Experiential Learning for improving student engagement in a project management course

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ABSTRACT

Motivating students to learn Project Management in a classroom environment can be a a challenge for educators. Learning using games or scenarios has been widely used to deliver project management concepts, to overcome student motivational issues within a class setting and to enhance student engagement in the learning process. This study investigates the pedagogical effectiveness of games and scenarios. It discusses student and lecturer perceptions of learning while using games and scenarios to deliver task management concepts. This study compares the level of student engagement and evaluates the student academic performance with the pedagogical approaches of games compared to scenarios are used. It further discusses the time spent by lecturers to prepare for and deliver task management concepts.

Keywords: game-based learning, scenarios, experiential learning, student engagement, ITPM

1. INTRODUCTION

There is a positive correlation between the outcome of student learning and student engagement in a learning activity, as shown in several studies, including that by Carini, Kuh & Klein (2006), who showed that students actively engaged in their learning task are more likely to achieve better academic results. Schuetz (2008: 312) defined engagement as "a state of interest, mindfulness, cognitive effort, and deep processing of new information that partially mediates the gap between what learners can do and what they actually do". Students' engagement in a task can be assessed in different ways, such as observations, student surveys, and interviews and with experience sampling (Stroud & ストラウド, 2015).

Engagement could be affected by many factors, and together these factors could improve engagement or prompt disengagement. Factors include other students, the teacher and pedagogical approaches, as well as "locations, structures, cultures, technologies, buildings and equipment" (Zepke & Leach, 2010: 174).

Pedagogical approaches such as project-based learning (PBL), games and scenarios have been widely used to engage students in their learning. It was found that PBL is an effective approach to motivate students in their study, especially if the project is designed to embrace teacher engagement and motivation as their students will ultimately try to achieve teacher expectations (De Graaff, Kolmos, & Vinther 2001). While PBL fosters different positive aspects such as engagement in the learning process, there are some problems associated with PBL. In particular, the assessment model and workload could negatively impact students' and teachers' motivation and engagement toward the project as an approach to improve teaching and learning (Fernandes, Mesquita, Flores, & Lima, 2014)

On the other hand, game development requires a development team that have a wide range of skills in addition to knowledge of contents and teaching expertise. The financial outlay for this method of delivery is another barrier that could be prohibitive to develop fully game-based courses (Epper, Derryberry & Jackson, 2012).

Several studies have compared the effectiveness of games as a pedagogical approach with other instructional methods. It was reported that instructional methods such as reading and projects had a positive impact on student achievement, whereas students reported higher subjective satisfaction with games (Von Wangenheim & Shull, 2009, Arnab, Berta, Earp, de Freitas, Popescu, Romero, Stanescu & Usart, 2012, and El Mawas 2014).

In this study, several tools are used to assess student engagement while they learn task management concepts in project management. The level of student engagement is measured by using questionnaire survey tools, observation and evaluating student performance as they progress with learning the given concepts. Survey, observation and evaluation together provide a broad range of data to evaluate the game and scenarios as learning approaches used in the class.

2. BACKGROUND

2.1 The traditional and experiential approach to learning project management

Project Management (PM) is the application of knowledge, skills, tools and techniques to project activities in order to meet project requirements. This is accomplished through the appropriate application and integration of PM processes and knowledge , such as the Project Management Body of Knowledge (PMBOK) (Guide, A, 2013), involving such aspects as initiating, planning, executing, monitoring, controlling and closing (Rose, 2013). A project is a temporary endeavour undertaken to create a unique product, service or result, under the constraints of time, resources and costs (Guide, A, 2013).

Traditional lecture-based courses are commonly structured with the assumption that knowledge resides in the teacher and textbook, that knowledge is static and that teaching is the process of transferring that knowledge from the source (the teacher) to the students. This is sometimes called the knowledge reproduction model and is based on the objectivist paradigm of education (Lightfoot, 2005).

Experiential learning, on the other hand, applies an active approach to learning which is based on the constructivist

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educational paradigm and uses the knowledge-building approach (Jonassen, Davidson, Collins, Campbell & Haag, 1995). In the knowledge-building approach, knowledge is not viewed as being static and does not reside solely in the mind of the teacher. Thus, when one speaks of promoting "active learning", the intent is to structure the class so that students are allowed to actively discover the knowledge and be direct participants in the learning process (Bailey & Collar, 1994). This participation should be geared towards building dynamic knowledge rather than memorising a body of static knowledge (Scardamalia & Bereiter, 1993).

