

Creating Meaningful Learning and Improving Students' Knowledge Using Game-based Learning in Higher Education

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Abstract

This paper aimed at investigating the use of game-based learning approach in creating meaningful learning experiences and its influence in improving students' knowledge on the subject matter. A total number of 120 students enrolled in the accounting system analysis and design course in a university participated in this experimental study. Grounded by Kolb's experiential learning theory, an experiment was conducted to explore how participants involve themselves in learning from experience by playing educational game. Data were collected through pre and post quiz scores, questionnaire surveys, interviews, and reflections on the students' feedback. The results of the t-test analysis showed that students achieved higher marks after the game intervention and the difference in the mean score between before and after the game played is statistically significant. The findings suggested that the game-based learning approach in teaching and learning can assist students in understanding the subject better than the teacher-centred approach. The results of the study also found that the learning sessions were more engaging and fun as the respondents enjoyed learning through playing games. In addition, the game-based learning approach motivates them to conduct self-study while seeking answers to solve the game tasks. Practically, this study contributes to disseminate awareness among academicians and industry practitioners in developing more educational games that can be used in teaching and learning. Theoretically, it contributes to the existing literature of game-based teaching approach.

Keywords: SOTL, gamification, system analysis and design, game-based education, crossword puzzle, higher learning, transformative teaching

1. Introduction

Good teaching practice involves the concern of the teaching process and its impact on the students learning; review teaching experience and continuous improvement for the best experience in the teaching and learning process. In order to go beyond the good teaching practice, a systematic inquiry of teaching and learning experience needs to be well-documented as it could be shared together in the community as part of continuous improvement. The researchers (i.e., teachers) in this study move towards implementing the scholarly approach to teaching as a means to comprehend better of how the teaching can increase the knowledge and create meaningful learning experience of students. Hence, this study is grounded on the critical reflection by the researchers to provide systematic evidence to improve teaching and learning and share it with the academic community in the hope that other educators benefited from the study.

2. Problem Statement

Students' knowledge can be enhanced if they actively participate in classroom activities, rather than just listening to their teacher's lectures passively. However, the challenge is great if the nature of the subject is conceptual. It is in terms of how the teacher can ensure that knowledge can be acquired by the students, which reflects how the learning outcomes can be achieved, and how the teacher can attract the interests of the students to engage in the classroom activities. Teaching a conceptual topic in a classroom resulted in a dull teaching session (Garfield, 2017). This situation led to a question of how to increase students' knowledge that can help them to grasp the conceptual subject.

The above mentioned challenges can be seen in Accounting Information Systems Analysis and Design (SAD) which

is one of the important subjects in accounting information system. In the SAD course, accounting students learn how to analyse and design a system using the systems development life cycle (SDLC) technique. Each topic covered in the SAD course is structured by SDLC phases, from system planning, followed by system analysis, system design, and system implementation phases.

Previous literature, however, highlighted that teaching SAD is both difficult and challenging (Barefah & McKay, 2016; Chen, 2006; Garfield, 2017; Rob, 2006) due to the topics in the SAD course are theoretical in nature (Barefah & McKay, 2016), which are not clearly defined and difficult to practice in a classroom setting (Chen, 2006). Learning SAD course is also difficult for students because of their limited ability to understand the significance of the course (Rob, 2006). As such, Rob (2006) explained that students could not see the importance of this subject as they will only appreciate the knowledge when they enter the workforce. Judging by the name of the SAD course, students commonly associate it as a technical subject, assuming it does not link with other accounting subjects. As a result, the students were unable to appreciate the importance of this course for their future. Barefah and McKay (2016) claimed that the low success rate of the SAD course is due to the lack of sound instructional course development pedagogies. The traditional way of teaching the SAD course is no longer appropriate to attract students' engagement and understanding. Thus, various approaches have been applied to teach this course, which include problem-based learning (PBL), role-playing, group projects (see, for example, Barefah & McKay, 2016; Garfield, 2017), simulations (Kerins, 2012), and flipped classroom approach (Tanner & Scott, 2015). The aim of such approaches is to ensure students' engagement to stimulate their motivation and interest to learn this conceptual course.

