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Encouraging Classroom Learning through Game-Based Learning (GBL) Approach

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Abstract: In recent years, gamification of learning through a student-centred approach (SCA) is getting more attention from educators to encourage student participation than the conventional teaching and learning (T&L) process. Nonetheless, the nature of hazards and incident risk in several university courses and training sessions in the industry including occupational safety courses constrains the implementation of SCA in a real-life situation as it can pose a risk to humans and the environment. Thus, this research was attempted to investigate the impact of game-based learning (GBL) approach on student participation and accomplishment in an occupational safety course. The total of participants are 30 second-year, from students studying the course of BNJ21102 Occupational Safety and Health for Bachelor of Mechanical Engineering Technology (Plant) with Honours (BNL) at Universiti Tun Hussein Onn Malaysia (UTHM). This research employed a quantitative quasi-experimental design, which involved non-equivalent groups of pre-and-post-tests. The experimental group (EG) received an online platform of the GBL approach, while the control group (CG) used a conventional method in the T&L process. As for quantitative data collection and analysis purposes, both groups took the pre-and-post-tests of the course and filled up a set of the survey questionnaire. The result of tests revealed the EG scored higher marks than CG. Based on the survey result, most students agree and strongly agree on the perceived usefulness and ease of use of online game-based learning (OGBL) in encouraging learning. The results also discovered that the race game genre, 4-players of game, Monopoly-size of the board game, and portable board game as the primary preference for design specification of a board game-based learning (BGBL). A computer-aided design (CAD) software was employed to design a model of BGBL based on the preferences. Overall, the study concluded that the effective use of GBL could contribute positive motivation and encouragement of learning to the students. Nonetheless, several recommendations are highlighted for further development and improvement of the research, including the real play-testing of the game with a combination of OGBL and BGBL towards increasing students' the overall learning.

Keywords: Game-Based Learning (GBL), Learning Technique, Occupational Safety And Health (OSH)

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1. Introduction

Over the years, gamification in education is receiving much attention from academics to motivate and encourage student participation in the learning process [1]. Nowadays, educational games or game-based learning (GBL) are alternative to traditional teaching methods in many schools and universities [2]. GBL approaches are typically created with clear learning goals in mind, which are based on established knowledge such as scientific concepts, historical facts, or mathematical techniques [3]. The game will strengthen the learning process in terms of lively-learning and interaction [2]. Several experts conclude that the use of games in classroom learning can be useful for academic accomplishment, inspiration, and an energetic classroom [3].

Gaming in the form of board GBL (BGBL) or online GBL (OGBL) is a technique that uses technology to have the near-real experience and promotes learning theory in a real-life scenario. Studies suggest that students are more likely to remain engaged in an educational activity if the technology is involved [4]. Web-based programs, mobile applications, and virtual simulations are a few examples of information technology and online platforms that can incorporate gamification. Some of the advantages of game-based platforms for example they are attractive, fresh, impart a healthier environment and aid the students to stay centered on the assignment [5], thus suggesting OGBL and BGBL as valuable educational tools in university academic and various industrial sectors.

2. Teaching and Learning Method

2.1 Teaching and learning process

Teaching and learning is a method of forming suggestions and reactions on an ongoing basis. Specifically, teaching is a process or method in which another person is taught or instructed. Teaching can be described as interacting with learners so they can understand and apply knowledge, concepts, and processes. In the situation of the classroom, teaching is called the act of imparting guidance to the learners. The ideal aim of teaching is to help students develop knowledge, concepts, talents, beliefs, ways of analysing and convey themselves, and, mainly, to educate them on how the learning process takes place [6].

The terms of learning by studying, training, being taught or experiencing something as an action or method of acquiring knowledge or skills. In other words, learning is a process by which behavior is originated or change through practice or training. It is about what students do, not about what the educators do. In short, teaching and learning is a method that involves several variables. Generally, teaching and learning methods could be categorised into conventional and non-conventional methods.

2.2 Conventional teaching and learning method

Conventional or traditional, or teacher-centered teaching and learning method refers to a teacher-centred approach (TCA), which involves instructors and students who interact face-to-face in the classroom. Students passively interpret the information and repeat the knowledge memorised in the tests [7]. Traditional methods are usually oriented to educators, in which students are trained to sit and listen in a conducive way [8].

