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Games as Learning Tools

A LITERATURE REVIEW

By

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Abstract

Student engagement has been referenced as one of the most important factors associated with improved learning. However, as students enter the middle grades, their engagement and motivation declines. This obstacle of disengagement has been shown to have negative impacts on learning. Numbers of studies suggest that games in the classroom have the potential to improve student motivation and engagement. Here, the author looks to the literature to, (a) examine what current literature tells us about the effectiveness of using games in the classroom as a learning tool, and (b) identify specific attributes that make games great for learning.

This work is dedicated to my beloved husband and our four daughters, Rylie, Sadie, Sydney and Scarlet, who have taught me that the most valuable lessons are often learned through play

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Chapter 1: Introduction

It is my personal belief that most teachers enter college with a vision of teaching. This is usually manifested in the form of reaching out to children, teaching them new concepts, celebrating success, working through failures, and helping students overcome challenges and obstacles that stand in their way of success and academic growth. The vision continues with a future image of oneself, standing in front of a classroom full of students who are eager to learn and ready to soak up the wealth of knowledge one just spent the last four years acquiring. It does not take long however, for reality to set in and for educators to realize that getting these precious children to take an active role in their education isn't as natural and painless as once thought. Indeed, one may realize that she may not truly be prepared for what lies ahead. Sure, we educators have the skills and knowledge to teach these children, however, not all of our teacher education programs focused on motivating the unmotivated, engaging the bored student, or drawing in the student who has so many other things going on in his world that the carefully planned lesson is not at all a priority for him. Instead, with all that there is to learn during those four precious years of college, our teacher education program might have allocated less time to motivational strategies and more time to pedagogy and content mastery in order to prepare us for what we'll be responsible for teaching. With this new revelation, one might find him or herself wondering, how can I successfully motivate the unmotivated, engage the unengaged, and draw students into the content that I am delivering in my classroom?

Numerous studies suggest that both digital and non-digital games in the classroom improve student motivation and engagement (Bragg, 2012b; Chang, Wu, Weng, & Sung, 2012; Lin et al., 2013; Chao, Chen, Star, & Dede, 2016; Pareto et al., 2012; Trujillo et al., 2016)

According to Bragg (2007), games help improve students' math dispositions and facilitate a positive learning environment in the mathematics classroom. In addition, "Seventy percent of teachers polled said using educational video games increased student engagement, and 60% acknowledged that games help personalize, instruction" (Bruder, 2015, p. 57). Osguthorpe and Graham (2003) also support the claim that blended instruction to include the use of computers and digital games in the classroom provide a more personalized learning experience for students.

Purpose

Recently, I have incorporated games such as *Find a Place* and *Quizizz* into my classroom instruction and have noticed that my students seem to be more engaged when games are part of the daily agenda. *Find a Place* is a non-digital place value game where students compete against a partner (partner A and partner B) in order to obtain a value closest to a target value in a series of targets (0, 10, 50, 100, 500, 800, and 1000). To play, each pair of students needs a scoring sheet (see Appendix A). The teacher will use a deck of cards with the Kings, Queens, and Jacks removed. Tens are worth 0, aces are worth 1, and all other cards are worth their face-value number. The teacher then takes turns drawing a card for all players A and then all players B. During their turn, students strategically select which box on their scoring sheet to write the value of their card (0 through 9) with the goal of creating a numeral value that is closest to the target value indicated in the center rectangle. Options include place values of ones, tens, and hundreds. Students may only use each card once and must fill in every box on their side of the scoring sheet. Again, the goal is to create a number either equal to or as close as possible to each target number in the center column of the scoring sheet. Once all open boxes are assigned a value (creating a number), the difference between the "target number" and the number created is

calculated. To get a final score, students add up the values in each small box on their side of the game sheet. The player with the lowest score wins.

Quizizz is an online quiz platform that allows players to compete against one another in answering multiple-choice questions. Teachers may create their own quiz or select from a library of quizzes made by others. I usually incorporate Quizizz as a fun way to review and practice previously learned mathematical content.

My students seem to enjoy both *Find a Place* and *Quizizz*. Although games are fun, I do not want to spend precious class time engaging in math related games if the engagement in such games is not likely to increase mathematical understanding and learning. The purpose of this extensive literature review is to (a) examine what current literature tells us about the effectiveness of using games in the classroom as a learning tool, and (b) identify specific attributes that make games great for learning. The knowledge I gain from reviewing the literature will be used to help me determine if the incorporation of games in my classroom is an effective, worthwhile strategy to increase learning of mathematical outcomes and engaging students in mathematics as well as to gain insight as to how to take an ordinary game and make it great for learning.

