

12-2015

# Learn to play, play to learn: Designing a digital board game for a law of torts class

Gary Kok Yew CHAN

Singapore Management University, garychan@smu.edu.sg

Swee Liang TAN

Singapore Management University, sltan@smu.edu.sg


Khe Foon Timothy HEW

Teck Chye Bernie Grayson KOH

Singapore Management University, berniekoh@smu.edu.sg

Bernie Grayson KOH

Follow this and additional works at: [https://ink.library.smu.edu.sg/sol\\_research](https://ink.library.smu.edu.sg/sol_research)

 Part of the [Asian Studies Commons](#), [Higher Education Commons](#), [Instructional Media Design Commons](#), and the [Legal Education Commons](#)

---

## Citation

CHAN, Gary Kok Yew; TAN, Swee Liang; HEW, Khe Foon Timothy; KOH, Teck Chye Bernie Grayson; and KOH, Bernie Grayson. Learn to play, play to learn: Designing a digital board game for a law of torts class. (2015). *Proceedings of the International Conference on Computers in Education 2015, Nov 30-Dec 4, Hangzhou, China*. Research Collection School Of Law.

**Available at:** [https://ink.library.smu.edu.sg/sol\\_research/1806](https://ink.library.smu.edu.sg/sol_research/1806)

This Conference Proceeding Article is brought to you for free and open access by the School of Law at Institutional Knowledge at Singapore Management University. It has been accepted for inclusion in Research Collection School Of Law by an authorized administrator of Institutional Knowledge at Singapore Management University. For more information, please email [libIR@smu.edu.sg](mailto:libIR@smu.edu.sg).

# Learn to Play, Play to Learn: Designing a Digital Board Game for a Law of Torts Class

Kok Yew Gary CHAN<sup>a\*</sup>, Swee Liang TAN<sup>b</sup>, Khe Foon Timothy HEW<sup>c</sup>, Li Siong LIM<sup>d</sup> & Bernie Grayson KOH<sup>e</sup>

<sup>a</sup>*School of Law, Singapore Management University, Singapore*

<sup>b</sup>*Centre for Teaching Excellence, Singapore Management University, Singapore*

<sup>c</sup>*Faculty of Education, The University of Hong Kong, Hong Kong*

<sup>d</sup>*Centre for Teaching Excellence, Singapore Management University, Singapore*

<sup>e</sup>*Centre for Teaching Excellence, Singapore Management University, Singapore*

\* garychan@smu.edu.sg

**Abstract:** This paper documents the learning journey and outcomes of designing an electronic roll-and-move board game, The Grade Inflation Game (GIGAME). It was developed by the Centre for Teaching Excellence (CTE) for classes conducted in the School of Law at the Singapore Management University (SMU). It investigates the effectiveness of using an electronic board game in teaching and learning. Based on the survey on 64 student-players of the game, the study revealed that the game enabled students to consolidate objective skills and knowledge while having 'serious' fun.

**Keywords:** Game-based learning, GBL, learning effectiveness, fun, RETAIN model

## 1. Introduction

Game-based learning (GBL) broadly refers to the use of games as a teaching/learning tool in the classroom or in any other learning environment. GBL are activities that have a game at their core and learning as a desired outcome (Kirkland, Ulicsak, & Harlington, 2010). GBL is also defined as “a form of experiential engagement in which people learn by trial and error, by role-playing and by treating a certain topic not as ‘content’ but as a set of rules, or a system of choices and consequences” (Perrotta, Featherstone, Aston, & Houghton, 2013). Sanford and Williamson (2005) lists the following key characteristics of game based learning: (a) it supports learning by presenting particular challenges to participants; (b) it has rules governing individual interactions; and (c) it provides participants the experience of exploring different tools with different consequences.

Despite the growing interest in GBL, not much research has been done in this area, particularly in the context of universities in Singapore. This paper documents the design of a board game, GIGAME, and investigates its effectiveness in undergraduate teaching.

In documenting the design of GIGAME for a Law module, namely the Law of Torts, this paper also contributes to the understanding of the use of digital games in university classrooms and is organized as follows: Section 2 provides the background and objectives of the project. Section 3 highlights features of the GIGAME that promote active learning, theories relating to certain of these features and the ideation process. Section 4 summarizes the feedback from students on the use of the game and the challenges faced in designing the game. Section 5 describes the CTE staff evaluation of the design of the game using the Relevance, Embedding, Transfer, Adaptation, Immersion and Naturalisation (RETAIN) Model by Gunter, Kenny, & Vick (2008). Finally, in the last section, we propose some design solutions and possible steps to take this project further.

