The Impact of game play and novel entertainment on cognitive skills

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Introduction

A variety of researchers have studied the effects of game-based learning on information retention and improvement of cognitive skills. Their efforts provided good cases exemplifying the design of learning games (Ke et. al. 2015). The recent meta-analysis on the effectiveness of digital games for learning indicated that digital games, compared with non-game instruction conditions, have a moderate to strong effect on cognitive learning outcomes (Clark et. a;. 2014). A common skepticism on game-based learning is that students can get distracted with the entertainment of the game and get frustrated with the learning part. The challenge is to integrate learning into core game elements while not violating or corrupting what is enjoyable about games (Garris et. al. 2002).

Game play is essentially a process of learning, in which players interact with the game to learn the rules and play strategies, then adapt and improve play skills to make progress in the game (Lindley and Sennersten, 2008). The effectiveness of game play impacts on ability and skill acquisition can help both students and teachers look for alternative ways to retain information and increase scores on school assignments. The goal of this literature review is to learn more about the effects of game-based learning and compare plan of actions that can aid in more successful testing strategies with students or individuals with learning disabilities. The review will discuss engagement elements, iterative learning moments during game play, and game-based learning as a teaching and learning approach.

Engagement elements

Engagement can affect as much as learning and motivation. This effect occurs because it was observed that games can engage players to learn, can include multisensory settings, and can

stimulate players' ability to think and create meaning (Jabbar, & Felicia, 2015). For a child to be engaged in a game, we have to find ways they can get motivated and interactive with the game. We also have to include fun elements along with multimedia elements that engage the player through physical or multisensory interaction. An important thing to keep in mind is that intellectual engagement includes both cognitive and emotional aspects. As described, game-based learning goes beyond entertainment attributions. Although cognitive learning experiences are related to learning and the skills or abilities acquired by learners, effective learning experiences relate to behavioral changes and the motivational aspects as a result or a cause of learning. Cognitive aspects and emotions are essential to learning and varies with each individual. In other words, emotions and thoughts both play a role in engagement and the learning process (Ke et. al. 2015).

Jabbar and Felicia (2015) conducted a systematic review and examined a variety of studies on the elements that influence engagement and learning in gameplay and the impact of these elements. The study investigated game-based learning for primary schools with children aged between 8 and 14 years. It showed that games had an impact on both cognitive and emotional engagement, as well as how these translate to learning and motivation. Some articles reported on both emotional and cognitive impacts of gameplay, and some report on both positive and negative outcomes (Jabbar and Felicia, 2015). From these findings, the researchers postulated that a large number of recent (between 2003 and 2013) peer-reviewed papers on game-based learning concluded that games are increasingly seen as an influential educational resource for the age group observed. Additionally, most reports focused on subjective views and self- reporting experiences.

Engagement also informs us about the relevance of the content and the effectiveness of the proposed interactive learning game. Learner's engagement is an effective indicator of their motivation, acceptance and attachment to the learning activity.

Coincidentally, one of the main ideas on implementing engagement elements is how they enable us to deal with the aspect of temporality. A theory-driven and qualitative approach study by Bouvier, Lavoue, Sehaba, & George (2013) sought to identify game-play engagement behaviours in low-constraint interactive systems, directly, continuously and under ecological conditions and over a long time period. The study collected twelve player's traces on the period from January to April 2012. It showed that the activities and actions level, and the rules allowing to infer activities from actions, are broadly shared by different types of games. For example, the action of Challenging another player has the same meaning as soon as there is a confrontation between learners (Bouvier, Lavoue, Sehaba, & George, 2013). The results of this study indicate that the effectiveness of the learning game depends on both the immersive and interactive features and the content.

