THE POTENTIAL USE OF AUGMENTED REALITY IN GAMIFICATION

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ABSTRACT. The use of augmented reality (AR) and gamification in various fields is currently gaining popularity for its capability in engaging users. Gamification is a term that defines the use of game-based elements, such as game mechanics, aesthetics, dynamics, and game thinking in the non-game context environment. Meanwhile, AR is a technology that has an ability to overlap computer graphics onto the real environment. However, as a newly emerging concept, gamification seems to have some arguments related to its elements, concepts, and effectiveness in a similar intervention. Therefore, this paper discusses gamification. Although dozens of studies have implemented AR games, there is still an obvious lack in discussing and relating it to a gamified platform. Nevertheless, previous adaptation of games in AR seems that there are also potentials to utilise gamification and AR concepts and elements, as well as AR and AR games in brief. This paper also justifies several previous empirical studies in AR and gamification to look into its elements, research design, and the potentials of AR and gamification combination.

Keywords: gamification, augmented reality, game elements

INTRODUCTION

Since its emergence, augmented reality technology receives a lot of attractions in the research world and currently the technology flourishes to be implemented for marketing as well as in the learning system (Holden, 2014). The capability of the current technology enables users to use AR in an affordable way, for example by using smart phones. At the same time, AR game has also appeared in view of AR can promise interactivity, presence, and experience in engaging people (Iwata, Yamabe, & Nakajima, 2011). Since then researchers and academics attempt to develop AR game in creative ways to engage the users. In the learning field, AR game can increase motivation and a well-designed AR game may also give positive impacts to the cognitive process (Ferrer et al., 2013). Besides games, currently, gamification concept appears in the game world. Gamification is the use of game elements in a non-game element context (Deterding et al., 2011). The game elements may consist of game mechanics, dynamics, and aesthetics. Perhaps, the most important value promoted by gamification is; it promotes gamified platform that can be fun and engage the users but the application is not portrayed as a full-fledge game system. Gamification can also save time, budget, and resources in its implementation, unlike a real digital game for entertainment. Despite of the AR games having existed for decades, there is a lack of discussion and explanation of the AR

games in the sight of gamification although the previous games certainly use game elements in their study. It seems that there is a huge possibility of gamification and AR utilisation as the AR game has been established in a long time but may need further justification related to gamification concept (Dunleavy, 2014). Therefore, this paper is an initial step for comprehending and clarifying AR game technology and gamification concept.

AUGMENTED REALITY GAMES

The capability of augmented reality to augment computer-generated information into the real world and operate in real-time interaction gives attraction to the researchers in the game field and industries. Since its emergence, there are myriad augmented reality games that have been developed and tested by researchers as well as the augmented reality games that have been developed commercially. Augmented reality games for entertainment are solely developed for the purpose of giving fun to the player and serious augmented reality games are developed for serious matters such as for education, military training, and the engineering field. Broll et al. (2008) identified two types of current or next generation mobile augmented reality games which are in the part of small and simple games and event-based or complex augmented reality games. Small and simple augmented reality games typically use standard technology apparatus such as ultra-mobile personal computers or smart phones. On the other hand, the event-based mobile augmented reality application combines several apparatus such as head-mounted device (HMD), computers, and others in which it requires a wide range of software uses and combination to run the mobile augmented reality games. By and large, augmented reality games can be in two different modes whether in indoor or outdoor modes (Carmigniani et al., 2011). Indoor augmented reality does not use GPS tracking to locate location for augmented reality and the outdoor augmented reality typically uses the technology and sometimes requires additional hardware for a complex augmented reality system. Table 1 depicts examples of previous augmented reality games that have been developed and tested in learning, entertainment, and transportation. The games have been developed for various purposes and it seems that augmented reality gains unexceptional attraction in the learning field. However, out of the studies, only Eleftheria et al. (2013) and Schroeter, Oxtoby, and Johnson (2014) discussed the gamification concept applied in their augmented reality game system. Although other studies also applied the concept of game such as quest (Bressler & Bodzin, 2013), points and levels (Ho, Chung, & Lin, 2012), and rewards (Holden, 2014) there is a lack of gamification concept or other game element explanation to clearly show the game elements used in the studies. At the same time, a variety of multimedia elements has been utilised as the augmented reality contents.