It is often the case that a traditional learning environment lacks the ability to engage students, and consequently students have difficulty in retaining knowledge while learning new concepts. In contrast it was found that using active learning approaches significantly improved both student achievement and subjective satisfaction (David & Watson, 2008).

2.2 Simulation games and scenarios

Educational computer simulation games have received a lot of attention in recent years as an approach that provides engaging and effective learning experiences for students (Management Association, 2010). This has increased the interest in both the potential of computer games as learning and teaching approaches, and in research into their use (Whitton, 2007, Arnab, Berta, Earp, de Freitas, Popescu, Romero, Stanescu & Usart, 2012). Many researchers have argued that games are a fundamental part of the evolving human experience and the way in which we learn, providing the opportunity to practice and explore in a safe environment, learning skills such as aiming, timing, hunting, strategy and manipulation of power (Koster, 2013; Whitton, 2007).

The inception of educational gaming dates back to the 1950s with the integration of war gaming, computer science and operations research, coupled with the emergence of constructivist educational theories that emphasised active experiential learning and reflection. The first computer games were developed in the late 1960s and it was not long before computer games were also being used and developed for educational purposes (Management Association, 2010). Educational game developers seek to teach simple skills such as using a hands-on approach, on the premise that games are best used to motivate student interest in subject domains that students find tedious to learn.

Various experiential approaches have focused on the simulation of real-world business practices in the classroom. Issues covered include communication and information management and PM (Cano, Rebollar & Sáenz, 2000; Zgodavova, Kosc & Kekäle, 2001). These experiential approaches intend to achieve a range of objectives using simulation game exercises:

1. Student-centred learning, seeking to provide learning through experience, engaging students far better than traditional lectures (Karns, 2006)

2. Connecting theoretical knowledge to application better than traditional approaches (Hayes & Reynolds, 2005; Pfahl, Laitenberger, Ruhe, Dorsch & Krivobokova, 2004)

3. Promoting skills including teamwork, interaction, communication, information gathering, conflict resolution, presentation and decision making, gained in the interpersonal exchanges seen in group study (Hayes & Reynolds, 2005; O'Malley & Ryan, 2006; Woolcock, 2007) and consideration of intergroup and interpersonal issues (Piercy & Caldwell, 2011)

In various studies, experiential approaches were identified and suggested to be useful tools in supporting the integration of diverse student groups (for example, Bradfield, Cairns & Wright, 2015). Extending group-based work into more experiential techniques, such as simulations, has received relatively limited investigation with regard to diverse student populations. The use of simulation games and exercises has been suggested as useful for encouraging students' participation, teamwork and learning (Piercy & Caldwell, 2011). Scenario-based simulation has been identified as a powerful approach to enhance student learning, because it promotes cognitive skills such as critical thinking and analysis, as well as improving the course success (Siddiqui, Khan, & Akhtar, 2008).

Albakry & Hossain (2014) noted that international students reported high subjective satisfaction with experiential learning approaches such as games and scenarios, and recognised these approaches as motivating, dynamic, satisfying, exciting and attractive. They also reported that this subjective satisfaction toward the learning experience improves students' engagement which consequently improves knowledge retention over time.

2.3 Game-based learning in project management

Educational games are generally designed to deliver a specific concept, whereas most PM games allow the user to play the role of a project manager and make decisions, and then monitor how these decisions affect the outcome of the project (Von Wangenheim & Shull, 2009). While a wide range of games are available to teach PM concepts, people who play PM games would like to learn how to react more effectively in certain circumstances and to know what the effects of their reactions will be (Sáenz, Cano & Román, 2004).

Some of these aspects can be analysed in an environment in which the researcher can get consistent, concrete and quick feedback, where most of the constraints that have an influence in the environment can be controlled. Different groups of participants can interact in the same scenarios and simulation game with the same constraints in which similar responses can be obtained after a certain round of a task (Cano & Sáenz, 2003).

This study explores the main characteristics and utilisation of the online PM simulation game, The Project Management Game (n.d.), which provides a methodology for knowledge acquisition and behaviour capture in the internet environment, as well as showing the application of simulation games in this field featuring cost, time and resource schedule management.