Acceptance of TCA can be very successful, particularly for details sharing which isn't effortlessly formed elsewhere, quickly presenting data, and educating students who learn finest by paying attention and listening. Anyhow, the techniques often present difficulties, together with that only a fraction of learners grasp finest by listening, it is also difficult to retain the attention of learners. The method appears to involve a few analytical thought, and the system suggests that both students study in the same unusual manner.

2.3 Non-conventional teaching and learning method

Non-traditional or student-centered approaches (SCA) often referred to as creative or new or blended methods of teaching, are methods requiring the use of technology, animation, special effects, or are typically interactive and blended in nature, such as the use of computers and videos to facilitate content delivery [9]. Earlier research suggests that student-centred approaches in the 21st century will boost teacher-centered teaching by creating a concrete framework for students to master their evolving abilities. [10].

Nowadays, in demonstrating applications, students prefer to see educators develop teaching materials where information technology and interactive elements such as visuals, animation, music, recordings, and text may draw the audience's attention. [7]. Many student-centred approaches have been explored by some researchers to enhance the delivery of teaching and learning processes, in particularly on the use of technology [11]. By using technology, the activity of teaching and in terms of management of time, cost, and practice, learning has become more scalable.

Furthermore, to interact and build information, students may use different kinds of technology. Classroom technology is essentially an enhanced way of helping students engage with the information and learn more effectively [12]. Over the years, several researchers have examined the efficacy of digital technologies in promoting learning, how often gamification or game-based learning (GBL) is in promoting learning.

2.4 Game-based learning (GBL)

Many authors differently interpreted the definition of games. By listing their structural elements, such as dynamic graphics, interaction, rules, and objectives, the game [13]. Games can be specified in line with the necessity of the games, for example the mission mentioned, the roles of the player, collective tasks to the objective, and the level of player control [14]. The game is often referred to as an artificially created, competitive task with a clear purpose, a collection of regulations and limitations located in a particular touch. [15].

A type of gaming that has described the learning outcomes is game-based learning (GBL). In general, GBL is developed to align the content of the subject with gameplay and the player's ability to maintain and adapt the content of the subject into the real-world. In other words, for teaching subject matter, GBL is the usage of games in the digital or analogue configuration. The idea is to get students to play ready-made games to accomplish the goal of learning. In addition, games have several problem-solving features, an unpredictable outcome, collective paths to an aim, the creation of a complication background, multiple player cooperation, and they incorporate the elements of competition and chance [16].

2.5 Digital and Online GBL (OGBL)

The majority of GBL studies have concentrated on digital and online GBL (OGBL). As well as interactive relaxation, computer games have graphical motion and audial effects. Typing exercise and inviting learners to defeat their competitor which includes game mechanisms [17]. While these learners' success was not substantially more significant than that of learners using traditional teaching methods, their typing abilities were remarkably a cut above before the evaluation. The students in the game structure team spent a slightly longer time typing than their peers in the standard class, showing that multimedia can impact the learners' learning enthusiasm [17].

As well as sharing knowledge, simplifying issues, and solving tasks, digital games that facilitate interactive learning generates new ideas. The capability of stern games is also apparent in the fact that they can be adapted easily to any technological format and can be used on desktop equipment or mobile devices of all kinds. The platforms that can integrate gamification include web-based programs, mobile

applications, and virtual patient simulations. Examples of the OGBL platform freely available on the internet include of Kahoot, Quizizz, Worldwall, and many others. In short, digital games and OGBL can develop an enthusiasm for learning and trigger encouraging emotions in students.

2.6 Board GBL (BGBL)

Board games are an effective tool for people of all ages in all subjects to include hands-on and heads-on abilities and the creation of knowledge. Well-crafted games not only creates an environment of interaction, but also have a non-threatening, playful atmosphere, but a competitive environment in which content is centred and learning is improved and implemented. Mistakes are useful and shows what we need to note. The board itself creates a graphic metaphor for linking details. Vehicles for learning are game elements, conversations, and issue solving with fellow team members about the content. Subtle redundancy should be built into the game design to improve learning and guarantee retention. Good questions challenges to be solved and situations to understand help players think about and integrate what they learn. [18].

Effective games help to systemise, knowledge and make it meaningful in a conceptual context. To combine new knowledge, they include analogies and metaphors. Members learn together while playing in teams; nobody ever feels left out for not understanding a response. Questions help to validate comprehension and show where further learning is needed. Games transform abstract ideas for those who learn best from tangible details. The metaphor (s) of the game itself encourages those who need to proceed with the big picture. In order to fit various learning styles, games are a perfect way. Meanwhile for team-based board games, in addition to requiring critical thought, when players work face-to-face to answer questions or fix conflicts, it help improve communication and relationship skills. The influence of teamwork becomes evident to all and can change working relationships in organisational settings.