Interactivity is highlighted as the mechanism that will enhance children's attentional interest and learning from the newer media. Calvert, Strong, & Gallagher (2005) conducted a two-factor ANOVA test on a study in which young children were exposed to a computer story that varied the amount of control that children had over the visual and verbal content. Participants were 53 preschool-aged children who attended one of the three facilities, one public primary school, one private school, or one private day care facility in Washington D.C. Children participated individually in their randomly assigned computer treatment condition for two sessions with an adult. Children in the no-exposure condition participated in only one 10-minute session where they answered a comprehension measure. In the experimental group, a trained

observer scored eyes on visual attention as “on” or “off” the computer screen. In the control group, children’s teachers were asked to rate each child on his or her early reading skills on a 3-point scale where 1= does not recognize any words, 2= recognizes a few words, and 3=recognizes many words. The study showed that children who controlled the computer demonstrated more attention and involvement than those who watched an adult control the experience. However, control had no effect on children’s memory of visual or verbal content (Calvert, Strong, & Gallagher, 2005). All in all, the study accepted the researchers study by confirming that children were less interested in the story and became less attentive across repetitions when an adult controlled the situation and children had little personal control of the learning situation.

As generations evolve, technology usage has increased and computer games can act as rich primers for engaged learning of educational content. Ke and Abras (2013) use a descriptive case study approach to focus on a detailed contextual analysis of the phenomenon of adult-supported, game-based learning for students with special needs. In this study, each educational game, with its associated gaming environment, was examined as an individual case. Nine middle school students (aged 13 and 14) were purposefully selected to represent children who tend to be academically disadvantaged with eight being minorities, six enrolled in the special education program and three being language learners (Ke, Abras, 2013). Researchers studied the effects of three different mathematical games on student’s engagement and learning. Each game was developed as “inclusive” games and presented different strategies to complete the given tasks which would hopefully help address the diverse needs of a general student group. The study suggests that educational games, if well designed and used, can promote engagement and learning for students with special learning needs (Ke, Abras, 2013). Researchers concluded that a

game needs to scaffold learners' play and learning activities by externalizing their mental visualizations or calculation via visual cuing or feedback (Ke, Abras, 2013).

Additionally, Kamran (2008) conducted a quasi-experimental nonequivalent pretest-posttest group design to investigate whether and how games can be designed to help children engage and learn mathematics in an enjoyable and motivating way. Kamran's strategy was to engage children with mathematical representations using a game as the learning context. In this strategy, representations of mathematical concepts are used to mediate between game-playing and learning (Kamran, 2008). The game takes children from almost no knowledge of geometry to at least some non-trivial knowledge. Results show that despite the explicitness and difficulty of the mathematical concepts involved, children found the learning process fun and engaging (Kamran, 2008). If children find themselves having fun during the game, their attention will be focused on the game and trying to complete its tasks and challenges. Furthermore, children exhibited significant improvement in their knowledge of transformation geometry concepts.

These studies are similar in that they all take their hypothesis and use it in real-life situations. While some focus on primary schools of children between ages 8 and 14, others try to focus specifically on children with learning disabilities. Jabbar and Felicia (2015) find that gaming has a lot to do with both cognitive and emotional engagement. Whereas Bouvier, Lavoue, Sehaba, & George (2013) go into depth with the how that engagement is an indicator of motivation and attachment to the learning activity over a long period. One study, working with students with special needs, supported game-based learning as long as an adult was helping guide them. While Calvert, Strong, & Gallagher (2005) find that games had a positive effect on engagement and no effect on memory, Kamran (2008) found significant improvement in students' knowledge when presenting a mathematical game to them.

Iterative learning moments during game play

While one of the noted observations about game-based learning is engagement elements, game-based learning also focuses on iterative learning moments to determine what variables help students retain information better. Danby, Evaldsson, Melander, & Aarsand (2018) present three ethnographic studies of young children's everyday peer interactions from three different settings and age groups: Australia (home), Norway (pre-school) and Sweden (afterschool). Across these settings, the findings identify how children collaborate with one another to progress the game by using multiple strategies, including instructing one another, monitoring each other's actions and problem solving. Results indicated that all three cases, across different settings and children's ages, identifies the universal phenomenon of children engaged socially in gaming practices: Example 1 showed two siblings coordinating their efforts to destroy the screen intruders; Example 2 showed pre-school children supporting a novice player; and Example 3 showed children's collaborative efforts to gain password access to a game (Danby, Evaldsson, Melander, & Aarsand, 2018). This study shows that the iterative learning moments were in collaboration and social interactions in order to gain access, play and reach successful outcomes.

