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OSH-DBG as a Method of Digital Problem-Solving for Learning Construction Safety and Health Course

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Abstract— Occupational safety and health (OSH) awareness at the sites are challenging for students. Nowadays, students can be very demanding because they have raised their learning criteria compared to the past generation. Therefore, new pedagogical paradigms need to emphasize creative thought. In this case, gamification in teaching and learning is a creative way to inspire students to learn by incorporating game features to achieve an enjoyable and exciting learning experience. Game-based learning incorporates new skills and concepts by voluntarily enhancing learning engagement and encouragement among players. Gamification is also a successful way to improve students' habits and attitudes towards learning. Here, OSH-DBG is a digital board game project created for OSH awareness. The board game promotes knowledge and information creation, particularly for built environment students. The result shows that students' experience in the game is more likely to encourage OSH learning. Besides, the built-in digital and online gamification was found interactive in terms of outcomes and playability. Therefore, this gamification project can help develop knowledge and information about OSH and improve essential skills for the construction industry's students and future personnel.

Keywords— *e-learning, gamification, interactive, learner engagement, direct digital learning.*

I. INTRODUCTION

The construction industry is an important key sector in stimulating Malaysia's economic growth to achieve a high-income, inclusive, and sustainable economy. Over the last 30 years, it forms a significant component of the national Gross Domestic Product (GDP). The industry is expected to grow at 10.3% per annum, contributing to RM327 billion (5.5%) to GDP [1]. The industry also provides about 1.2 million employment opportunities representing 9.5% of Malaysia's total workforce [2]. Therefore, the construction sector is considered one of the country's primary sources of economic growth. In Malaysia, occupational safety and health (OSH) are important sources of green growth highlighted in the Construction Industry Transformation Plan (CITP) 2016-2020 [2]. Therefore, improving OSH is one of the strategic thrusts formulated by policymakers. In the construction industry, workers perform several physically demanding work tasks with varying exposures and risks [3]. Frequent accidents have plagued the construction industry. As noted, fatal accidents tend to occur more in the construction industry than in other industries, even though more accidents can occur in other industries as well [4]. According to the DOSH statistical report, between 2002 and 2009, most of the fatalities in the construction industry were caused by "falls of persons," being "caught in or between objects," "stepping on, striking against or [being] struck by objects," being "struck by falling objects," and "electrical shock" [4].

Unfortunately, when looking at fatal and nonfatal injuries, construction workers have significantly higher rates than other industry workers. Therefore, the rapid change in workforce demographics previously described (the new generation of workers) is undoubtedly a critical factor in allocating OSH educational and training resources. Education and training have been suggested as an effective means of influencing attitudes and practices in relation to OSH at work [5]. Better educated/trained workers are

more aware of the hazards in the work environment. Appropriate training and education on OSH are now widely recognized as crucial in reducing and preventing injuries. OSH has become an important issue for stakeholders to manage human resources effectively [6].

As a result, OSH training conducted aims to overcome the higher rate of accidents on construction sites and related construction deliveries. Further, as mentioned by Brunette [3], the training must also provide a sense of responsibility towards OSH's importance. The education must start early, such as tertiary level, to ensure the successful promotion of the OSH concern in the construction industry. However, currently, available OSH training approaches are still lacking in terms of delivering hands-on training and are more theoretical- instead of being more practical-based [7]. Thus, in recent years, gaming products have increasingly been used to enhance learning and training development in the academic and commercial sectors. Gaming is an approach that applies technology to provide an almost real experience interactive field training and supports the theory of learning by doing with the real case scenario. Furthermore, students at the tertiary level with no real experience on the site can use the gaming approach to nurture their interest [8]. Student motivation and engagement are an ongoing challenge for classroom instructors and the basis of various research endeavors [9].

In terms of knowledge, understanding, and awareness in construction OSH, the student should grasp the OSH's importance in the construction industry. Moreover, the interactive gaming approach also provides positive reinforcement for working with others to accomplish the activity's goal. As a result, the game outcomes and playability must be measured using proper instruments to ensure the gamers/students feel the board game's learning and entertainment objectives are fulfilled based on the developed features [10]. Therefore, this study aims to identify students' perception of OSH-DBG board game based on the outcomes and playability for developing a teaching tool.

II. METHODS

This preliminary study uses a quantitative approach. The instrumentation involved in this study is the questionnaire survey. The multiple-choice questions based on five (5) points Likert scale were used to grasp respondents' opinions. The respondents' key selection criteria are they should be students who currently or have attended Construction Safety and Health subject (BGN292) in UiTM, Sarawak Branch. The students have tested and engaged in the interactive board game developed. The survey will be a cross-sectional survey since it took place at a single point in time. This study involves five (5) students that meet the criteria. The sample was drawn based on a random sampling method where the respondents were chosen. It is a small sample study since the board game is still in the prototype version. None of the questions can identify the respondent's identity. The respondents responded to the survey using the Google Form application. The measure of central tendency, i.e., mean score is used to analyze respondents' opinions. A score of more than 2.5 points means that the respondents agree with the statement.