## 2. BACKGROUND

The first author (i.e., the instructor) had been using a Snakes and Ladders style board game in his course, Legal System, Legal Methods and Analysis in 2011 and 2012. Aptly named the “Snakes and

Lawyers” game, it was played in class by students to revise the relevant concepts. He assigned the students into groups of 4 or 5. He placed the board game on the overhead projector and beamed the multiple choice questions (MCQs) on PowerPoint slides, one at a time. If a particular group answered the question correctly, it had another turn to roll a virtual dice and advance on the Snakes and Lawyers board. The group of students that managed to reach the top of the board was declared the winner.

The activity was generally well-received by the students, but the instructor had some feedback:

1. Students were not able to play the game on their own outside of the classroom.
2. The questions and answers during the gameplay could not be tracked so students and the instructor had no effective way to recall what they had learned.
3. Some students expressed a lack of “game features” to motivate them to play.
4. Each group knew its own position as represented by its piece on the board game but not the state of play amongst the competing groups.

Based on the case study of Snakes and Lawyers Game, the objectives presented to CTE to design a new game for a Law module for the benefit of students consisted of the following:

- Consolidate their objective skills and knowledge while having ‘serious’ fun i.e. playing serious games or games for serious purposes (Abt, 1970);
- Enable them to play on their own or compete with peers, as an in-class or out-of-class activity; and
- Allow them to reflect on their performance through system feedback and competition with peers.

### 3. DESIGN AND FEATURES OF THE GIGAME

The GIGAME was conceptualized in January 2013 and its development was completed in March 2014. As shown in Figure 1, the GIGAME was designed as an electronic roll-and-move style board game.



Figure. 1: Screen capture of GIGAME

Players are given a C+ grade at the start of the game which is equivalent to 6700 points. Each player will roll the dice and move around the board according to the number indicated on the dice. When the players land on a square, they have an allotted time to answer True/False questions that test their basic understanding of legal concepts, or Multiple Choice questions to test their ability to apply concepts to scenarios (see Figure 2). If the players answer the question correctly, they will be awarded points, and their grades improve. If the players answer the question wrongly, points will be deducted and their grades deteriorate.

At the start of the game, the players take on an avatar role with special powers in the form of “power cards” that enable them to have an edge over others in terms of their abilities. Each player has three of each of the following set of cards:

- The Smarty avatar starts with “remove option” cards, which allow the player to have any 2 options in an MCQ question which are not the correct answers removed
- The Sporty avatar starts with “quick dash” cards which allow the player to move 2 extra spaces.
- The Science avatar starts with “time extension” cards which give the player more time to answer the questions.
- The Sneaky avatar starts with “stealth” cards which allow the player to evade the “Professor” character.



Figure 2: True/False, Multiple Choice and Open-ended Questions are used to challenge the players

There are 2 “Professor” characters roaming on the board. If the players land on the same square as the “Professor”, they will be asked more difficult questions with extra points for correct answers. The players have the option of using the power card in their hands. For example, for players who take on the Sneaky avatar role and do not feel confident in their content knowledge, they could opt to use the stealth card if they land on the same square as the Professor.

The game can be played in the single player mode or the classroom setting mode. In the single player mode, the player starts in the inner ring and moves to the outer ring after she/he has accumulated the prerequisite number of points. The player’s score is displayed on a leaderboard where the scores of all individual players are ranked (see Figure 3 below). To be ranked high on the leaderboard, individual players are motivated to collect as many points as possible by answering more questions correctly. Thus, the leaderboard feature is an important design of the game for the single player mode. The game ends when the player succeeds in opening the golden chest with the four golden keys each of which is strategically positioned at each corner of the board. The player collects a golden key after landing on the square and answering the question correctly (See Figure 1). The game is set to end automatically when the player’s score deteriorates to an “F” grade.

However, the player has an option not to land on the square with a key, but he/she could continue the game to answer questions to improve his/her scores. Less bonus points are awarded if the player spends more time to play the game (see Figure 4). This presents players with a choice of either finishing the game quickly and scoring the highest number of bonus points (with less overall points from answering questions from the board) or attempting to answer as many questions from the board as they can (with less bonus points based on time).