Finding similar results, a mixed-method, multi-case study was conducted by Ke and Moon (2018) to examine the association between a 3D virtual playground and design themed architectural gaming among high-functioning autistic (HFA) children and learners participation patterns and their game-based social interaction. The virtual playground affords competition-themed social gaming, role-play gaming. Eight 10 to 14 year old HFA children participated in the study's learning program at home. During baseline, participants' social interaction behaviors were observed and coded both infield in a community setting (a public library, at home or a university activity room), and virtually via video conferences and a VR orientation session in

which participants explored a plain virtual land without gameplay and in the same natural way as they interacted with a digital tool in everyday life (Ke, Moon, 2018). The study found that virtual reality-based gameplay increased participants' performance of the targeted social skills during the intervention phase. Overall, the study findings supported the implementation of virtual-reality based collaborative gaming for autistic children as it promotes the knowledge and awareness of typically developing children in communicating with autistic peers (Ke, Moon, 2018).

Lee, Chen, Wang, & Chung (2018) conducted observational research and used the ARCM (Augmented Reality Concept Mapping) training system to teach children with autism spectrum disorder to better understand different social relations and learn appropriate responses in social situations. In this study, a certified occupational therapist with more than 4 years of experience working with children with ASD conducted all the sessions and taught the children how to use the ARCM training system. The ARCM system has three characteristics: (1) it provides full 3D virtual objects combined with a tangible tabletop role- play game that can be used to promote learning motivation; (2) it increases users' understanding of relationships between roles and helps them role-play; and (3) it focuses on a broad range of nonverbal social cues to teach children with ASD how to appropriately reciprocate when they socially interact with others (Lee, Chen, Wang, & Chung, 2018). The children practiced their social greeting behavior and tried to mimic emotions. The purpose of this experiment was to examine the differences in answers and greeting behavior responses between baseline and maintenance phases (Lee, Chen, Wang, & Chung, 2018), similar to game-based learning strategies. Results showed significant data as researchers successfully transformed the tradition training task by combining it with AR technology. Lee, Chen, Wang, & Chung (2018) state that the intervention

system was effective for helping the three children with ASD maintain their focus on greeting behavior clues and understand social situations.

An evaluative study and post hoc analyses were conducted by Pareto, Haake, Lindstrom, Sjoden, & Gulz (2012) of how an educational game affects (1) conceptual understanding and (2) attitudes towards mathematics, the subject in which the game is being tested on. Nineteen students played the game in pairs once a week during math lessons for 7 weeks (the experimental group) while another nineteen students followed the regular curriculum (the control group). Results show that math comprehension scores increased significantly for the game-playing group but not the control group ($p < 0.05$). However, there was no significant difference in attitude change between the two groups (Pareto, Haake, Lindstrom, Sjoden, & Gulz, 2012). All in all, it was shown that collaborative and competitive activities seem to carry a strong motivational influence on students to play the game.

Similarities between studies were finding significant results with the interactions with other children and how they integrate learning moments during game play. One study even conducted a 3D virtual playground tested on autistic individuals to see learner's participation patterns and their game-based social interaction. Differences include the type of approach taken with students to find effective learning moments. Another study used a training system that included a role-play gaming application. All in all, these studies mainly supported that collaborative and competitive activities seem to carry a strong motivational influence.

Game-based learning as a teaching and learning approach

Researchers usually tend to look for more ideas and theories that can help future research or benefit society. Game-based learning is a great area to study for teachers who work with students with learning disabilities or students looking for alternative ways to retain information.

Kloper, Osterweil, & Salen (2009) use a combination of the archival research methodology to present secondary empirical evidence and a large-scale survey methodology to provide empirical evidence of viable research directions to move the study of digital games for learning forward. The survey methodology looked at multiplayer and single motivations for playing games in education. The article depicts game-based learning as a useful alternative for learning and encourages future research in the field. When educational games are embedded in a classroom context, teachers will need to evaluate how well the students play the games and whether they've gotten enough out of the experience. Many games are inherently collaborative, so teachers may need to revisit their policies on cheating and plagiarism (Kloper, Osterweil, & Salen, 2009). As there are many applications of games related (more or less) to learning games, the paper lays out the ecology of games with a purpose beyond play (Kloper, Osterweil, & Salen, 2009).