Statement of The Problem

Today's youth are entertained in all aspects of life. From television at home to movies in the car, to hand held digital devices and tablets on the go, children have technology at their disposal (Lenhart et al., 2008). According to Rideout, Foehr, and Roberts (2010), "over the past five years, there has been a huge increase in media use among young people" (p. 2). Lenhart et al. (2008) found that "97% of teens ages 12 – 17 play computer, web, portable, or console

games” (p. 2). In their study, Rideout et al. (2010), found that “eleven- to fourteen-year-olds average just under nine hours of media use a day (8:40), and when multitasking is taken into account, pack in nearly 12 hours of media exposure” (p. 5). With their favorite TV show or movie just a click away, today’s adolescents have not had to wait for their favorite show to air on Tuesday evening at 7 PM Central time, to fast-forward the cassette tape to their favorite song, or even put the Compact Disc into the CD player to play a particular song. Instead, with the flexibility of portable devices, today’s youth are able to Google the music video they want to see at anytime and anyplace (Granich, Rosenberg, Knuiman, & Timperio, 2011). With the advances in technology, people do not seem to experience much waiting at all. With technology being readily accessible, it’s no wonder that media use among our youth is on the rise. Entertainment is at their fingertips at every waking hour of the day.

This desire to be entertained seems to follow students to school. As a middle level mathematics educator, I have found that my students seem to want to be entertained rather than taught. I frequently see students on their smartphones (even though they know it is policy to keep these devices out of sight) and observe students disengaged in the tasks and activities at hand. I often hear comments of, “this is boring!” or, “can I listen to music on my phone?” I frequently observe a lack of student engagement and motivation from my students. This is a big problem as it interferes with learning and college readiness.

According to Chao et al. (2016), “Students’ motivation to learn mathematics often declines during the middle grades” (p. 253). This claim is further supported by other researchers to include: Archambault, Eccles, & Vida, 2010; Blackwell, Trzesniewski, & Dweck, 2007; Dweck, 2007; Eccles-Parsons et al., 1983; and Steen, 2003. With the astounding amounts of disengagement in school, the potential for success is low. In fact, it has been shown that

disengagement has negative effects on learning (Brint & Cantwell, 2012) and educators have found that the lack of engagement in their students leads to ineffective learning (Heaslip, Donovan, & Cullen, 2014).

The challenge of engaging students is not limited to middle school. According to Bragg (2012b), with the diverse needs, interests and abilities of students, primary school teachers find it challenging to sustain student engagement in learning tasks. My experience is consistent with Bragg's statement. Many of my students enter middle school at-risk for not graduating high school and it is common for students to enter 6th grade two or more grade-levels behind in mathematics, and therefore have large gaps in their skills and abilities. With the vast diversity in my students' abilities, backgrounds, and needs, I too am challenged when it comes to facilitating students' maintained engagement in learning activities.

“Student engagement is one of the most important factors associated with improved learning, and much of the research to date [2016] has indicated the importance of student engagement leading to a positive impact on learning outcomes” (Poondej & Lerdpornkulrat, 2016, p. 1). Without the implementation of effective strategies to increase student engagement, I am afraid that gaps will grow rather than shrink. With that said, I am perplexed with how to increase student engagement in my classroom and hope to discover useful tools and strategies by conducting this literature review.

Research Question

This research was guided by the following question: What does the literature tell us about the effectiveness of using games in the classroom as learning tools?

Methodology

The procedure for this extensive literature review consisted of research, review, and the synthesis of numerous peer-reviewed articles on the topic of gamification and game-based learning. In order to find relevant and valid publications, I conducted numerous key word searches using databases such as, ERIC, Education Source, and PsycINFO. Such key words included, *student engagement and games, game-based learning to increase student learning, games and their impact on learning, effectiveness of games in the classroom, games and at-risk students, engaging at-risk students, mathematics and games, middle school and games, and, attributes of effective education games*. After reviewing sufficient literature, I synthesized information into categories that became the different sections of this literature review.