The play is slightly different in the classroom mode. In this classroom mode, the player starts in the inner ring but there are no keys to collect and the game ends only when the instructor decides that it is over. In the classroom mode, there is no leaderboard feature. All the questions and responses can be reviewed by the instructor with the entire class.

The instructor selects the questions, the length of time dedicated to the question and the number of points to be awarded or deducted using a web-based content management system. This game can be



customised for any course with content-specific knowledge and skills that may be assessed by a variety of objective questions.



Figure 3: Leaderboard feature

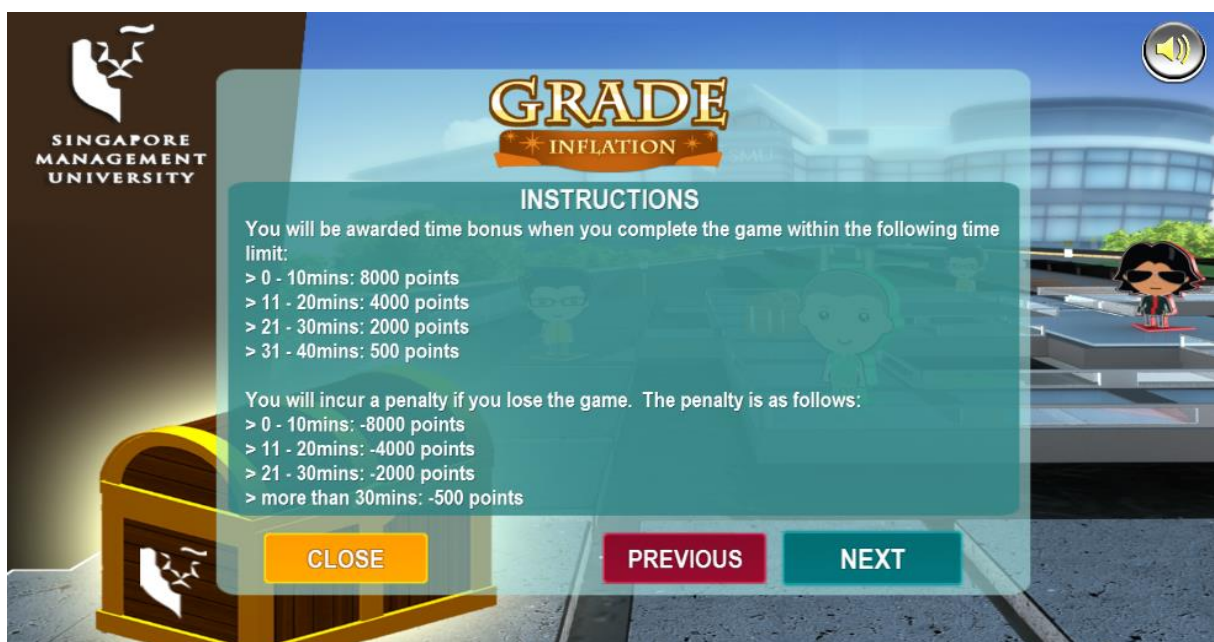


Figure 4: Bonus points based on time

For a hands-on trial, click <http://cte.smu.edu.sg/gigame/>. The game is available and can be played across 3 platforms - Web browser (<http://smu.sg/gigame>), iPad Tablets and Android Tablets. The game was launched on the iOS and Android platforms in August 2014. By December of 2014, it had been downloaded by 189 users worldwide with 35% of them from Singapore. As of 31st March 2015, the number of total downloads stood at 273.

### 3.1 Theories Underpinning GIGAME

GIGAME fulfils the three key characteristics of game-based learning that were previously described. Specifically, it supports learning by presenting particular challenges to participants (i.e., correctly answer questions within the allotted time); it has rules governing individual interactions (e.g., points for

grades, opening the golden chest with the four golden keys); and it provides participants the experience of exploring different tools (e.g., using different power cards which result in different consequences).

In this section, we describe five theories (goal-setting theory, self-efficacy, social comparison, self-determination theory, and Skinner's reinforcement theory) that underpin our use of avatars, points, leader board, and power cards in GIGAME.