2.4 Scenario-based learning in project management

Using a scenario to teach PM concepts is one of the most popular learning approaches in a PM class, as it requires students to have sound knowledge, understanding and ability to critique information. Scenarios are applied by the project managers to create a plan containing the project's tasks, resources, risks and constraints. Applying scenario-based learning could help learners to respond appropriately in real PM situations.

Scenario-based learning is helpful to engage learners in interactive situations, either as reflective observers or active participants (Norton, Taylor, Stewart, Blackburn, Jinks, Razdar, Holmes & Marastoni, 2012). In PM, learners are expected to participate actively with the scenarios, and are required to make decisions which could open up or close down different alternatives in the scenarios. Using case discussion, students can learn about their leadership, problem-solving style

and their approach to dealing with novel ideas while reflecting on what goes on during the discussion (Argyris, 1980).

3. PROCEDURE AND DATA COLLECTION

A study was conducted to investigate students' acceptance of the proposed approaches and to measure engagement in the learning process, as well as to evaluate the challenges and strengths of each approach. All students who enrolled in an Information Technology Project Management course were invited to participate in this study, a total of 27 participants, all of whom were international students. Indian students made up the largest group of 13 students, with the remainder being distributed among Chinese and Pacific Islanders; 17 participants were Graduate Diploma students and 10 were Bachelor's degree students.

Initially the lecturer introduced the topic to the students, and then the students were invited to apply the knowledge gained by using two different approaches, for which students were divided into two groups.

- Group one (G1) used the Project Manager Game. There were 14 participants. The game is designed to give feedback to players after the completion of each round. The game alerts the player once during each round for notification, and the player has the choice to stop the game and read the notification, and then modify resource allocation accordingly to improve the project outcome. In addition, a player can change staff assignments at any time until the project is complete or the game is over. While most of the alerts are designed to help players improve the project outcome, there are several alerts that could badly affect the project outcome if player decided to respond to the alert.

- Group two (G2) used scenarios. There were 13 participants. To maintain consistency between the two groups, scenarios were kept at the same style and level of complexity as the PM Game. The lecturer provided brief feedback to each participant individually after each scenario completion, and the participants then could modify their answer according to the feedback.

Both groups were given clear instructions as to what they needed to do to complete the task. G1 was instructed to carry out the following steps**:**

1 Every participant should use the PM Game website to play two rounds of the game.
2 All G1 members should then get together to share knowledge and identify strategies to complete the remaining rounds of the game successfully.
3 Every participant should use the PM Game website again to play three more rounds of the game.

Students were instructed to save screenshots as required for each game round. The time needed to complete the whole task was recorded, and students' performance was evaluated.

Similar instructions were given to G2. However, they used scenarios instead of the game website. Every participant was given five scenarios in total. G2 was instructed to carry out the following steps**:**

1. Every participant should complete two scenarios.
2. All G2 members should then get together to share knowledge and identify strategies to complete the remaining tasks successfully.
3. Every participant should work individually to solve the requirements of the remaining scenarios.

The time needed to complete the task was recorded and students' performance was evaluated.

Learning approaches were evaluated based on the outcome of each group in terms of individual members' performance and efficiency. In addition, a questionnaire was distributed to investigate students' confidence and subjective satisfaction toward each approach.

Each group discussed within their group the benefits of the approach used for learning, and then held a whole-class debate as to the benefits of each approach. The lecturer's comments on the manageability of the approaches in the class environment were also reported.

4. RESULTS AND DISCUSSION

4.1 Performance and efficiency

Performance was measured by the percentage of students who were able to achieve the correct answer in each round, the correct answer reflecting that the knowledge has been well grasped by the students and they are able to apply the knowledge using a specific approach.

Table 1 shows the participants' results for each round differentiated according to whether they used games or scenarios in their learning approach. A tick indicates that the participant was able to complete the task using available resources within time and budget constraints. The clock icon signifies that the participant did not manage to complete the project within the time limit. A dollar sign shows that the participant did not manage to complete the project within the budget limit. A skull and crossbones indicates that these participants were not able to manage human resources appropriately, they overloaded one staff member and under-utilised others. This led the project to fail as a result of staff burnout. The correctness figure indicates the percentage of participants who were able to complete the task using available resources within time and budget. Since there were 13 participants in the scenario group, we do not have results under the Scenario columns for participant 14.