Chapter 2: Literature Review

Introduction

Disengagement has adverse effects on academic achievement and learning outcomes (Brint & Cantwell, 2012; Green et al, 2006; Kaplan, Peck, & Kaplan, 1997; Leim, Lau, & Nie, 2008) and educators agree that the shortfall of student engagement in academics is a problem leading to ineffective learning (Heaslip et al., 2014). As student engagement has been cited as one of the most important factors associated with improved learning (Poondej & Lerdpornkulrat, 2016), the exploration of effective strategies to promote student engagement is a worthwhile and necessary topic. As “gamification has been described as one strategy to increase knowledge retention while engaging learners in an immersive environment” (Brull & Finlayson, 2016, p. 372), I seek to explore games as one possible strategy to address the problem of disengagement in the classroom.

Games are not typically used in the classroom as a strategy to promote learning or to increase participation and engagement; rather, they are often employed as a reward or a supplemental activity in the classroom (Armier, Shepherd, & Skrabut, 2016). This is unfortunate because literature on the topic suggests that with thoughtful implementation, games have the potential to offer abundant educational benefits (Bragg 2012; Bruder 2015; Brull & Finlayson, 2016; Kapp, 2012; Simkin, 2013). Such benefits include positively impacting student engagement, motivation, and learning outcomes. In addition, games have been shown to foster self-directed learning (Armier et al., 2016; Brull & Finlayson, 2016), improve student attitudes towards learning and mathematics, improve self-efficacy, increase time on task, and improve learning for low-income and struggling learners (Calder & Campbell, 2016; Ke & Grabowski,

2007; Wery & Thomson, 2013). In this chapter, I will discuss what the literature reveals about the impact of incorporating games into the classroom as a learning tool.

First, I define the following terms: *game*, *gamification*, *digital game* and *non-digital game*. Second, I go beyond the definition and dive a bit deeper into motivation, engagement and learning by describing each of these terms in more depth. Third, I discuss what the literature says about the effectiveness of using games as a learning tool. This includes exploring what the literature states about how games impact student motivation, engagement, and learning in the classroom as well as the conditions that were met in studies that resulted in educational benefits through games. Finally, I discuss the drawbacks and limitations of using games in the classroom according to the literature.

Definitions

For the purpose of this review, it is important to understand what is meant by terms such as *gamification*, *digital games* and *non-digital games*. In this section I provide definitions for each term.

Gamification. Kapp (2012) describes a *game* as “a system in which players engage in an abstract challenge, defined by rules, interactivity, and feedback, that results in a quantifiable outcome often eliciting an emotional reaction” (p.23). He further defines *gamification* as “using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems” (Kapp, 2012, p. 10). *Gamification* includes the incorporation of game elements (i.e. badges, rewards, leaderboards, levels, points, etc.) in non-game settings in order to engage or motivate customers, students, and targeted audiences (Cronk, 2012; Prince, 2013). Gamification may take on the form of a teacher-modified game such as *Jeopardy* that is

designed to meet the needs of learning outcomes and includes particular game elements. This would be classified as *gamification* because it is played in a non-game setting (the classroom) and includes particular game elements such as points, rewards, or levels. With this in mind, it is important to understand that gamification encompasses technology in its gaming mechanisms; therefore, *gamification* is applied through the Internet, a computer, an iPad, or through some other electronic means (Domínguez et al., 2013). According to Karagiorgas and Niemann (2017), “*Gamification’s* main goal is to foster more engagement in people by helping to create more robust experiences in everyday life events utilizing game mechanics” (p. 502). For the purpose of this literature review, *gamification* will refer to the incorporation of game elements using electronic devices into non-game settings such as the classroom.

Digital games. Although digital games are similar to and may fall into the gamification category, they have their differences. Unlike gamification, a *digital game* does not include the incorporation of particular game elements and is not restricted to non-game settings. Rather, *digital games* are played in any setting and are reported to have a number of their own commonalities (Abt, 1970; Dempsey, Haynes, Lucassen, & Casey, 2002; Juul, 2003; Kinzie & Joseph, 2008; Prensky, 2001; Salen & Zimmerman, 2004). These commonalities include:

- A goal, an objective to achieve;
- An activity or process that requires the player to take an active role in the game;
- Rules of the game that need to be followed;
- Game outcomes defining how one wins/progresses or loses. Tracking points, coins, etc. may do this;

- Conflict or competition, either against the challenge itself, your own personal score, or with one or more opponents. (Huizenga et al., 2017, p. 106)

For the purpose of this review, *digital games* will include the aforementioned commonalities with the addition of being played on a digital device (desktop, laptop, iPad, tablet, smartphone, etc.).