A goal is an outcome that an individual aims to achieve. According to goal setting theory, students' motivation and learning can be promoted when the goals are specific and moderately challenging (Locke & Latham, 1990). In GIGAME, all participants are given a C+ grade at the start of the game which is equivalent to 6700 points. Subsequent correct answers to questions would result in a participant gaining more points, which would in turn improve his or her grade. Having points for grades gives participants a goal or target to aim for.

Self-efficacy is one's belief in how well he or she can deal with prospective situations (Bandura, 1982). It can determine the efforts and the persistence that an individual would exert when facing obstacles (Bandura, 1982). According to Richter et al. (2015), personal achievement is the most influential way to foster self-efficacy. In the present GIGAME, the use of points system can stimulate self-efficacy through personal achievement by measuring an individual's progression and providing direct feedback on performance (Gnauk et al., 2012).

According to social comparison theory, human beings evaluate their opinions and abilities by comparing with those of others (Festinger, 1954). Two types of social comparison may be found: upward-identification which refers to individuals comparing themselves with more competent people and believing that they can be as good as those better performers, and downward-identification which means comparing with others who are worse off (Suls et al., 2002). The ranking an individual has achieved in a leaderboard can help drive upward-identification comparison. Upward-identification can positively influence students to be more engaged in learning (Chen & Chen, 2015). Moreover, in a game context, comparisons with other players based on "quantitative measurements" (eg, the points system and the leaderboard in GIGAME) provoke "competition" and such competition can serve as a "challenge to master given tasks" (Richter et al., 2015).

In GIGAME, students were given some choices to make such as whether they should answer the questions quickly and score bonus points, whether to initiate challenge against competitors, or whether to use the power cards. The availability of choices serves to cater to an individual's need for autonomy. According to the Self-Determination Theory of motivation, all humans possess several psychological needs – one of which is the need for autonomy (Deci & Ryan, 2000). Autonomy refers to an individual's need for freedom over one's action. Gamified practices that offer individuals the freedom to choose their preferred activities to complete can address this need. Having a sense of autonomy can increase participants' behavioral and emotional engagement (Skinner et al., 2008).

Finally, behavior can be motivated or forestalled by its resulting consequences (Skinner, 1957). A reinforcer is one of many consequences that strengthen a behavior (Skinner, 1957; Woolfolk, 1998). One of the most frequently used reinforcers is positive reinforcement. Positive reinforcement occurs when a new stimulus is presented as a consequence of a behavior, which consequently strengthens the behavior (Skinner, 1957; Woolfolk, 1998). More specifically, gamified practices that give a reward (e.g., points) for every correct response is one example of continuous reinforcement schedule. We employed continuous reinforcement because we wanted to foster students' interest in using GIGAME since this was the first time the game was introduced to the students. The current GIGAME also deducts points for wrong answers. This provides an immediate feedback to the participants which can help increase a student's self-efficacy. In this way, individuals would know if they need to re-learn the content to better answer the questions.

### 3.2 Ideation Process

The ideation process started with analysing the Snakes and Ladders board game and its attendant shortcomings. Based on this analysis, the CTE team researched on digital gaming and found the *Talisman* (Harris, 1983) an appropriate board game on which to model the new game. There are features - gameplay, avatars, random elements and leader board - in the *Talisman* which the CTE designer identified as relevant to the objectives of their project. The result is GIGAME.

Here is a brief description of how the *Talisman* game is played. It contains three regions: the Outer Region, the Middle Region and the Inner Region. Players start in the Outer Region and try to

progress inward. The Inner Region contains the Crown of Command, the central board position. To reach the Crown of Command, characters must possess a talisman which allows them to enter the Valley of Fire, hence the name of the game. Each player selects a character at the beginning of the game. Each character possesses different and special abilities. One of the main goals of the game is to build up a character (through conquering or destroying monsters) so that it is strong enough to venture inward, and eventually reach the Crown of Command. Similar to the game features in *Talisman*, GIGAME poses questions of varying levels of difficulty and players are required to ‘earn’ sufficient points to enter the outer ring. The game is completed when the player (or team) succeeds in collecting the four keys.