3. Methods

3.1 Research design

The study outline relates to a coordinated system and experimental analysis into a particular issue with the goal of seeking solutions to it. [19]. The choice of a study design depends heavily on the type of data needed, the number of materials, and the researcher's ability to control the independent variables. [20].

It is important to group the study design into experimental and non-experimental designs. The independent variable is controlled to determine its predictive relationship with the dependent variable with the experimental design is perturbed. On the other hand, in a non-experimental design, the investigator does not control the variables under analysis. The experimental design is concerned with manipulating the independent variable to establish its causal relationship with the dependent variable. On the other hand, in a non-experimental design, the researcher does not manipulate the variables under study [21]. This study requires controlling an independent variable without random assigning of respondents to conditions that include non-equivalent classes of pre-and-post studies, and a quantitative quasi-experimental method is also used in this research work.

3.2 Research design process

There are five main phases involved in this research towards achieving the objectives of the study. The research begins with the initiation phase, which focusing on the exploratory research gap, identifying of game design requirements, and determining OSH requirements. The second phase of the research project emphasises the development of the game including the activity of validation and testing, in which the pre-and-post assessments were reviewed for content validity by two lecturers in the field of occupational safety education, which concerns, primarily, the adequacy with which the test

items adequately and representatively sample the content area to be measured. This validation was intended to ensure that the questions and answer scheme were related and clearly interpreted to the topic's contents . The third phase underlies the quasi-experimental design, which attempt to establish a cause and effect relationship between an independent and dependent variable. The next phase is a conceptual design, which involves data collection and analysis for learning achievements of the online game-based learning (OGBL) and feedback from participants for board game-based learning (BGBL). The final phase summarises the outcomes of the research through discussion, conclusion, and further works. Figure 1 depicts the process flow chart of the overall research design.