The performance results are summarised in Figure 1. Since we did not distribute students between the two groups based on their academic level, we judged the results by the participants' progress over the rounds. Figure 1 shows that participants who played games initially started with a very low performance, but progressed rapidly in the second round. The results of the first round could be improved by allowing students to have one round as a trial before starting the experiment. It was observed that playing five rounds was not enough for some students to master the task management concepts through learning by doing or learning by failure.

Table 1: Participants' results, using game and scenario tools

Round	1		2		3		4		5	
Participant	**Game**	**Scenario**	**Game**	**Scenario**	**Game**	**Scenario**	**Game**	**Scenario**	**Game**	**Scenario**
1	☠🕒	✓	✓	✓	🕒	$	✓	✓	✓	✓
2	☠🕒	✓	$ 🕒	✓	✓	☠	✓	✓	✓	✓
3	$ 🕒	✓	✓	✓	✓	✓	🕒	✓	✓	✓
4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5	$	✓	✓	🕒	$	☠🕒	🕒	✓	$	$
6	🕒	🕒	✓	☠🕒	✓	$🕒	✓	✓	✓	✓
7	✓	✓	✓	✓	$	$	✓	✓	🕒	✓
8	🕒	✓	✓	✓	✓	✓	✓	🕒	✓	✓
9	🕒	✓	$	✓	☠🕒	✓	✓	✓	✓	✓
10	☠🕒	🕒	☠🕒	✓	✓	✓	✓	$	$	✓
11	✓	🕒	✓	✓	✓	✓	✓	✓	✓	$
12	$🕒	☠	✓	✓	✓	✓	✓	✓	🕒	✓
13	✓	✓	✓	☠	✓	$🕒	✓	🕒	✓	$
14	$🕒	---	✓	---	✓	---	✓	---	✓	---
Correctness	28.6%	69%	78.6%	77%	71.4%	54%	85.7%	77%	71.4%	77%

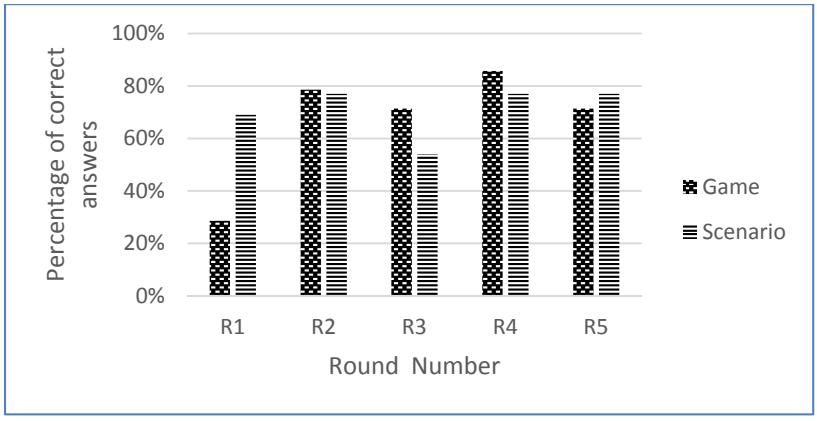

Figure 1: Participants' results, using game and scenario approaches

As is clear from Figure 1, the scenario group's performance started high, and slightly improved in the second round. For both approaches, the group discussion did not seem to have an effect on the outcome in the following rounds.

Overall the average difference in the correctness of each group was fairly similar; the average correctness of the last four rounds for the game group was 76.8% and for scenario group was 71.3%.

The results presented in Table 1 were collected over two semesters. Each semester this course was run, the lecturers were heavily involved with the scenario group. Over the 90 minutes taken to complete the task, the lecturer was involved with each participant individually, provided brief feedback on suggested solutions and invited participants to address issues in the following round. In contrast, only 30 minutes was taken by the game group, during which game team participants were learning by feedback provided by the game on the completion of each round. In addition, the game provided only one

opportunity for participants to readjust their resources while the project was in progress.

The game restricted completion time to a couple of minutes for each round; in contrast, the scenario participants were able to readjust their solutions as many times as they desired, with no time limitation.

4.2 Group debates and outcomes

After the completion of five rounds of scenarios and games by teams G1 & G2, students were requested to discuss their experience within their group and then debate as a whole class. The discussion mainly centred on time: the game team finished one hour earlier than the scenario team. The scenario team reported that the task took longer while using assumptions, whereas the game team was able to see the real-time performance of the project by making changes or redistributing tasks. After round 2, the game team took five minutes to discuss with their game team members, whereas the scenario team took ten minutes. The game group participants argued that the game approach helped them to practise the acquired knowledge faster.