In this study, the substantial part of the SAD course is how the student acts as a system analyst to design a system by applying the concept of SDLC. The objective of the SAD course is to achieve five course learning outcomes (CLOs), and it is achieved through two teaching approaches, namely PBL and lecture sessions. The focus of the game-based learning is on the CLO 5 that is to demonstrate the systems implementation methods and maintenance management (last phase in the SDLC) in which the current learning approach uses the lecture approach. While obtaining students' engagement through the PBL sessions for other CLOs of the course is impressive, the lecture session for achieving CLO 5, on the other hand, is challenging. Due to the abstract concept of the system implementation and maintenance topics, it is a challenge for the teacher to conduct a lecture session to convey the topic and ensure the students understand them. Unlike other topics, the hands-on activities within the PBL session are possible as varieties of application could be used, such as Microsoft Project for scheduling application, other free applications on the web for data modelling, and Microsoft Access for database application. The topic covered in CLO 5 is crucial as it is a manifestation of the earlier system development phases that the students have learnt in previous topics, and their ability to demonstrate and link it with the final phase of system implementation methods and maintenance. Nevertheless, most of the students could not relate and apply their knowledge. The topic in CLO 5 is highly theoretical in which the teacher was unable to use hands-on activities to stimulate the student learning experiences. It is evidenced by the data extracted from the course outcome achievement analysis for CLO 5 (see Table 1).

Table 1. The course outcome achievement analysis for CLO 5

Semester	Excerpt from Course Outcome Achievement Analysis for CLO 5
A172	Despite almost reaching the satisfactory level, the students did not perform very well in the CLO 5, with only 62% fetched.
A181	As for CLO 5, 82 students achieved 86% of the target, with the majority of students at the Good level. However, the achievement of the students in CLO 5 was comparatively lower compared to other CLOs that were covered by the PBL approach. CLO 5 was not included in PBL and was assessed only through the final examination.
A182	The low achievement of 57% is somewhat consistent with the previous semester's results.

2.1 Teacher's Reflection on Previous Semester Teaching Approach

The aforementioned problems have led to a question of seeking evidence on the effectiveness of a specific teaching strategy that is currently used in teaching the SDLC's implementation phase: *Will the students' knowledge increase and meaningful learning be created if they play games while learning, instead of the traditional lecture teaching*

approach?

In order to understand the students' preferences and obtain their opinions on the existing teaching approach, a short survey (needs analysis) was conducted. A total of 20 students who enrolled in the SAD course in the previous semester (Semester A172) participated in the short survey. As for the preferred teaching approach for learning SAD-topic 5, 40% of the students chose the game-based learning (gamification), as depicted in Figure 1.

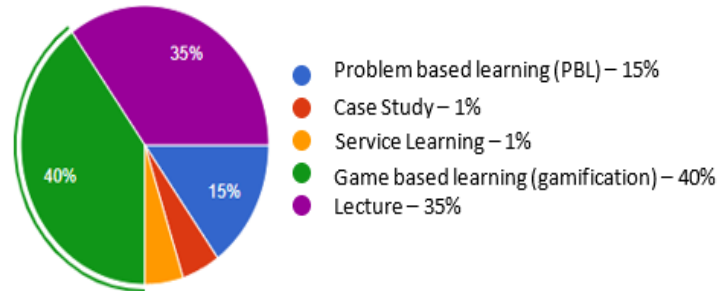


Figure 1. Preferred teaching approaches for SAD-topic 5

The survey also revealed that 65% of the respondents were interested in having a game-based learning (gamification) approach as part of the teaching and learning process for SAD-topic 5, as shown in Figure 2. Among the reasons are, the respondents stated the game-based learning (gamification) is a new way of learning, fun to learn, it is an interesting and engaging approach, and sparks the students' interests to learn the topic.

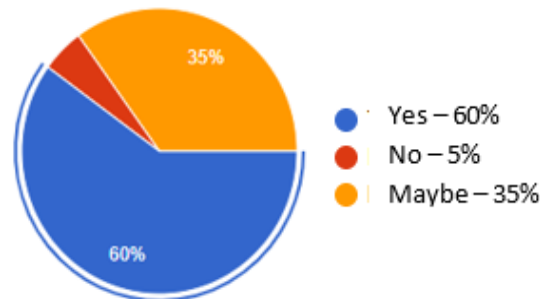


Figure 2. The respondents' opinions of the game-based learning (gamification) approach for SAD-topic 5

In a nutshell, the challenge of teaching the SAD course, particularly for the CLO 5 topic, is on the nature of its content. This viewpoint concurs with Barefah and McKay (2016); Chen (2006); Garfield (2017) and Rob (2006). The teacher needs to take up the challenge in stimulating students' interests and engagement and at the same time, acknowledge that the students have diverse abilities and interests, with different skills to construct their own understanding of such topic. Since the theoretical concept related to CLO 5 still uses the lecture-centred approach, the researchers suggest for improvement by involving game-based learning as part of the teaching and learning process. By doing this, it is expected that such activity could attract students' engagement and stimulate their knowledge and understanding of the related topic. This new approach is foreseen to help students gain knowledge on the topic without memorising, but increase their knowledge through playing educational games.