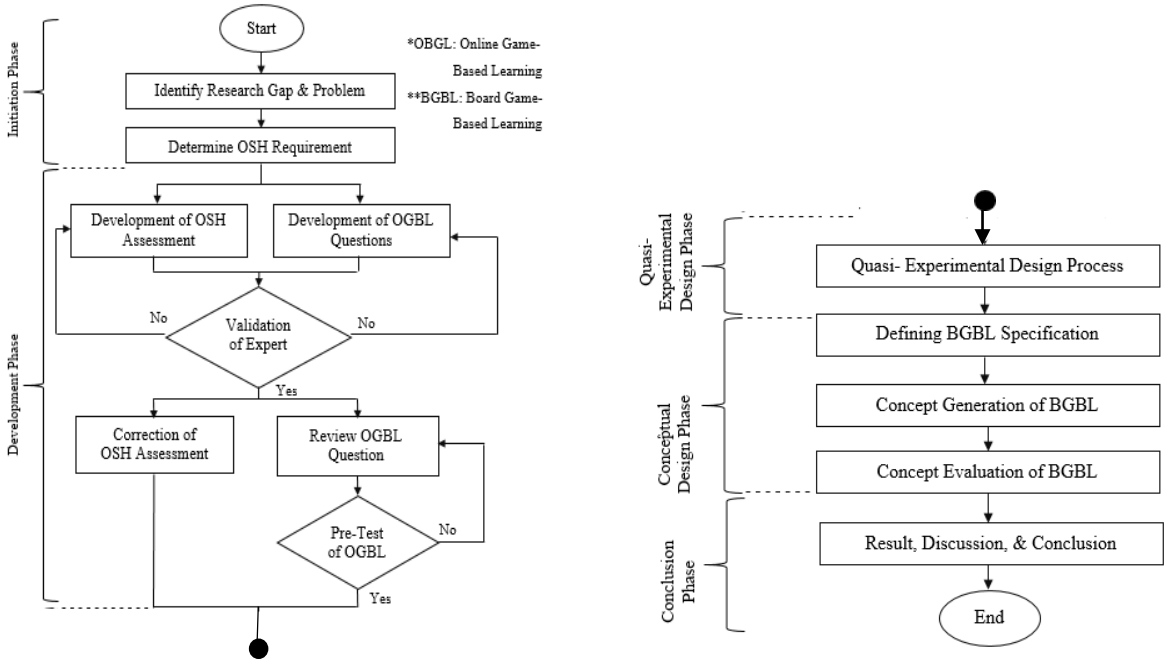

Figure 1: Flow chart of the research design process

3.3 Conceptual framework

The research study utilised a quasi-experimental design, which involved 30 students in the second year studying the course of BNJ21102 Occupational Safety and Health (OSH) for Bachelor of Mechanical Engineering Technology (Plant) with Honours (BNL) at Universiti Tun Hussein Onn Malaysia (UTHM). The experimental design was divided into two different interventions: the experimental group (EG) of 15 students and the control group (CG) of another 15 students. A conceptual framework has been developed as illustrated in Figure 2 to portray the relationship between the independent variable (IV) and the study's dependent variable (DV).

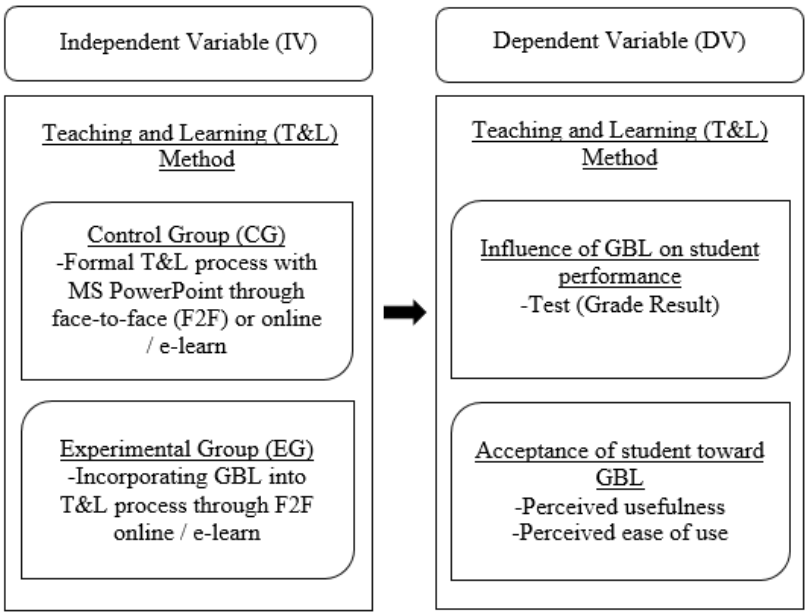

Figure 2: Conceptual framework

The IV of this research is the implementation of different teaching and learning (T&L) methods of the occupational safety and health (OSH) course. The experimental group (EG) receives the content by incorporating the GBL approach into a formal T&L process with multimedia PowerPoint through face-to-face (F2F) or e-Learning. Meanwhile, the control group (CG) a formal T&L process with a multimedia PowerPoint of the content through F2F or e-Learning. On the other hand, the DV is the achievement of students in OSH education utilising the influence of OGBL on student performance and their acceptance towards GBL.

3.4 Development of OSH assessment

The main aim of the OSH evaluation material was to test the student's interpretation of the OSH aspect. In the course module, the scope of the test was focused on the learning materials. In the evolution's evaluation, the content was referred to problems and questions in the syllabus which was compiled by the course coordinator. The assessment was included true or false, and multiple-choice questions, for a cumulative score of 100 marks, each of the contributing marks. The examination was given to the participants as a pre-test (before) and post-test (after) of the learning task after the validation was completed by two intellectuals as an OSH expert group, with the questions from the pre-test being re-ordered in the post-test to minimise the impact of repetitive exercise.

3.5 Online game application (Apps)

Several game-based learning platforms are openly accessible on the internet such as Kahoot, Quizizz, Worldwall, and many others. For instance widely used a gamified learning environment in the education sector is Worldwall as employed in this research study. In either language and on any platform, Worldwall helps educators to create minutiae quizzes. educator and student can use the quizzes on any platform and in any place that has a mobile or internet connection. Inside a physical class environment, Worldwall questions can be used in two ways: questions are displayed on a big screen and each student responses to the questions on their smartphone, or students display the questions on their smartphone and upload the answers. In order to build a competitive atmosphere, the Worldwall environment offers limited time and scoring.