At the end of the whole-class discussion, both teams concluded that scenarios should be used to nurture their knowledge, and games to apply that knowledge practically.

4.3 Lecturer opinion

Lecturer experience is discussed in term of engagement and time required to prepare, manage and organise materials needed for each approach.

For scenario-based learning, the lecturer spent two hours to prepare five scenarios to be used for five rounds. During each session, the lecturer was fully involved for a total of 60-90 minutes discussion, providing feedback with each student individually. After the session, the lecturer spent one hour marking the submissions from five rounds for 13 students. The time required for managing the session and marking the scenarios grew with the number of students in the class, which made it unrealistic to provide individual feedback for the full class of 20 students, within the class time frame.

On the other hand, the simulation game provided answers to the task, and thus the lecturer was required to monitor students' progress only, rather than time or effort.

We have used the online-based Project Management Game to let students practise their knowledge and it was found that using the game helped the lecturer to manage class time, compared to scenarios. However, the effort involved in developing such games of our own is not yet justified and we would like to investigate this factor further in the future.

4.4 Survey results

There were 27 participants in the survey. Fourteen used the game as a learning approach and 13 used scenarios. We compared these two groups' perceptions of using the learning approaches and the effectiveness of group discussion. Participants were given the following statements (Albakry & Tanveer, 2014):

Q1. The approach used to teach the topics raised my interest in learning.
Q2. The approach used to teach the topics captured my attention and kept me focused.
Q3. The approach used to teach this topic encouraged me to try different ways of learning and thinking.
Q4. My level of confidence in solving similar problems increased as I progressed.
Q5. Using the approach raised my confidence to contribute to the group discussion.
Q6. The approach enhanced my in-depth learning of time, resource and budget planning topics.
Q7. The approach provided me with the opportunity to play the role of project manager.
Q8. The initial round of using the approach encouraged me to interact in the group discussion.

Figure 2 shows a comparison of participants' opinion towards using games and scenarios over the Likert-scale of 1-5, the percentages of participants who agreed or strongly agreed to survey questions (Q1-Q8). Games participants show higher percentage of satisfaction that the approach raised interest in learning, captured their attention and kept them focused, encouraged different ways of thinking, raised their confidence to contribute to the group discussion and enhanced their in-depth learning, provided them with the opportunity to play the role of project manager and encouraged them to interact in the group discussion. Both groups equally agreed that the approach used improved their confidence in solving similar problems. The overall level of satisfaction rate with the learning experience of participants using games was 89%, in contrast scenario participants indicated a lower learning experience overall satisfaction of 73%.

In regard to participants' opinions towards group discussion after round 2, the following survey questions were distributed.

Q1. My level of confidence in solving similar problems increased after the group discussion.
Q2. The group discussion provided me with a more effective way to communicate in relation to the topic.
Q3. I found the group discussion an effective way to share knowledge.

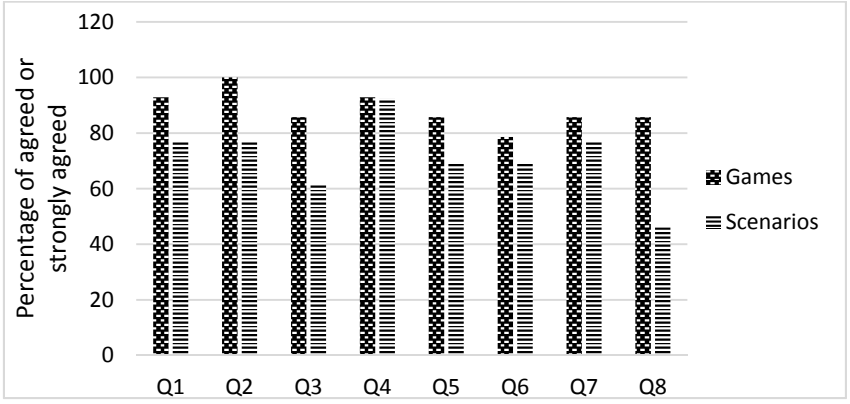

Figure 2: Participants' opinions, using game and scenario approaches

Figure 3 shows a comparison of game and scenario participants' opinion towards group discussion effectiveness to improve their performance in the following rounds. Figure 3 outlines that both scenarios and games participants agreed that the group discussion raised their confidence level to solve similar problems, and it is an effective way to communicate and transfer concept understanding. Games teams indicate 81% satisfaction rate compared to 87% of scenarios teams satisfaction.

