality on training contents, training environments, facilities and materials, the training schedule and presentation style and training effectiveness. This suggests that training activities do not meet trainees' needs and expectations. Statistically, training contents, training environments, facilities and materials, training schedules and presentation styles show a significant positive correlation with training effectiveness (Hajjar and Alkhanaizi, 2018). Also, the Construction Industry Development Board (CIDB, 2018) provided EMT for the construction industry however this course is currently inactive due to a lack of participation (CIDB, personal communication, September 25, 2022). In Malaysia, EMT provided are more relevant for industrial sectors compared to construction sector. Hence, standardization of EMT would be helpful, acting as a proper guideline to assist construction players in EM.

Many construction activities have immediate and direct negative effects on the environment (Yahaya and Abidin, 2020) as it happened gradually such as flood and landslide, different from health and safety risks whose consequences happened immediately, especially suffered by labors. Environmental harm is difficult to comprehend, but its detrimental effects are progressively developed. Significant gaps between the training provided and the abilities demanded by the construction industry are that most training is classroom-based, despite the industry needs more workers with practical experience, it is disconnected from real-world tasks and lacks practicality on the work site, it does not consider the various construction jobs performed by different classes of contractors, and most contractors attend training because it is required of them (Zahrizan *et al.*, 2013). EMT should be interactive, immersive, practical and provide participants with the skills they need to manage the environment safely and effectively. However, existing training delivery is lacking in these areas; it is difficult to learn from mistakes and simulate hazardous demonstrations in the real world.

4. EFFECTIVE MEASURES IN EMT

Successful training outcomes are significantly affected by training design and delivery which are challenged with training space, interaction and conduct in training design and provision with a market-based approach (Gekara and Snell, 2018). The practical implementation, organizational factors, motivational factors, human-related factors and behavioral factors are the major success factor for construction safety training (Tezel *et al.*, 2021). Comprehensive environmental training received by employees is needed for successful EMS development. Human resources factors are key elements in EMS practice, which includes top management support, environmental training, employee empowerment, teamwork and reward systems (Daily and Huang, 2001). Top management commitment, employee training and green programs are found to be statistically significant for perceived environmental performance (Lather and Shikha, 2015). Besides, there is a positive

relationship between barrier factors; a lack of guidelines for the setting of objectives and the involvement of employees, suppliers and other stakeholders, and a lack of guidelines to achieve the continuous improvement of the standard, leading to the implementation of an EMS (Ismail *et al.*, 2015).

5. GAMIFICATION POTENTIALS IN EMT

Although the construction industry is largely dependent on technology, construction EMT has not yet evolved towards embedding technological elements especially gamification. Gamification is defined as "the process of making activities more game-like," which emphasis the significant gap between the elements of games and the whole experience of gamefulness (Werbach, 2014). Meanwhile, serious games aim to communicate a message for the purpose of training or to develop particular skills and behaviors that can be transferred to the real world (Mettler and Pinto, 2015). Capabilities of serious game can be seen in promoting lean construction training (Liu *et al.*, 2020), risk and hazard identification in the construction industry (Mohd *et al.*, 2019) and increases occupational safety knowledge (Kazar and Comu, 2021). This supports the idea that serious game-based training is effective to ensure safety knowledge retention over time. Besides, serious games are also noticeable in different job training industries such as flood safety training (Mokhtar, Ismail and Muda, 2019), enhance problem-solving skills (Uskov and Sekar, 2014), better knowledge interpretation and engagement (Li *et al.*, 2017). Thus, this provides a good opportunity to explore gamification potentials and improve current training delivery for construction EMT. Hence, this study proposes to integrate gamification and a serious game approach with construction environmental training.

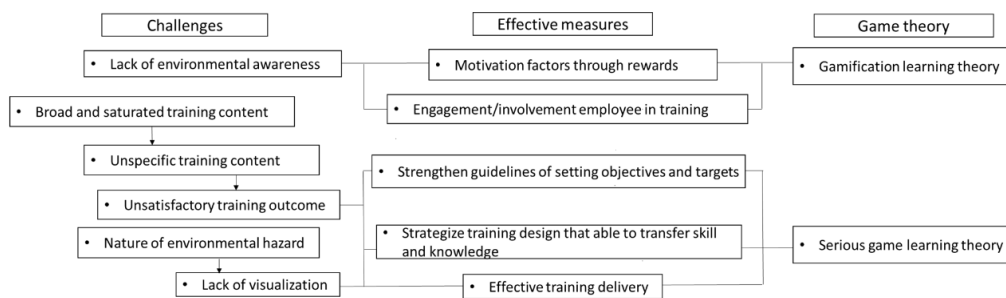


Figure 1. Theoretical framework of gamification and serious games for environmental management training

Figure 1 illustrates the theoretical framework which provides an initial view of gamification's potential to improve the efficacy of EMT. The link between EMT and gamification can be made meaningful by identifying challenges and its effective measures. From the gamification focal point, environmental behavior can be stimulated through improving motivation of workers. A rewards system in gamification has the potential to attract, engage and encourage workers towards positive environmental behavior. Trainees would become more environmentally conscious and motivated to understand the concept of EMS. Engagement through points, badges, and leaderboards would provide a competitive approach among trainees and challenge them to perform better. Trainees able to get involved in EMS can bring about changes in terms of workers feeling more responsible, environmentally aware and having a better image. Meanwhile, from the serious game dimension, knowledge and skills in EMS can be attractively transferred to trainees. Training objectives must be identified before strategizing the training design to meet those needs. Saturated EMS training content can be grouped into smaller subject matters and arranged with better engagement and visualization. Nevertheless, through the development of gamification and serious games for EMT, the effectiveness and outcomes can be discussed further.

6. CONCLUSION

This paper highlights the challenges in EMT, which are the lack of environmental awareness, the lack of participation in environmental training, the broad structure of training content, and the lack of visualization due to the indirect nature of environmental hazards. Furthermore, effective measures of EMT discussed are employees' motivation, employees' involvement and engagement, strengthening guidelines for setting objectives and strategic training design that is able to transfer skill and knowledge, and effective training delivery. From these challenges and effective measures, gamification and serious game strategy have seen their potential to assist in improvised EMT. Gamification concepts have the opportunity to increase trainees' motivation and engagement during training, which later also improves environmental performance. Meanwhile, the serious game concept has seen its potential by embedding the concept of purposeful knowledge and skill transfer in EM. However, it is also crucial to study the training objectives, which can later be designed into effective training delivery. Limitations of this study are that the topics of study are quite specific, which are EMT in construction projects, gamification, and serious games. The methodology of the study focused on synthesis from a literature review, and it is expected to provide a significant outcome from a combination quantitative and qualitative research approach. Although the proposed framework is merely an initial work, there is a need for more research on the application of gamification for EMT in construction projects. Also, the realization and adoption of gamification and serious games in EMT can be explored further.

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