3. Game-based Learning

Game-based learning is a type of edutainment that enable learners to understand complex concepts without losing the connection between abstract ideas and the real problems (Shaffer et al., 2005), with an ability to stimulate the development of logical thinking and problem-solving skills (Vos, Van Der Meijden, & Denessen, 2011). Gamification is defined as the use of game design elements in non-game contexts (Deterding et al., 2011). Yildirim (2017) argued gamification is the process of transferring the elements of game design (e.g., badges, points) to non-game contexts in harmony. Specifically, gamification outcome is gamefulness (Deterding et al., 2011; Landers et al., 2018), which is designed to encourage a particular attitude or behaviour. Previous studies have evidenced that gamification and game-based learning have positive impacts on the learning process (see, for example, Buckley and

Doyle, 2016; Sanmugam et al., 2016), which can be beneficial both to school teachers and educators at the higher learning institutions.

Gamification and game-based learning are similar in terms of their ability to increase learner's engagement and sustain motivation in the teaching and learning process. However, unlike the game-based learning that embed game characteristics and principles in the learning activities (see, for example, Plass, Homer & Kinzer, 2015), gamification incorporates the elements of computer games, such as points and badges into non-game contexts (see, for example, Alsawaier, 2018; Deterding et al., 2011; Papp, 2017; Yildirim, 2017). Previous literature highlights the positive impact of gamification and game-based learning on students learning and motivation. For example, Alsawaier (2018) found a direct relationship between gamification and motivation and level of engagement. Su (2016) claimed that well-designed gamification affected both students' learning motivation and academic performance. In a different study, Banfield and Wilkerson's (2014) findings revealed that gamification and game-based learning increased the student intrinsic motivation and self-efficacy. Hence, it can be concluded that gamification and game-based learning are embedded as a pedagogy to create a meaningful learning process to help students maintain their motivation and stimulate active learning. In addition, embedded gamification and game-based learning in teaching is part of active learning, where the students are involved in the knowledge discovery process (Huang & Levinson, 2012), which leads to an interactive learning experience. On this basis, Kostianen et al. (2018) highlighted meaningful learning experience as the learning processes and various events, activities and circumstances that students regard as having a special meaning to them, being personally valued and rich.

In the context of the SAD course, particularly to achieve the CLO 5, the researchers proposed a new game-based learning approach in enhancing the teaching and learning process. A non-computer game, in particular, a board game, was chosen because of its ability to bring the students into the scenario, which allows the students to control the process (Huang & Levinson, 2012). Adopting the concept of board games, such as the crossword puzzle, this new idea of board game promotes the concept of fun while learning that engage students in learning by doing, which also helps improve the knowledge of the students. In addition, according to Jaramillo, Losada and Fekula (2012), the crossword puzzle has the ability to promote the exercise of the mind for intellectual development. They suggested that this type of board game could stimulate students' experience in "acquiring new vocabulary, making differentiations between similar words, correctly spelling terms, practicing dictionary-search and/or pronunciation skills, making inferences, evaluating choices, developing logical thinking, drawing conclusions and an appeal to their individual learning styles" (p. 214).

Previous literature indicates that various approaches have been applied to teach SAD course, which includes problem-based learning (PBL), group projects (for example, simulations (Kerins, 2012) and real projects (Chen, 2006)), case studies (Garfield, 2017), e-tutorial modules (Barefah & McKay, 2016), and the flipped classroom approach (Tanner & Scott, 2015). Suscheck and Huff (2007) used game, namely a Process Game (a variation of a card game) to improve the students' understanding of the use of processes in the SAD. On the other hand, Tepper (2014) applied a constructivist approach by asking the students to design their own board games that contain the four elements of SDLC in the SAD course. Based on the above discussion, previous literature has shown that SAD is a highly conceptual subject that needs to apply various teaching techniques to increase the engagement and understanding of the students. However, little is known about a study that uses a board game to improve the students' knowledge and contributes to meaningful learning. Therefore, this study fills the gap by introducing a board game based on the crossword puzzle. This research is expected to achieve the following learning outcomes:

1. Create a meaningful learning experience by using a game-based learning approach

The concept of game-based learning in classrooms carry the concept of learning through play. It makes the learning session more engaging and fun. The students will be able to learn from a different perspective, which they will never have been noticed and experienced in the traditional teaching and learning settings.