The GIGAME is an educational learning-type game where students answer questions posed from discipline-specific contents, in this case to learn the subject of law. One important ideation in the design of the game is to make learning fun. Features are included in the GIGAME to raise different types of emotions to motivate students to play. For example, the possibility of meeting the roaming Professors or the impossibility of getting the 4 keys can create emotions of excitement and frustration. A multiplayer classroom mode can evoke emotions that come with collaboration or competition within and among members in the team. According to Lazzaro (2009), there are four types of fun - Easy Fun, Hard Fun, Serious Fun and People Fun. These four types of fun generate a wide range of emotions and enhance the game experience. For example, Easy Fun emotions maintain player attention without challenge through novelty and inspiring fantasy. Hard Fun creates challenges with strategies and puzzles. Serious Fun teaches or accomplishes real work. People Fun motivates group interaction, interpersonal relations and creates emotions between players. These emotions have a significant effect on enjoyment, attention, memory, learning, and performance.

#### 4. STUDENTS’ AND FACULTY’S RESPONSE TO THE GAME

In the last week of the semester in March 2014, GIGAME was introduced to 90 students in two classes of Law of Torts. The game was played as a form of revision of materials.

Each class was divided into 8 groups with each group represented by an Avatar. Each group took turns to roll the dice, move their pieces and answer questions. The “Professor’s” questions in this game were given verbally by the instructor. If the GIGAME is played online, the system will generate the Professor’s questions automatically based on the input in the content management system.

At the end of class, an online survey was sent out to all students, and a total of 64 students responded to the survey yielding a participation rate of 71%. The results of the survey are shown below:

Table 1: Summary of survey results

Parts in the survey	Survey results (out of the 64 survey respondents)
1. technical problems which students encountered;	<ul style="list-style-type: none"> <li>43 (67.2%) reported technical problems - mainly due to the text font. Comments given here relate to issues of blocked views, lagging/hanging of game, dizziness etc.</li> </ul>
2. impressions of the learning activity in terms of the instructional design;	<ul style="list-style-type: none"> <li>63 (98.4%) agreed that the design of the game was appealing and highly motivating.</li> </ul>
3. impressions of the effectiveness in helping them to learn;	<ul style="list-style-type: none"> <li>59 (92.2%) rated the game to be effective in helping them to learn.</li> </ul>
4. perceived change in knowledge after the activity; and	<ul style="list-style-type: none"> <li>37 (57.8%) reported a perceived increase in knowledge after the activity.</li> </ul>
5. overall satisfaction of the game.	<ul style="list-style-type: none"> <li>64 (100%) agreed that they were satisfied with the learning activity.</li> </ul>
6. suggested enhancements	<ul style="list-style-type: none"> <li>28 students (43.8%) requested for features that would enable them to review the questions, answers and explanations so that they could learn from their mistakes.</li> <li>7 students (10.9%) commented on certain time-consuming elements of the game (e.g. time lag of dice rolling and movement of the avatars/characters, and the constant popping up of the instruction panel).</li> </ul>

7. other feedback	<ul style="list-style-type: none"> <li>• “Very engaging and appealing, the interface was designed very well. The game helped to further my understanding of the finer points of tort law and was very helpful in clarifying certain misconceptions.”</li> <li>• “I liked the smooth interface of the game. The questions incorporated into the game were also challenging, which made the game useful as a learning tool.”</li> </ul>
-------------------	---

In a similar vein, the instructor commented: “Students could not see the entire Snake and Ladders game unfolding and the state of play amongst the competitors. They could only see their own position on the gameboard. For GIGAME, everyone can view the state of play contemporaneously which enhances the competitive element. Many students found the GIGAME interactive and fun. It also allowed them to assess their own level of knowledge on the law of torts at the end of the course. When I revealed the MCQ answers, there were at least a few eureka moments for certain groups of students...”

The instructor was satisfied with the outcomes of the CTE-designed game. It served his need for a fun interactive activity that promoted knowledge retention and application.

Based on the feedback of the students, the CTE team agreed that project has, in general, met the 3 objectives mentioned in Section 2:

1. Students consolidated their objective skills and knowledge while having ‘serious’ fun. 19 students (29.7%) mentioned that the activity was a fun way to revise.
2. Students played on their own or competed with peers, both as an in-class and out-of-class activity.
3. Students reflected on their own performance through feedback and competition with peers.