Non-digital games. Non-digital are a different category of games. They differ from digital games in that they are not played electronically. Rather, *non-digital games* used for educational purposes include card and dice games, board games, and paper/pencil type games that can be used to develop skills, such as mathematical skills of students (Bragg, 2012a). Harvey and Bright (1985) describe a game as an activity that one participates in *voluntarily*, the game is governed by a set of rules and there is a challenge or competition where the player competes against a task or one or more opponents. Because this review is focusing on games in an educational context, I will include Oldfield's (1991) definition that was used in mathematical education. Oldfield (1991) described a mathematical game to "...[have] a distinct finishing point [and to address] specific mathematical cognitive objectives" (p. 41). For the purpose of this review, these definitions were synthesized to develop a definition that is appropriate for this review. In this paper, a *non-digital game* will refer to a non-electronic game that (a) is governed by a set of rules, (b) involves a challenge or competition either against a task or against one or more opponents, and (c) is aligned to a desirable outcome.

Motivation

In order for learning to take place, one must be actively engaged, and in order to sustain the level of engagement that leads to learning, one must be motivated (Berkeley Center for Teaching and Learning, 2017). Therefore, motivation is essential to engagement and learning. In fact, motivation has been noted to have a direct impact on the quality of learning (Ryan & Deci, 2000). Motivation can be described as being moved to do something (Ryan & Deci, 2000). We all experience the motivation to do or complete something, and our motivators, whether internal or external, vary from one person to the next. This internal or external drive to do something can be defined as either intrinsic or extrinsic motivation (Ryan & Deci, 2000). Ryan and Deci define *intrinsic motivation* as “doing something because it is inherently interesting or enjoyable, and *extrinsic motivation*, [as] doing something because it leads to a separable outcome” (p. 55).

“Because intrinsic motivation results in high-quality learning and creativity, it is especially important to detail the factors and forces that engender versus undermine it” (Ryan & Deci, 2000, p. 55). The question is then, what fosters intrinsic motivation? Well, according to Ryan and Deci’s definitions, we can conclude what inhibits it –boring and unenjoyable tasks.

Many of the tasks employed by teachers are rather boring and viewed as unenjoyable by students, therefore, successful teaching must look to strategies to promote enjoyment and interest in order to foster intrinsic motivation in our students (Ryan & Deci, 2000). These strategies should incorporate elements of autonomy, competence, and relatedness (Ryan & Deci, 2000). Because students view games as enjoyable and freely choose to participate in different forms, the literature suggests that games may be a useful tool for promoting student motivation, engagement, and cognitive development (Brull & Finlayson, 2016; Cook, 2013; Pinter, 2011).

Engagement

Student engagement can take on a number of forms. According to Sinatra, Heddy and Lombardi (2015), engagement can be described as multidimensional to include emotional, behavioral, and cognitive dimensions. Each dimension addresses different elements of engagement. For example, attendance and participation in school activities are elements of behavioral engagement; whereas valuing the school and having a sense of belonging are elements of emotional engagement (Sinatra et al., 2015). “Cognitive engagement [can be] described as [the] willingness to engage in effortful tasks, purposiveness, strategy use, and self-regulation” (Sinatra et al., 2015, p. 2). Zimmerman (1990), further described self-regulation to include student demonstration of persistence during adverse tasks and the setting of learning goals in order to be successful in school.

For the purpose of this review, *engagement* means wanting to participate in an activity, and, while not being distracted, demonstrating enjoyment and having fun while participating (Hiuzenga et al., 2017). Furthermore, *student engagement* will take into account “... the extent of a student’s active involvement, the degree of attention, interest, and passion that a student shows when they take part in the learning process” (Poondej & Lerdpronkulrat, 2016, p. 1).

Learning

The Learning Process. Recall that engagement includes taking part in the learning process, in order to understand what it means to take part in the learning process, one must first understand what a learning process is. According to the Berkeley Center for Teaching and Learning (2017),

Learning is a process that:

1. **is active** - process of engaging and manipulating objects, experiences, and conversations in order to build mental models of the world (Dewey, 1938; Piaget, 1964; Vygotsky, 1986). Learners build knowledge as they explore the world around them, observe and interact with phenomena, converse and engage with others, and make connections between new ideas and prior understandings.
2. **builds on prior knowledge** - and involves enriching, building on, and changing existing understanding, where “one’s knowledge base is a scaffold that supports the construction of all future learning” (Alexander, 1996, p. 89).
3. **occurs in a complex social environment** - and thus should not be limited to being examined or perceived as something that happens on an individual level. Instead, it is necessary to think of learning as a social activity involving people, the things they use, the words they speak, the cultural context they’re in, and the actions they take (Bransford, et al., 2006; Rogoff, 1998), and, that knowledge is built by members in the activity (Scardamalia & Bereiter, 2006).
4. **is situated in an authentic context** - provides learners with the opportunity to engage with specific ideas and concepts on a need-to-know or want-to-know basis (Greeno, 2006; Kolodner, 2006).
5. **requires learners’ motivation and cognitive engagement** to be sustained when learning complex ideas, because considerable mental effort and persistence are necessary. (*Lawrence Hall of Science/UC Berkeley NSF-WIDER Grant: [Faculty Learning Program](#)*)

Games as Learning Tools

There are a number of studies that support the use of games in the classroom to increase student motivation, engagement and learning (Chao et al., 2016; Pareto et al., 2012; Trujillo et al., 2016). Huizenga, et al. (2017) conducted a study that evaluated the perceptions of 43 secondary teachers who currently use digital games in their teaching practices. The study aimed to answer the question, “What are teachers’ practice-based perceptions of the value of digital-games with respect to students’ engagement with the games, their motivation to learn, and their cognitive learning outcomes?” (Huizenga et al., 2017, p. 107). Results of this study demonstrate that educators who use games feel that games positively impact student engagement and improve cognitive learning. In fact, 38 of the 43 teachers reported that using games in their classrooms supported learning outcomes.

In addition to positively impacting learning, Huizenga et al. (2017) findings suggest that digital games also positively impacted student motivation and engagement. Although some of the teachers “...stated that a minority of their students did not like games or that enthusiasm decreased after the first lessons” (p. 110), 17 teachers reported that the gaming components increased student interest in the subject and that students seemed to connect value to what they were learning. Furthermore, of the 43 teachers in this study, 41 reported that students who were playing or creating a game demonstrated high levels of engagement. These teachers also stated that students were enthusiastic and eager to begin the lessons. These results are consistent with Bruder (2015), who found that K-12 educators who have applied gamification in their teaching saw an increase in engagement and knowledge retention.

There is evidence that the application of gamification in college education has positive impacts on learning and student engagement as well. For example, Poondej and Lerdpornkulrat

(2016) found that the incorporation of gamified learning activities in online and offline lessons resulted in higher engagement in learning for undergraduate students. Afari et al. (2013) conducted a study that “explored the effectiveness of jeopardy-type games in terms of students’ perceptions of the learning environment and attitudes towards mathematics classes in the United Arab Emirates” (p. 138). This study incorporated a computerized game board where points and leveled math problems were presented. Students worked in teams to solve problems and present solutions to the class. Pre and post survey results of this study suggest that the application of gamification to mathematics class positively affects students’ enjoyment in mathematics as well as their academic efficacy. Armier, Shepherd, and Skrabut (2016) conducted a study in which technology integration university students were invited to participate in a digital gamified project. The study took place over two semesters and included nine classes. Five of the nine classes took part in the gamified project while the other four did not. Armier et al. (2016) found that “the game increased student engagement, effort, and task participation. Participants in gaming sections spent more time in groups working on the project. They also completed a wider variety of tasks” (p. 70). The researchers suggest that their results support the use of gamification to promote self-directed learning.

Kapp (2012) also supports the notion that games are effective for learning. In his book, *The Gamification of Learning and Instruction*, Kapp examines several meta-analyses focused on the effectiveness of educational games. In one study, the incorporation of games in mathematics learning had the highest percentage of favorable results when compared to other subjects such as biology, logic, physics, language arts, and social sciences (Kapp, 2012).

Table 4.1 shows synthesized findings from the studies reviewed by Kapp in order to gain insight on the effectiveness of instructional games. The major findings of these studies

support the notion that when designed to meet educational objectives, games are effective for learning. For example, one study demonstrated that the use of interactive simulation and games over traditional methods of teaching resulted in increased learning and improved attitudes towards learning. Another study found that game-based approaches resulted in “significant knowledge-level increases” compared to conventional methods of teaching (p. 78). Finally, a different study found that games increased confidence levels by 20 percent, increased factual knowledge by 11 percent, and increased procedural knowledge by 14 percent. Indeed, by reviewing the data provided through these meta-analyses examinations in conjunction with current literature on the topic, one can see that games positively impact learning and engagement in the classroom.