To present, the online portal has been used primarily as a digital method to promote the transmission of knowledge in corporate environments and elementary and middle schools, but that is not yet

commonly used in educational institutions [2]. Compared to several other virtual formative evaluation applications, Worldwall's main advantage may be the ability to view high-quality images or videos with the best detailed graphic experience. Nonetheless, the online game question game based on the Worldwall platform in this study were distributed to the students after completion of validation by two academicians.

3.6 Accessing and playing the OGBL

Students need access to the Apps link that allowed them to play the games. The lecturer gave the link with the game password or credential ID. Using the credentials provided to them, they would be able to log in and use the application to continue with the interactive games. The forum for games offers time restrictions and scoring to create a fun learning atmosphere. In addition, each student was be allowed to answer the questions on their computer or mobile device.

3.7 Quasi-experimental design process

The experimental group (EG) of students used game-based learning (GBL), and the control group (CG) utilised the conventional approach of teaching and learning (T&L). Students under EG were played the online OGBL, doing pre-and-post-test of Topic 1 – Health Safety and Environment Management assessment of OSH, and filling out the survey questionnaire afterward. Meanwhile, students in CG were receiving conventional T&L. In order to avoid influence from bias or prejudice, this research study was set up the control variances by providing the same lecturer or instructor, Health Safety and Environment syllabus content, and duration of test for both groups. Figure 3 shows the quasi-experimental design for comparing GBL and conventional T&L approaches.

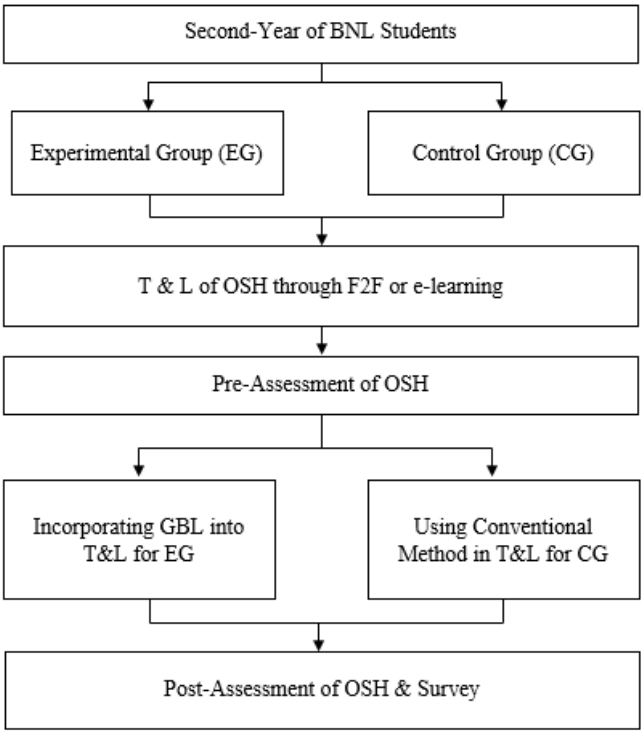

Figure 3: Quasi-experimental design process

3.8 Survey of OGBL and BGBL

A set of survey questionnaire with five scales of satisfaction was distributed to the EG of students to get feedback on the perceived usefulness and ease of use toward playing the OGBL. Meanwhile, a survey questionnaire with five scales of satisfaction was developed as per the technology approval's

structure, a model of board GBL (BGBL) to obtain the extent to which learners have embraced board games knowledge. Each question of the questionnaires holds specific information that can be elaborated into the specification of BGBL as preferred by the students.

3.9 Pugh concept selection method

This research study employed Pugh's method to select the best concept in designing the BGBL. A variety of design candidates to be compared to which essentially fits a set of parameters better which is required by the PUGH method (PM)'s type of matrix diagram. Perhaps it allows for a scope of contextual optimisation of alternative ideas by hybrid candidate generation. The PM method is simple to utilise and depends on a variety of correlation comparisons among design candidates against several specifications or parameters. The ability to accommodate a wide range of decision parameters is one of its main benefits over other decision-making devices such as the Decision Matrix.

3.10 Computer-aided design (CAD) modelling

The use of computer tools to plan and record the design process of a product is a computer-aided design (CAD). CAD is also utilised to execute conceptual designs and layouts, plan descriptions and measurements, to construct 3-D models, create and release sketches, and communicate with analytical, communications, production, and end-user workers. The CAD of SolidWorks software was utilised in this research in designing the BGBL model.