Peng, Lin, Pfeiffer, & Winn (2012) conducted an experimental study of a self-determination theory guided exergame to examine how the game features impact players' need satisfaction and game experience. The study employed an in-house developed exergame and manipulated the game features in a 2 (autonomy-supportive game features: on vs. off) x 2 (competence-supportive game features: on vs. off) experiment to predict need satisfaction, game enjoyment motivation for future play, effort for gameplay, self-efficacy for exercise using the game, likelihood of game recommendation, and game rating (Peng, Lin, Pfeiffer, & Winn, 2012). The results indicated that the manipulation was successful for both independent variables, reject the null hypothesis. All in all, need satisfaction of autonomy fully mediated the effect of autonomy-supportive game features on game enjoyment, motivation for future play, game recommendation, and game rating (Peng, Lin, Pfeiffer, & Winn, 2012).

Chiou (2007) conducted a two experiment study to explore, from the perspective of cognitive theory, the psychological motivations of Taiwanese adolescents who are addicted to online games. Study 1 focused on the differential motivations between the addicts and nonaddicts. Study 2 was conducted to examine whether four factors that moderate the detrimental effect of extrinsic motivators on intrinsic motivation would function as predicted. Results indicated that extrinsic rewards would undermine intrinsic motivation when they were high expectancy, high relevance, tangible, and noncontingent (Chiou, 2007). The study can help teachers learn and grasp ideas on how to employ intrinsic motivators to affect their intrinsic motivation.

Moreover, an empirical study was conducted by Benwell, Pavlas, Heyne, Lazzara, & Salas (2012) focusing on direct comparisons between learning outcomes of serious games and those of more traditional training methods. This article presents a game that represents shared mental models of game subject matter experts (SMEs). Findings show that with a refined taxonomy of games, research on game attributes and their effects on learning can progress in a purposeful and unified fashion. The article encourages research in the serious games community to focus on cognitive and emotional spheres; the study of motivation, emotion, attention, and many other psychological constructs (Benwell, Pavlas, Heyne, Lazzara, & Salas, 2012).

Lastly, Haworth, Bostani, & Sedig (2010) conducted an exploratory study on any negative effects on gameplay using decision trees (a simple visual representation of all possible choices available to players and the consequences of each choice) to support children's analytic reasoning. Results showed four tentative conclusions: (1) the inclusion of the decision tree may have positively affected the player's reasoning by aiding and focusing their decision-making process, (2) the inclusion of the decision tree did not have obvious negative effects on the

players' enjoyment of the game (3) implementation of mediating actions through the decision tree seemed to have negatively affected the players' enjoyment of the game, and (4) designers should be careful about how the actions of players are mediated in a digital game if decision-support structures are included to ensure that gameplay is not negatively affected (Haworth, Bostani, & Sedig, 2010). This suggests that in future studies or practices, a more natural implementation of mediating the children's actions is required.

Similarities between these studies show that motivators of the game and careful instruction should be a priority when introducing game-based learning. Although, while some studies focus on the cognitive and emotional spheres that teachers should be aware of, others focus on the natural implementation of instructing the children's actions.

Conclusion

While most of these studies have determined that game-based learning is in fact beneficial to learning, more research needs to be conducted to further expand knowledge of how teachers can integrate game-based learning techniques. I have explored a variety of elements that help game-based learning be considered as effective in different environments with participants of different backgrounds. Using game-based learning would provide teachers and or physicians to look at alternative ways to help students grasp information better, especially those with learning disabilities. Certain key performance components related to retaining information from game-based learning can be fostered and improved through further research and practice in real-world situations, such as in school classrooms. I hypothesize that game-based learning can help a variety of students who usually have trouble retaining information through traditional teaching techniques. To explore this hypothesis, a randomized control trial can be conducted to evaluate

the differences in the effects of two different classroom settings for reintegration of children with learning disabilities- verbal teaching with an adult versus game-based learning with a computer.

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