Table 7. Several Examples of Previous AR Games

Researchers	AR Games	Game Elements Used	AR Elements Used
Bressler and Bodzin (2013)	School Scene Investigators: The Case of the Stolen Score Sheets	Quest was used to determine the flow and activities of the game by scanning the QR codes.	Texts, video, graphics, and audio source were used in this study to give information to the learners.
Eleftheria et al. (2013)	AR Game for Science Education	Used the flow theory in the design and development guidelines, and the system incorporated other types of game elements (onboarding, score, etc.).	Used all the multimedia elements.
Ferrer et al.	AR for passive	The users could interact with appli-	The application used

(2013)	solar energy education (AR-SEE)	cation, change the position, and play around the effect of solar energy in different conditions. No specific game mechanics were testified.	3D graphics, animation, and video.
Herbst, Braun, McCall, and Broll (2008)	TimeWarp – Interactive Time Travel with Mobile AR	Included time portal game element whereby it allows time travelling and small, self-contained challenge (buy items to solve problems).	Utilised full 3D animation, sound and text
Ho et al. (2012)	AR Intelligence Matrix Learning-by- Playing System –GoGoBox	The playing contents were graded by level and the game must be finished in a certain time (timer). The points were calculated based on right or wrong answers.	Utilised text and 2D graphics.
Holden and Sykes (2011), Holden (2014)	Mentira	Gave player prizes in terms of assets or items.	Used narrative and texts
Iwata et al. (2011)	AR Go	Not testified, but from the authors' view it may be related to the number of stones that have been successfully attacked by players (points).	Graphics, text, and animation
Juan, Carrizo, Abad, and Gimenez (2011)	AR Game for Endangered Animal Species	Basic game element, just playing around the markers.	2D graphics
Schroeter et al (2014)	AR and gamification to avoid boredom for drivers	Used the gamification elements (such as badges, points, and others).	Texts and graphics
Wang, Chen, Hong, and Tsai (2013)	Game-Based AR Library Instruction System (GARLIS)	Used game engine to help users between real environment and courseware developed but no other game mechanics were discussed.	Text, audio, and 3D graphics

GAMIFICATION

One of the infant approaches that appeared is gamification. It refers to the use of game elements in the non-gaming context to improve users' engagement and experience (Deterding et al., 2011). It was utilised in various fields such as marketing, health care, business, and recently evoked in the academic and learning research areas as well. Gamification in learning is a simple gameplay to support productive interaction for expected types of learners and instructors. The use of gamification in learning has been identified as being able to improve students' engagement, which can bring positive impact to learning outcome (Burrus, 2012).

Gamification Elements

As the gamification concept is a very infant concept, the game elements which are the most prominent for justifying the gamification have caused several misidentification in its explanation, for example the dynamic and mechanic elements. The design patterns may consist the basic elements of the gamification visibly or invisibly, which are the game mechanic, dynamic and aesthetic elements based on the game design theory (Kim & Lee, 2013). Game mechanics is a variety of tools, techniques, and widgets used to gamify an application or web-

site (Sicart, 2008). It consists of achievement, levels, leaderboards, avatars, quests, challenges, and others (Deterding, 2014). Dynamics is the run-time or interaction-feedback behaviour of the mechanics acting on player inputs and outputs over time; meanwhile, aesthetics is referred to the desirable emotional responses induced by the player while interacting with the game application (Kim & Lee, 2013). Most of previous literature agreed that the heart (core) of any game design is the 'challenges' in the gamification application whereby it can evoke the gameplay experience (Deterding, 2014). The challenges in the gamification application can simulate the motivation and enjoyment experience towards the content. Hence, the goals, objects or opponents, and rules (specifying ways of acting on them) should be clear and explicit in structuring the challenges in the application (Deterding, 2014). Concisely, previous studies proposed that a challenge needs to be not too easy or not too difficult for maintaining players' motivation and engagement towards the game. In a game system, given positive feedback message can simulate players' affective state that can engage them to the game. The messages can be texts, audio, graphics, or animations that are presented to the players after they undertake the right step in the system or anything else. Most good computer games have different difficulties of levels, which are playable by the players and apparently good games also have several different levels of goals that will provide challenges and determination in their effort (Malone, 1981). As depicted in Table 2, previous studies tested and utilised various mechanic elements in their studies. It can be seen that score or point, badges, and leaderboard are the most used game mechanic elements in previous studies whereby they were used more than half. This is in line with Codish and Ravid (2014) who said, in which point, badges and leaderboard are the most common used game mechanics in gamification. However, referring to the table, the level can also be seen as one of important and mostly applied element in previous gamification studies. Out of 14 empirical papers read, 11 utilised the level mechanic in their study. Normally, levels are related to challenge completion by players and are allowed to face new challenges in another level. In this paper, title and experience point are concluded as the similar types of rewards in terms of possessing quite a similar use of experience point whereby the title is given whenever users complete several levels or tasks (complete several experiences).