2. Improve students' knowledge

The students have the ability to deliver the concepts and terminologies used in the SDLC implementation phase. In order to solve the game, the students must be able to identify and understand the terms used in this particular topic. Hence, the students' knowledge will be tremendously improved.

4. Theory

This Scholarship of Teaching and Learning (SoTL) project is grounded by Kolb's experiential learning theory that allows students to involve themselves in learning from experience by playing the SAD game. The learning process cycle is categorised into four components namely, (1) concrete experience, (2) reflective observation, (3) abstract

conceptualisation, and (4) active experimentation. In this context, the students were expected to gain informative experiences (as a basis for reflection) through playing game.

The reflection helps the students to assimilate the information into the form of abstract concepts (i.e., make sense of it) and apply it in real-life. Firstly, students learn by playing the game and creating concrete learning experience as they apply the SAD knowledge in completing the game tasks. They also experience it when they discuss actively with team members in searching for the answers. Then, in the reflective observation cycle, they reflect their understanding of what they learnt and observed from the game. In this project, the students conducted their reflections both in pre and post reflections. Next, students developed abstract conceptualisations from their reflections and experiences to provide the overall ideas that help them in understanding the concept of SAD. Finally, the students applied their conceptual ideas and linked what they learnt with the real-life SAD project.

5. Research Method

5.1 Research Design

In this study, the researchers embedded the game mechanics into the context of teaching and learning of system implementation and maintenance subject by setting up rules to the game, providing clues of game questions that the player need to find in order to solve the game, point and scoreboard. Apart from that, game mechanics, such as challenge, collaboration among players, motivation, time pressure and reward were also incorporated to boost students' interest and acquire complete knowledge on the content of conceptual topic. In short, this SoTL project is divided into three phases, as explained below:

Phase 1: Pre-implementation. A pre-implementation quiz and questionnaire survey were conducted prior to the experimental treatment. The scores of the quiz were assessed by the quiz schema/ rubric. Both the quiz and survey were to explore the students' current understanding of the selected course subject and their perceptions of the method in learning the subject before playing the game.

Phase 2: Intervention/implementation. In this phase, the teachers (researchers) conducted the experiment in the classrooms by using the board game. The experimental setups were as follows:

(a) At the beginning of the class, the teachers notified the students about the game-based learning approach that will be used in the subject. Students were assigned into groups and briefed on their tasks and the game rules. The following are the game mechanics (rules and procedures that guide the students (players)):

1. The game can be played by more than one group of players (4 to 5 players in a group) at the same time;
2. Each group receive one set of crossword puzzle that contains a crossword puzzle game board, a set of questions (20 QR codes) and a set of letters;
3. The students are allowed to refer to teaching and learning materials during the game;
4. The students must plan and strategize the best way to scan the questions, find the answers, and place the letters on the board;
5. The time allotted for this game is 30 minutes with an additional 15 minutes after the allotted time expires. The winner is selected based on finishing time and all of the sentences are correct.

(b) Before the experiment starts, sets of crossword puzzles were distributed and all of the students were given introduction on how the game could be played. This step was important especially to make sure that the students had appropriate QR code scanner installed in their phone and know how to use it.

During the implementation, the researchers observed and prepared notes related to the game play to ensure the game mechanics are clear and support the learning outcome. From the observation, the students did not like the mechanic related to time frame for playing the game, as they said they needed extra time to scan the QR code for obtaining the questions. For them, 30 minutes with an additional 15 minutes after the allotted time expires were not sufficient. Hence, the researchers allocated more time to play the crossword puzzle up to an hour. The decision had improved the learning experience and the students were happy with the new adjustment.

Phase 3: Post-implementation. Consequently, at the end of the experimental treatment, a post-implementation quiz and survey were administered. In addition, interviews and on-action reflections regarding the game experimentation were carried out for both the students and teachers.

5.2 Instructional Design

This game-based learning approach is designed following ADDIE (Analysis, Design, Development, Implementation,

and Evaluation) instructional design mode (see Table 2).