It is interesting to note that some students prefer to play the game together as a class, with comments such as “will most probably not play it at our own time” whereas a few stated that the game could be used as an after class activity, as “class time should be used for discussing cases” and “class discussions are more effective”. Hence, it may be of interest for future research to find out how differently students respond to the game as individual players and as team players. In addition, future studies could be conducted on a larger scale to investigate the effectiveness of games as a revision activity, a teaching of new concepts activity or part blended learning where students could learn new concepts outside the classroom.

## 5. ASSESSMENT OF THE GIGAME BY THE CTE STAFF

The survey results and the instructor’s comment showed that GIGAME was able to address the shortcomings of the original Snake and Lawyers Game and provided the fun learning moments in a university classroom.

The positive feedback from both students and instructor affirmed the effectiveness of the use of games in the classroom. The team first discussed as a small group and then as a large group, to do a team-rating of the GIGAME using a framework drawn up by Gunter, Kenny and Vick (2008). This framework, consisting of 6 components, addresses the different elements in learning. The rating scale from Ulicsak and Wright (2010) was used to rate the effectiveness of GIGAME in terms of delivering the objectives. The ratings were adjusted after several rounds of discussion to arrive at a consensus. One important outcome of this exercise is that the team had useful assessment frameworks to guide conversation of team members with diverse expertise. Another important outcome is that the team was able to identify areas for improvement of the game (see Table 1 below).

Table 1 below summarises the assessment of GIGAME. Column 2 in Table 1 explains the six components in the RETAIN model from Gunter et al (2008), as well as the summary of the rating scales from Ulicsak and Wright (2010). Column 3 shows the team’s assessment of GIGAME using the RETAIN model and rating rubric as well as potential areas for future research and work.

Table 1: Assessment of GIGAME.

6 Components of RETAIN model		Assessment of GIGAME
1. Relevance	<ul style="list-style-type: none"> <li>• Presenting materials in a way that is relevant to learners, their needs,</li> </ul>	The objective of revising various concepts in the law of torts is clear. The



	<p>and their learning styles.</p> <ul style="list-style-type: none"> <li>Ensuring the instructional units are relevant to one another, linked together and built upon previous work as the learner's skill increases.</li> </ul> <p>Rating scale (Ulricsak &amp; Wright, 2010)  Level 0 - Little stimulus for learning  Level 1 - Limited educational focus, some irrelevant content  Level 2 - Learning objectives are defined, interest is created  Level 3 - Game is relevant to learners, and challenges or is adequate for learning</p>	<p>design of the game is attractive to the undergraduate audience:</p> <ul style="list-style-type: none"> <li>63 out of the 64 respondents agreed or strongly agreed that the design of the game was appealing and highly motivating to use, and</li> <li>62 out of the 64 respondents agreed or strongly agreed that the game and the whole activity were engaging.</li> </ul> <p>Questions posed are related to the concepts taught in the previous lessons so that students can link them with their prior knowledge and build upon them to answer new application questions.</p> <p>Team assessment: Level = 3</p>
2. Embedding	<ul style="list-style-type: none"> <li>Assessing how closely the academic content is coupled with the fantasy/story content (i.e. the narrative structure, storylines, player experience, dramatic structure, fictive elements, etc.)</li> </ul> <p>Rating scale (Ulricsak &amp; Wright, 2010)  Level 0 - Learning content disrupts play  Level 1 - Learning is exogenous to (or "outside") fantasy context  Level 2 - Includes intellectual challenge and problems  Level 3 - Content is endogenous to fantasy and fully involves learner</p>	<p>Setting the game in the context of achievements and grades in SMU presents a situation that students can identify with.</p> <p>Our suggestion for a courtroom fantasy-like setting may enhance the embedded features in the game.</p> <p>Team assessment: Level = 1</p>
3. Transfer	<ul style="list-style-type: none"> <li>how the player can use previous knowledge and apply it to another area/ level</li> </ul> <p>Rating scale (Ulricsak &amp; Wright, 2010)  Level 0 - Levels of challenge are not mapped to objectives  Level 1 - Levels of challenge are too similar, some useful content  Level 2 - Easy progress through levels through active problem solving. Higher level knowledge should be transferable  Level 3 - Authentic real life situations and after action reviews</p>	<p>The game comprises largely of true/false and MCQs, and the knowledge transfer applies to objective, factual and law-based knowledge. The questions are flashed randomly, without input on players' response to prior questions; thus there is no mapping of the difficulty level of the questions to the students' level of understanding. In other situations where higher cognitive thinking skills and argumentation are required, the transfer would be less.</p> <p>Team assessment: Level = 1</p>
4. Adaptation	<ul style="list-style-type: none"> <li>Refers to a change in behaviour (i.e. learners being forced to change or create new knowledge to deal with something that does not fit existing ideas and understanding as a consequence of transfer)</li> <li>Create new knowledge to make sense of something that does not fit their existing ideas or understanding</li> </ul>	<p>The game may not promote directly the student's adaptation of knowledge. This is because the design of the questions is in the format of MCQs or True/False questions.</p> <p>However, when the game is played in the classroom mode, some of the questions are open ended in nature, hence the adaptation rating can be higher.</p>