Table 2. Gamification Elements Used by Previous Studies

Researchers	Game Mechanic Elements
Afifa et al. (2013)	Score/point, badges, leaderboard, title, level
Barata et al. (2013b)	Score/point, badges, leaderboard, level
Barata et al. (2013a)	Score/point, badges, leaderboard, level, experience point, avatar, storytelling
Domínguez et al. (2013)	Badges, leaderboard, level, experience point, avatar
Browne and Anand (2013)	Utility rewards, level, avatar
Goehle (2013)	Badges, level
Ibanez, Di-Serio, and Delgado-Kloos (2014)	Score/point, badges, leaderboard
Jayasinghe and Dharmaratne (2013)	Score/point, level
Lee, Ceyhan, Jordan-Cooley, and Sung (2013)	Score/point, badges, leaderboard, level, avatar
Li, Grossman and Fitzmaurice (2012)	Score/point, title, level, avatar
Morrison and DiSalvo (2014)	Score/point, badges, leaderboard
O'Donovan, Gain, and Marais (2013)	Score/point, badges, leaderboard, level, experience point, storyline
Erenli (2013)	Quest
Welsh (2014)	Score/point, badges, level

Gamification Research Design

Previous studies have investigated the potential and effectiveness of gamification from numerous views of research design. Although the main goal of gamification in learning is to improve and encourage learner engagement towards the learning process (Borges et al., 2014), the interpretation of the engagement impact has been investigated differently by researchers based on their understanding and study. As an infant concept in the research field, gamification still has many things to be empirically explored and investigated. Gamification has also been tested for their acceptance, satisfaction, and behavioural or attitudinal changes. Table 3 simplifies several investigations and methodologies used by previous studies related to gamification. It shows that gamification is mostly applied in the context of higher education rather than in other learning levels. It clearly indicates a lack of empirical studies of the gamification utilisation in other education levels. In fact, the utilisation of gamification in various levels can discover the gamification effectiveness in broader scope. Data-logs, qualitative investigation (observation or interview), and of course the quantitative investigations have been widely used in previous studies. Several studies have also compared the effectiveness of gamified platform within gamified and non-gamified environment of learning. Behavioural change, satisfaction, and performance are the most outcomes studied for the gamification impact on the users. However, we believe that there are more any other evaluation measurements that can be investigated in relation to the main outcome of gamification, which is engagement. Besides that, gamification environment has also been embedded or applied in conjunction with other type of computer-based learning platforms such as learning courseware, e-learning system, homework, and tutorial system as well as in the virtual world system. This indicates the opportunities of gamification to be applied in a variety of computer-based learning applications such as augmented reality and others.

Table 3. Previous Gamification Study Investigations

Researchers	Respondents/ Focus Users	Embedded in	Qualitative/Quantitative	Outcome
Afifa et al. (2013)	High School Students	E-Learning System (Moodle)	Qualitative (Observation) Log-Data	Behavioural Change
Barata et al. (2013a)	Postgraduate	Virtual World (Moodle + AvatarWorld)	Qualitative (Observation, Interview)	Satisfaction Behaviour
Barata et al. (2013b)	Postgraduate	Virtual World (Moodle + AvatarWorld)	Qualitative (Observation, Interview) Quantitative Data-Logs -Gamified & Not Gamified Setting	Behaviour (Active Participation)
Browne and Anand (2013)	Undergraduate	Educational Software	Quantitative	Satisfaction
Domínguez et al. (2013)	Undergraduate	E-Learning System	Qualitative (Observation, forum) Quantitative -Control Group	Behaviour (Active Participation) Performance
Goehle (2013)	Undergraduate	Online Homework System	Qualitative (Observation) Quantitative	Behavioural Performance
Ibanez et al. (2014)	Undergraduate	Gamified Platform	Qualitative (Open-Ended) Quantitative Data-Logs	Behavioural Performance
Jayasinghe	Undergraduate	Gamified Plat-	Qualitative(Observation)	Satisfaction

and Dharmaratne (2013)		form	Quantitative	Performance
Lee et al. (2013)	Postgraduate	Gamified Platform	Qualitative (Interview) Game-Log	Behaviour
Li et al. (2012)	Adults	Interactive Tutorial System	Quantitative Qualitative (Open-Ended) -Gamified & Non-Gamified Setting	Performance (Completion Rate) Satisfaction
O'Donovan et al. (2013)	Undergraduate	Gamified Platform	Quantitative -Gamified & Non-Gamified Setting	Performance Behaviour Maintenance Cost
Erenli (2013)	University Student	Gamified Platform	Quantitative (Not Mentioned) Qualitative (Observation)	Performance
Welsh (2014)	University Student	Gamified Platform (Online gamification for Library)	Qualitative (User Feedback) Data-Logs	Behaviour

DISCUSSION AND CONCLUSION

AR and gamification have several similarities as both can engage people in certain activities as well as provide experience, motivation, cognitive, and other psychological effects to them. As an infant concept, gamification is currently gaining popularity in the academic and research world. Although there is little discussion about AR system and gamification combination, it is possible to make it happen since AR games have existed for decades. Additionally, previous AR games also utilise game elements, but lack discussion in elements which have been discussed in former studies as important in gamification platform; for example the rewards system (including points, badges, and others). The huge possibility of gamification and AR utilisation may need further justification related to gamification concept. Furthermore, the most essential is that, both AR and gamification still need further empirical testing to determine their effectiveness. Therefore, after this we will look forward how to design and develop a gamified and AR environment that is not only fun, but also has the capability to engage people.

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