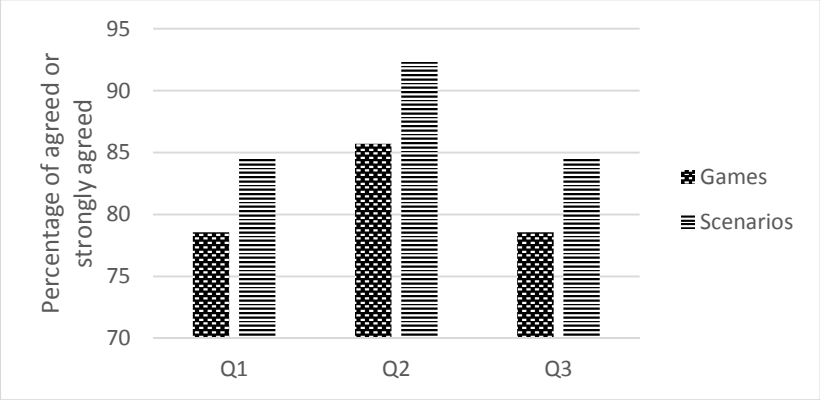

Figure 3: Participants' opinions, group discussion effectiveness

Finally, we investigated participants' subjective satisfaction regarding the learning approaches used in this study. Figure 4 shows the satisfaction factors along with the percentage of participants who agreed with the factor from each group. The figure reflects that more than 80% of participants found the approaches used student-based learning. Both approaches were highlighted as motivating, dynamic, enjoyable, satisfying, exciting and attractive. A higher percentage of participants believed that games are dynamic, satisfying and attractive, while in contrast a higher percentage of participants believed that scenarios are motivating, enjoyable and exciting. In addition 14% of game participants found it unrealistic; this could be due to variation in students' personalities, motivation and interest to play games.

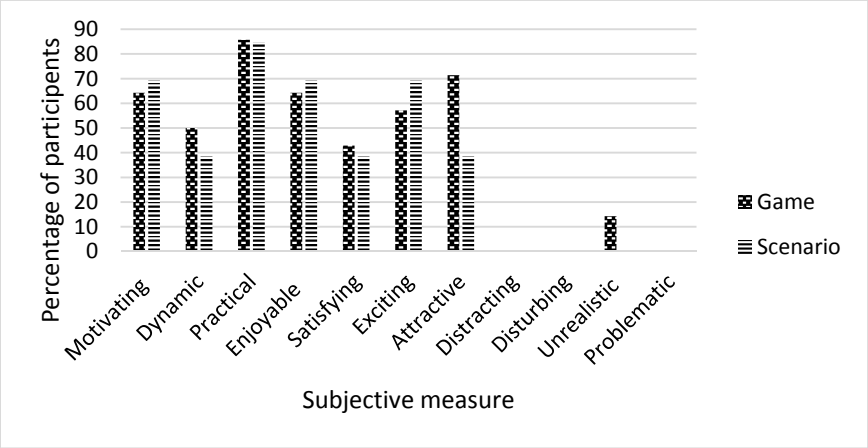

Figure 4: Game and scenarios participants' subjective satisfaction comparison

5. CONCLUSION AND FUTURE WORK

This paper identifys an engaging learning approach to deliver Project Management to keep students motivated and participating in the learning process, by utilizing games and scenarios. From the data collected and systematic observation of the students' interaction with the two different approaches, it was found that both approaches encourage students' engagement in the learning process. There was little difference in students' achievement while using each approach, although the correctness average of students who used games to determine knowledge was slightly higher than the scenarios group. Therefore, we believe that both approaches allow students to actively discover knowledge; both approaches promote in-depth and dynamic learning. However, game-based learning needs less lecturer time to manage the class; in contrast, scenarios are easier to develop than games.

In addition, students were highly motivated by the experience, and students reported high subjective satisfaction with both approaches, describing aspects of the learning experiences as motivating, practical, enjoyable and exciting.

For future work, we plan to investigate further the effect of these two approaches within a larger group of participants. We will evaluate students' exam results to measure the effectiveness of each teaching approach in stimulating in-depth learning and student's retention over time, and will try to design and implement an education game for teaching Information Technology topics whenever appropriate.

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