	<p>Rating scale (Ulricsak &amp; Wright, 2010)</p> <p>Level 0 - Fails to engage in interactive, unstructured information</p> <p>Level 1 - Builds upon existing cognitive structures, engages in cognitive conflict</p> <p>Level 2 - Learners are encouraged to go beyond given information. Old schemas are identified and adapted to new situations</p> <p>Level 3 - Learning becomes an active process that integrates prior knowledge</p>	<p>A suggestion is to incorporate in the game more authentic real life problems that encourage the player to discover for themselves new concepts based on their prior knowledge.</p> <p>Team assessment: Level = 1 for single player mode; 2 for classroom mode</p>
5. Immersion	<ul style="list-style-type: none"> <li>the player is investing intellectually in the context of the game</li> </ul> <p>Rating scale (Ulricsak &amp; Wright, 2010)</p> <p>Level 0 - No formative feedback, little active participation</p> <p>Level 1 - Elements of play are not in sync with learning objectives, players are not engaged</p> <p>Level 2 - Learners are involved cognitively, physically and emotionally</p> <p>Level 3 - Favours belief creation and includes opportunities for reciprocal action</p>	<p>The game requires the player–learner to be fully engaged and on-task with targeted academic content/questions.</p> <p>Taking on avatar roles with special powers and landing on the same square as the “Professor” character can enhance players’ experience and motivate players to complete the game.</p> <p>Team assessment: Level = 2</p>
6. Naturalisation	<ul style="list-style-type: none"> <li>How well players develop habitual and spontaneous use of information is derived within the game</li> </ul> <p>Rating scale (Ulricsak &amp; Wright, 2010)</p> <p>Level 0 - Little opportunity for mastery of facts and skills</p> <p>Level 1 - Replay is encouraged to improve speed of processing</p> <p>Level 2 - Encourages synthesis of elements and judgment</p> <p>Level 3 - Learners become efficient content users and spontaneously use acquired knowledge</p>	<p>Repeated playing, if done purposefully, enables content to be ingrained in the players’ natural way of thinking.</p> <p>We suggest adding formative feedback to remediate misconceptions of learning. If students feel that they are learning, they will be encouraged to play repeatedly. More variations to the gameplay (such as new questions, bonus challenges) can add curiosity and context variation to the game, encouraging students to revisit (and internalize) the academic content.</p> <p>Team assessment: Level = 1</p>

The framework is useful for the developers and instructors to be informed about characteristics in games that engage and deepen learning (in particular, to make the game “relevant” with “immersion” in and “transfer” of learning). An important learning for the team is that game-based characteristics can enhance the learning experience of students. Therefore, game designers have to be aware of these game-based characteristics during the designing process.

## 6. CONCLUSION

The GIGAME, with its game features, appealed positively to the students’ sense of fun and competitive spirit. The fact that the game is available on-line means that students have another avenue to revise the lessons on their own outside the classroom.

Of the items that are rated on the lower end (transfer, adaptation, naturalization and immersion), the team will explore ways to improve these ratings. The team opined the first three items as key focus that could be explored for future modifications of GIGAME. Firstly, questions that test the same

concepts but in new situations can be designed and sequenced in a way to scaffold learning based upon prior questions. This aims to provide students with opportunities to transfer knowledge from one situation to another. Secondly, we could have questions that prompt students to adapt to real-world problems by using higher-order thinking skills and forming new principles. This suggestion applies to the current single player mode as the classroom mode of the game already allows open-ended real-world problems to be included. Thirdly, more ways to improve naturalization and to motivate replaying of the game can be explored. For example, we can allow students to access the content management system to obtain the correct answers after the game. We can also add more variations to the gameplay (such as having new questions and bonus challenges) as it creates curiosity and novelty and a sense of competitiveness. The nature of digital games allows these features to be changed and this works to the advantage of game developers and course instructors.