4. Results and Discussion

4.1 Pre-test-and-post-test and OGBL results for the experimental group (EG)

As highlighted in Figure 4, there is a significant improvement of marks scored for EG students based on the result of the pre-and-post-test and OGBL. This is due to the OGBL to some extent which shows a positive impact on the learning method, which may result in students' overall achievement.

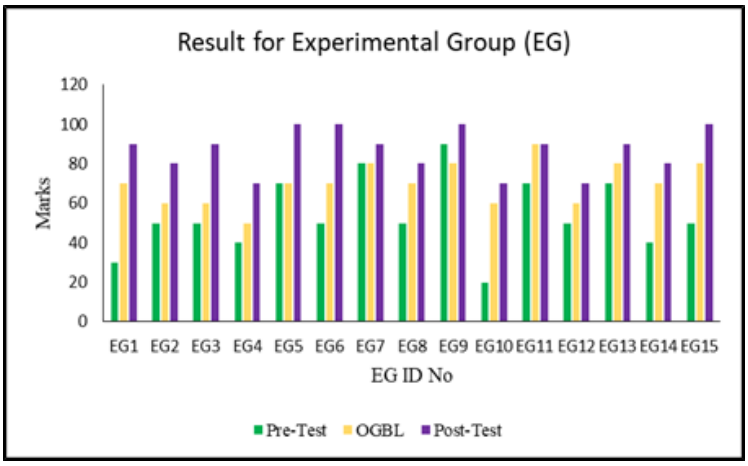

Figure 4: The marks obtained in pre-and-post-test and OGBL for the experimental group (EG)

4.2 Pre-test-and-post-test results for the control group (CG)

Figure 5 shows the result of pre-and-post-test for the control group (CG). The findings indicated that the result for both the pre-test and post-test of CG students was not up to par compared to EG.

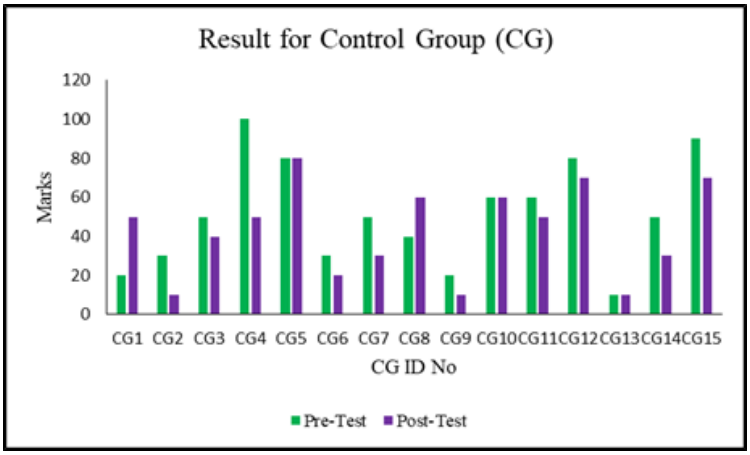

Figure 5: The marks obtained in pre-and-post-test for the control group (CG)

4.3 Perceived ease of use of OGBL

Discern and ease of use, where this analysis is assessed by students' responses to how quick and convenient it would be for students to use computer games in motivating and enhancing learning. Based on the survey result and analysis, 45.5 % of students agreed that OGBL helps understand the lecture notes. In addition, students were strongly agreed (31.8 %) and agreed (40.9 %) respectively towards the increase of motivation for class/topic using games. Meanwhile, the majority of students were strongly agreed (50.0 %) with the OGBL questions that can assist them to identify the main point of the topic, and 40.9 % of students also strongly agreed that the question was leveled appropriately for the learning content. Moreover, students were strongly agreed (36.4 %) and agreed (40.9 %), respectively on OGBL brings a positive effect on the skills of studies.

4.4 Perceived usefulness of OGBL

Perceived usefulness in this research, the reactions of students to the importance of learning, collective value, and independent growth are evaluated. For each build of the satisfaction scale, mean and standard deviation were obtained from the survey questionnaire. The results specifically indicated a high score (above 60.0 %) for each respondent's perception in terms of easiness to access the games, fun playing, clarity of rules of the game, and the intention in playing the game again. Overall, the perceived usefulness of OGBL in particular, good scores were achieved, suggesting that by studying with the OGBL, the students believed they could acquire OSH knowledge and useful for learning.