III. RESULTS AND FINDINGS

A questionnaire survey was conducted to find out students' experience playing OSH-DBG Board Game. The survey consists of respondent's background and game outcomes, and playability. Here the word respondent is used interchangeably with the student. It was found that all respondents are 21 years old when they responded to this survey. It indicates that 40% (2) are female while 60 % (3) are male. Figure 1 shows the result of the students' experience playing this game. Each item of number represents the students' experience as tabulated in Table 1.

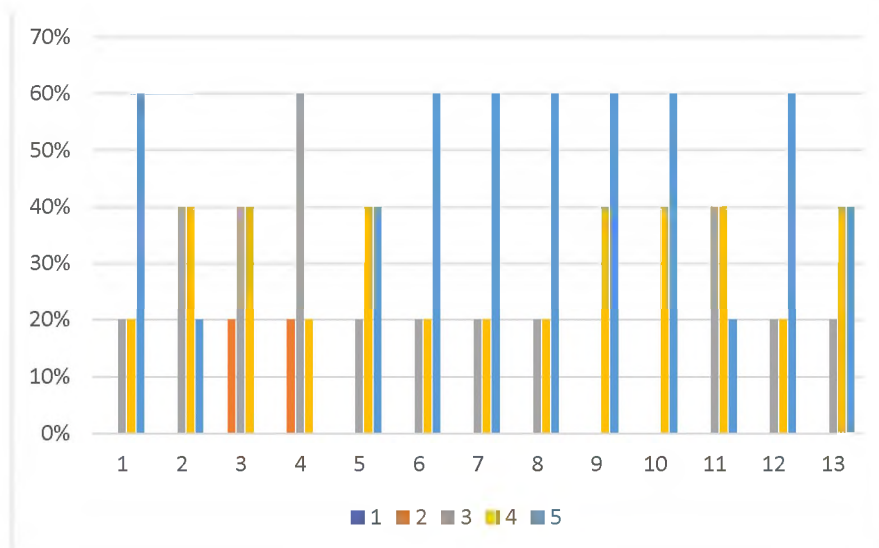


Fig. 1. Bar chart of students' experience based on percentage versus Likert scale.

Table 1. Students' experience based on game outcomes and playability.

Item	Students' experience	Item	Students' experience
1	Familiarity playing board games	8	The level of achievement on the learning objective
2	Respondents' level of knowledge	9	How straightforward the game information?
3	The course's level of difficulty	10	How instant to learn to play the game or read a manual?
4	The view on traditional teaching method	11	The level of confidence while playing the game
5	The game can improve respondents' knowledge	12	The game is liked because they were informative and exciting
6	The level of easiness to play the game	13	The game can help to understand OSH
7	The level of easiness to navigate the game interface		

Figure 1 and Table 1 indicates that, for item no. 1, most respondents are familiar with the game rules and style because it is similar to ordinary board game rule. The average score for item no.1 is 4.4. The result shows that, for item no.2, most respondents are quite knowledgeable on the course's subject. The average score for item no.2 is 3.8. However, the level of difficulty of the course can be more than average (item no.3). The average score for item no.3 is 3.2. For item no.4, in term of learning, most respondents think that the traditional face-to-face learning can be uninteresting for this subject. The average score for item no. 4 is 3.0. They agree that this board game can improve their knowledge of OSH (item no.5). The average score for item no. 5 is 4.2. Also, for item no.6, most respondents think that the game is easy to play. The average score for item no.6 is 4.4. In addition, for item no.7, most respondents think that the game interface is relatively easy to navigate. The average score for item no. 7 is 4.4. Also, they believe that the game can achieve the course's learning objective (item no.8). The average score for item no.8 is 4.4. Here, for item no. 9, the game information is straightforward to be understood by respondents. The average score for item no.9 is 4.6. For item no.10, most respondents find that the game manual is easier to read, and they can start the game almost instantly. The average score for item 10 is 4.6. They are confident in playing the game (item no.11). The average score for item no.11 is 3.8. For item no. 12, most respondents think that the game are informative and exciting to play. The average score for item no.12 is 4.4. Lastly, most respondents believe that the game can help them to understand OSH more (item no.13). The average score for item no. 13 is 4.2.

IV. CONCLUSIONS

The need to raise construction occupational health and safety awareness (OSH) is challenging. Accidents at construction sites can be fatal than in other industries. Accidents can also be problematic for construction resources because the loss of human resources can affect productivity and project deliveries. The current green growth policy is looking for better ways to improve OSH levels to promote sustainable development in the construction sector. Therefore, it is essential to equip students with a high level of OSH awareness. However, the pedagogy approach can be challenging due to the current needs for a better teaching approach that should include creative thought using a hand-on approach. In this case, this paper proposed the OSH-DBG boardgame as a method of digital problem-solving for learning construction safety and health. The result shows that the board game has achieved its objectives and playable for students who undertake an OSH course at the tertiary level. Therefore, a better-refined teaching tool can be further developed as part of the mass introduction as a teaching tool for this subject. It is also hoped that future development on this boardgame can raise its application to other construction and health education in the future.

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