## References

- Abt, C.C. (1970). *Serious Games*. New York: Viking.
- Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, 37 (2), 122–147.
- Chen, Y-H., & Chen, P-J. (2015). MOOC study group: Facilitation strategies, influential factors, and student perceived gains. *Computers & Education*, 86, 55-70.
- Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological inquiry*, 11(4), 227-268.
- Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: defining gamification. In *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments* (pp. 9-15). ACM.
- Festinger, L. (1954). A theory of social comparison processes. *Human Relations*, 7 (2), 117–140.
- Gnauk, B., Dannecker, L., & Hahmann, M. (2012). Leveraging gamification in demand dispatch systems. *Proceedings of the 2012 Joint EDBT/ICDT Workshops* (pp. 103–110).
- Gunter, G. A., Kenny, R. F., & Vick, E. H. (2008). Taking educational games seriously: using the RETAIN model to design endogenous fantasy into standalone educational games. *Educational Technology Research and Development*, (5/6), 511
- Harris, R. (1983). *Talisman* [Board Game]. UK:Games Workshop Ltd
- Johnson, B. (2005). Design Ideation: The Conceptual Sketch in the Digital Age. *Design Studies*, 26 (6), 613-624.
- Johnson, L., Adams, S., Cummins, M., Estrada, V., Freeman, A. & Ludgate, H. (2013). The NMC Horizon Report: 2013. Higher Education Edition. New Media Consortium. Retrieved May 5, 2015, from <http://www.nmc.org/pdf/2013-horizon-report-HE.pdf>
- Kirkland, K., Ulicsak, M., & Harlington, M. (2010). Game-Based Learning Experiences: Testing the principles with teachers and students. Futurelab. Retrieved May 5, 2015, from <http://futurelab.org.uk/resources/games-based-learning-experiences-testing-principles-teachers-and-students>
- Lazzaro, N. (2012). Why We Play: Affect and the Fun of Games. In Jacko J. A. (Eds.), *Human-Computer Interaction Handbook . [electronic resource]: Fundamentals, Evolving Technologies, and Emerging Applications* (pp. 725-748). Hoboken : CRC Press, 2012.
- Locke, E. A., & Latham, G. P. (1990). *A theory of goal setting and task performance*. Englewood Cliffs, NJ: Prentice Hall.
- Perrotta, C., Featherstone, G., Aston, H. & Houghton, E. (2013). *Game-based Learning: Latest Evidence and Future Directions*. Slough: NFER.
- Richter, G. Raban, D. R and Rafaeli, S. (2015). Studying Gamification: The Effect of Rewards and Incentives on Motivation. In T. Reiners & L. C. Wood (Eds.), *Gamification in Education and Business*. Cham: Springer International Publishing : Imprint: Springer, 2015.
- Sandford, R., & Williamson, B. (2005). *Games and learning*. A handbook from FutureLab. Retrieved on August 25, 2015 from [http://www.educationscotland.gov.uk/Images/futurelabgames\\_and\\_learning\\_tcm4-452087.pdf](http://www.educationscotland.gov.uk/Images/futurelabgames_and_learning_tcm4-452087.pdf)
- Skinner, B. F. (1957). *Verbal behavior*. New York, Appleton-Century-Crofts [1957].
- Skinner, E., Furrer, C., Marchand, G., & Kindermann, T. (2008). Engagement and disaffection in the classroom: Part of a larger motivational dynamic? *Journal of Educational Psychology*, 100, 765–781.
- Suls, J., Martin, R., & Wheeler, L. (2002). Social comparison: Why, with whom, and with what effect? *Current Directions in Psychological Science*, 11 (5), 159–163.
- Ulicsak, M. & Wright, M. (2010). Games in education: serious games. A Futurelab literature review. Futurelab. United Kingdom, June. Retrieved May 5, 2015, from: [http://media.futurelab.org.uk/resources/documents/lit\\_reviews/Serious-Games\\_Review.pdf](http://media.futurelab.org.uk/resources/documents/lit_reviews/Serious-Games_Review.pdf)
- Woolfolk, A. (1998). *Educational psychology* (7th ed.). Boston, MA: Allyn & Bacon