Table 2. The course outcome achievement analysis

ADDIE	Activity	Description
Analysis	Identify the problem and learning outcome	<ul style="list-style-type: none"> The problem is identified based on teacher experience Identify the targeted learning outcome to be improved
	Conduct needs analysis	<ul style="list-style-type: none"> The aim is to understand the students' preferences and acquire their opinions on the existing lecture-based approach
Design	Prepare the storyboard of the game-based learning approach	<ul style="list-style-type: none"> This is important to determine the type of game-based learning approach to be used in the transformative teaching and learning. Based on its benefit in promoting mind exercise for intellectual development, the crossword puzzle game board is selected. The game board is designed to allow the students to actively participate, collaborate, and engage with the learning process
	Prepare game board, teaching tools, and materials	<ul style="list-style-type: none"> The questions for the crossword puzzle are developed QR code for the questions are created and printed The crossword puzzle board and its letters are developed and printed
Implementation	Pre-implementation	<ul style="list-style-type: none"> Conduct a pre-test quiz
	Conduct game	<ul style="list-style-type: none"> Conduct games in the classrooms Observe students' knowledge during game sessions
Evaluation	Post-implementation	<ul style="list-style-type: none"> Conduct a post-test quiz
	Reflection	<ul style="list-style-type: none"> Reflection of the whole class Individual reflection on the learning process

5.3 Data Collection

The participants in this research were students from the SAD course who enrolled in Semester A191. The primary data for this study were collected through quiz scores, questionnaire survey outcomes, and interviews on students' feedback, as well as their reflections, before and after the game-based learning experimentation. The objective of the experimentation is to adopt a gaming approach, and the manner in which they can apply the lessons in the SAD through the board game used in the experiment. The experiment was used to uncover new methods to create meaningful learning and enhance students' understanding in learning the SAD course using a game-based learning approach.

6. Findings

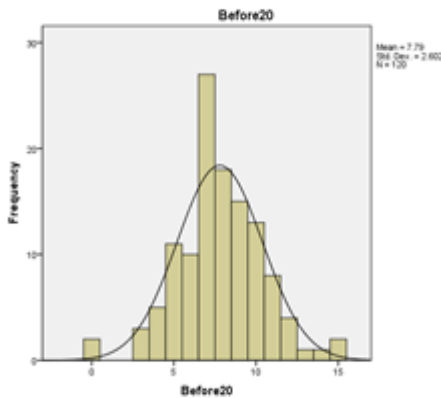
6.1 Pre and Post Implementation Quiz

A formative assessment in the form of quizzes was conducted to assess students' understanding of the topic, before and after the game activity. The quiz comprised of objective questions that carries a total of 20 marks. Table 3 shows the mean score of the quiz marks before the game played is 7.79 (sd=2.60), and the maximum score is 15 out of the total score of 20 marks; whereas the mean score after the game played is higher, which is 13.93 (sd=3.61) with the maximum score obtained is 20 marks. It depicts that the students' quiz scores increased after the students play the game.

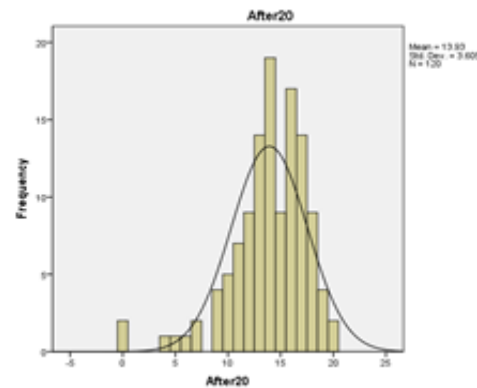
Table 3. Mean score before and after playing game

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Before	7.79	120	2.602	.238
	After	13.93	120	3.605	.329
		Group	Before	After	
N	Valid		120	120	120
Mean				7.79	13.93
Std. Deviation				2.602	3.605
Skewness				.000	-1.301
Std. Error of Skewness				.221	.221
Kurtosis				.938	2.859
Std. Error of Kurtosis				.438	.438
Maximum				15	20

Figure 3(a) below represents the frequency of the quiz marks before the game. Meanwhile, Figure 3(b) shows the frequency of the quiz marks after the game. It shows that students achieved higher marks after the game intervention.



(a) Frequency of quiz marks before the game



(b) Frequency of quiz marks after the game

A paired t-test was also conducted as shown in Table 4, to compare the means of the two scores, whether there is a significant difference between the before and after game scores. Based on the results, it is found that the mean score difference between before and after playing the game is statistically significant ($p < 0.05$). This result suggests that transformative teaching using game-based learning can assist students in understanding the topic better.