4.5 Specification preference for BGBL

Based on the analysis of the BGBL survey, the majority of students chose race game (60.0 %) as a preferred genre than other types of game, four players (80.0 %) as preference number of player to play the game, preference of size of Monopoly board game (53.3 %), and portability board (53.3 %). The preference of the respondents was then used as input to select the best concept of BGBL through Pugh's method.

4.6 Pugh selection method of the BGBL design concept

Table 1 shows a completed three design concepts of options A, B, and C for BGBL employing the game's concept and mechanics. The option of Design A represented the concept of a war game with a territory capture mechanism. Meanwhile, Design B signified a race game for the concept with dice mechanics, and Design C characterised the concept of alignment and block building mechanism.

Table 1: BGBL design option

Design Option	Concept	Mechanics	Example
A	War Games	Territory Capture	Chess
B	Race Games	Roll & Move(Dice)	Snakes & Monopoly
C	Alignment Games	Block Building	Domino, Scrabble

These design concepts were evaluated against several criteria, which include usability, learnability, durability, duration, and excitement as suggested in the literature. Table 2 describes Pugh's evaluation matrix of criteria and design concepts for BGBL. The design of BGBL was tested in accordance with Pugh's matrix based on the criteria of usability (ease of use), learnability (ease of learning), durability (material life span), duration (playing time), and excitement (enthusiasm and emotion). The results suggested Design B as the best design option for BGBL based on the total score obtained.

Table 2: Pugh's design concept selection for BGBL

Criteria	Design Option		
	A	B	C
Usability (Ease of use)	+	+	-
Learnability (Ease of learning)	-	+	-
Durability (Material life span)	+	-	+
Duration (Playing time)	-	+	+
Excitement (Enthusiasm & emotion)	+	+	-
∑ (+)	3	4	2
∑ (-)	2	1	3
∑ =	1	3	-1

4.7 CAD modelling of BGBL

The model shown in Figure 6 is a conceptual design of BGBL based on the specification preference of the respondents, which includes the war game genre of Monopoly sizing by four players. The design of the model for BGBL has been developed using SolidWorks CAD software.

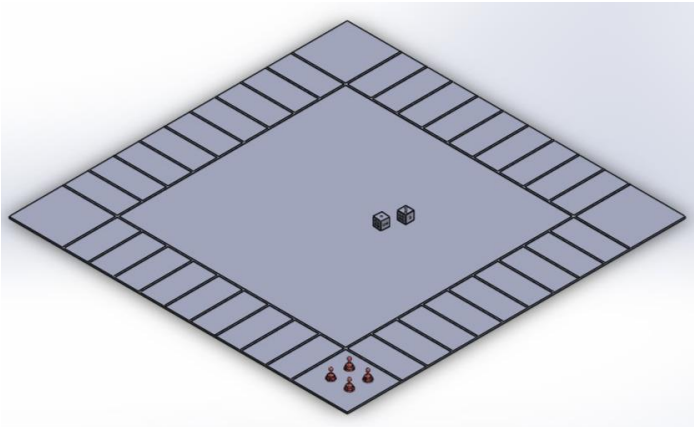

Figure 6: The BGBL model

5. Discussions

The focus of this study aims is to establish how online game-based learning (OGBL) can enhance students in their learning. acquiring OSH subject-related knowledge. The respondents showed optimistic attitudes towards the use of the OGBL and thought that the technique led to learning.The majority of student welcomed this learning method, and they were planning to use this technique in the coming times continuoudly. The students also indicated that non-conventional learning could help them gain scientific knowledge and the game-based learning process strengthened their interest in transport and energy mode. The pre-test and post-test show that the OGBL significantly increased the scientific knowledge of the student concerning OSH subject. The overall findings of this study could support and correlate with the use of game-based learning in previous research studies [3] [11] [16] [18].

6. Conclusion

In conclusion, the gamification approach utilising online games or using board games as the toolbox of didactic means for educators could help as alternatives to choose from where to implement a mixed learning concept involving immersive and self-learning components. In this study, the literature study and reviews received from the respondents suggest that the game is suitable for addressing the criteria defined for the planned use of the online gamification process in developing the GBL process of OGBL for OSH course.

The study on motivating classroom learning through a game-based learning approach has been proven based on the comparison results of pre-test and post-test marks scored by EG and CG to reflect the discern utility and efficiency of use of OGBL. The model of BGBL is designed using CAD software based on the preference specification as proposed by the respondents. Overall, the findings of the study reveal that playing the games as the T&L method could bring a positive impression on the students and subsequently produce fun and encouraging learning.

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