Table 4. Paired Samples T-Test

		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	After - Before	6.133	4.207	.384	5.373	6.894	15.971	119	0.000

6.2 Students' reflection on meaningful learning experience

A game-based learning approach carries a concept of learning through play, where it makes the learning session more engaging and fun. Student #1 shared her learning experience after playing the crossword puzzle as,

“Yes, I think I understand the topic better because it is more interesting and, a more fun way of learning. So, it is an easier way for me to memorise and understand this topic better” [Student #1]

Students #2 and #3 explained that they had fun learning while playing,

“Today’s class game is very fun. After playing the game, I understand more about the topic”. [Student #2]

“This approach is interactive, and students really love it. Students enjoyed playing the game, and at that same time, they learned something. They gained new knowledge about this topic. This approach makes us communicate well

between group members and we also need to plan strategies to finish the game quickly”. [Student #3]

The game-based learning approach became a meaningful learning experience for Student #4, as he enjoyed the game and was willing to study on his own,

“I actually really like this type of learning, and of course when I enjoy learning, it enhances my knowledge and understanding of this topic because I am no longer feel like I am forced to learn something but now I actually willingly want to study by myself”. [Student #4]

Game-based learning also offers the students a meaningful learning experience whereby they obtain it through playing rather than memorising the definition of the concept,

“We can learn the keywords for the questions answered. We understand better by looking at the keywords. We don't have to memorise it word by word. But we can use the keywords and draw a small map for those keywords” [Student #5].

6.3 Students' reflection on improving knowledge

Game-based learning can help the students to understand the lessons better than regular classes that use the teaching-centred approach. For example, the students #6 and #7 described that,

“Yes, I'm able to understand the topic very clearly because the game helps me to remember, understand, and create alternative strategies to solve the riddle in the topic” [Student #6]

“Yes, 100% agree. It (the game) definitely enhances our knowledge as we know that we only need to understand certain keywords and remember what it is about. Similarly, the game provides specific keywords in the question to help us understand. In the long run, we will probably remember the fun but challenging games we have played compared to what we read or listen in regular lectures” [Student #7]

According to the students, the game has helped them to understand the topic better and in turn, improve their knowledge related to the topic. Student #8 explained that,

“After playing the game, I understand this topic better since all group members discussed it together. This game also helps me remember the questions and answer them better than just reading about the topic”. [Student #8]

In the view of students #9 and #10,

“Yes, I'm able to understand the topic very clearly because the game helped me to remember, understand, and create alternative strategies to solve the riddle in the topic” [Student #9]

“My knowledge of this topic became even better as all the team members discussed the answer again after the game ended. Each member tries to understand the answer obtained by finding the definition of the answer and explaining it to each other” [Student #10].

7. Discussion

The objectives of the SoTL project are to create meaningful learning experiences and improve students' knowledge by using a game-based learning approach. Firstly, the findings of this study support the notion that game-based learning can help create meaningful learning experiences as highlighted by Kostianen et al. (2018). Kostianen et al. (2018) stated that meaningful learning experience refers to learning processes and activities that students perceive as special meanings to them, where they personally valued. In this context, the students are free to explore and use various strategies to play the game that lead to the creation of meaningful learning from their direct playing experience. Based on the reflections, it can be concluded that when the students play and have fun, they become active in the teaching and learning session and easily collaborate with the team members. It leads to the students' satisfaction and enjoyment, which is part of the positive and meaningful learning experience. As a result, the students had fun and also improved their knowledge.

Secondly, the study's aim at improving students' knowledge by using the game-based learning approach has been found to be significant. The results showed a significant difference between before and after game scores using the formative assessment. In this context, this study provides evidence to support that students' knowledge improved as a result of the game-based learning approach. The reflections provided by the students supported the findings that their knowledge increased with the game-based learning approach.

8. Conclusion

In conclusion, this study has achieved in answering its research questions that were depicted in a twofold objective, which are to investigate the use of a game-based learning approach in creating meaningful learning experience and

its impacts on students' knowledge. The significant different results of both pre and post-test analyses of this study supported by the feedback from students' reflections have suggested favourable impacts of the game-based learning approach in students' teaching and learning experience. It is recommended that the game-based learning approach to be implemented as a stimulating approach in the teaching and learning process, especially for subjects that are conceptual and theoretical in nature. Game-based learning can be used to engage the students in the learning process so as to create meaningful learning experiences for them. Meaningful learning experiences assist students in understanding the lessons better and more significant knowledge retention. Future research may be carried out to investigate the factors that contribute to the success of both game-based learning and gamification approach, and more advanced statistical analyses may be conducted to validate the relationship.

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