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The effect of serious gaming on elementary student learning

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The effect of serious gaming on elementary student learning

Abstract

With our ever-changing technological world, schools need to incorporate more engaging learning activities that expose and extend students' learning with technologies. This literature review investigated the effects of serious gaming activities on student achievement. Thirty peer-reviewed journals were selected, analyzed, and evaluated. These studies were conducted about a variety of subject areas in the elementary setting in different areas around the world. Research evidence suggested that serious gaming, whose primary goal is not entertainment but instead to educate the user, can improve student achievement, meet their different learning styles, and enhance student motivation across curricular areas and regions. Recommendations for adopting serious gaming were discussed.

SERIOUS GAMING IN ELEMENTARY EDUCATION

The Effect of Serious Gaming on Elementary Student Learning

A Literature Review

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SERIOUS GAMING IN ELEMENTARY EDUCATION

Abstract

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The Effect of Serious Gaming on Elementary Student Learning

According to Granic, Lobel, & Engels (2013), “Today, in the United States, 91% of children between the ages of 2 and 17 play video games” (p. 66). It is estimated that “by the time an average American turns 21, he or she will have spent 10,000 hours playing computer games” (Owston, Wideman, Ronda, & Brown, 2009, p. 977). Today’s students are being brought up differently than people were even ten years ago. Technology is a main focus in their lives. With the technology that students now have at their fingertips, what can teachers do differently to engage their students? The importance of this topic is that there could be a new way for educators to help their students learn by adopting gaming. Gaming can be one of the possible solutions for engaging students, because “when playing games, learners are emerged in personal learning experiences, which are less accessible in regular educational settings” (Vos, Meijden, & Denessen, 2011, p. 128).

Technology has changed the way people interact with one another as well as how they proceed with everyday life. The use of video games in the classroom may be a method to motivate today’s students. When the type of the game “whose primary goal is not entertainment, but instead to educate the user” (Petkov & Rogers, 2011, p. 9), it is defined as a serious game because having students connecting with their own experiences may increase the rate information becomes ingrained into their memories. “Games have the potential to enhance motivation for learning, because they stimulate curiosity and interest by presenting learning activities in meaningful contexts in which the learner is in control” (Vos et al., pg. 128). Serious gaming allows students to engage actively and reflectively in developing

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problem solving and literacy skills. “Recent research has identified computer-based serious gaming as an enhancer of educational learning, motivation, knowledge retention, and performance on cognitive ability tests” (Dennis, Bhagwatwar, & Minas, 2013, p. 227).

Serious gaming can be used in a variety of educational contexts to benefit students.

Increasing motivation as well as connecting students’ learning to prior experiences has the potential to enhance student learning.

The purpose of this paper is to examine the effects of serious gaming in the elementary classroom setting on engaging students in particular. Serious gaming is used for more than just entertainment, it is created for a primary purpose - to educate the user (Petkov & Rogers, 2011, p. 9). Elementary teachers could use this analysis to support their decision of using or not using gaming in their classroom. The research conducted about serious gaming shows that gaming in the classroom has shown great benefits in motivating students.

These are the questions that are addressed through this literature review:

1. How does gaming affect student learning outcomes?
2. How does gaming affect the mental process of gaining knowledge for the elementary student?
3. When gaming is used in a classroom, how does student motivation change?
4. How can serious gaming address different learning styles?

The significance of this review is to provide teachers with research evidence about the effect of adopting serious gaming in the elementary setting so that more teachers can use serious gaming to enhance student learning.

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Methodology

As mentioned above, the purpose of this literature review was to investigate the effects of serious gaming on elementary student learning. The researcher began with a familiar search engine, EBSCOhost, to search for articles related to this topic. Using the Boolean word AND to separate “gaming” and “elementary schools” helped to find 10 valuable articles.

While searching the University of Northern Iowa Rod Library for other search engines, the researcher came across the Google Scholar. The researcher was successful in finding useful research about gaming in the elementary classroom. The following descriptors were used in the search for these articles: “effects of gaming” and “elementary school”, “effects of gaming in elementary”, “gaming effects in schools”, and “gaming and elementary schools.” After reviewing numerous articles on Google Scholar the researcher then began searching ERIC. The researcher found another 55 articles that related to this topic.

Lastly, the Academic OneFile was used as a research tool. “Effects of gaming in elementary” was the descriptor used to find twelve academic journals. Four of which were relevant to the topic. Two of the articles discussed the effects of gaming in two specific subject areas, math and science.

The researcher chose the articles for the research by looking at different aspects. First was, whether the article aligned with the research questions. Second, were the sources written within the last ten years, and third the methodology of the empirical studies. The fourth is

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whether it is related to elementary education. The last is the number of times each article was cited by other authors.

After 30 peer-reviewed journal articles were selected, a matrix was created to list these articles, including the authors, year of publication, references, participants, a summary of what the study found, and where the article was found.

Analysis and Discussion

In this literature review, thirty empirical studies were analyzed for their validity of how gaming changes students' performance in education. Each study was evaluated to determine age, grade level, location, experimental design, and results of the research. There were four major themes that emerged from the 30 articles: 1) student learning outcomes, 2) cognition, 3) motivation, and 4) meeting different learning styles

Effects of Serious Gaming on Student Learning Outcome

The first theme of the review is about effects of serious gaming on student learning. Ten articles support the idea that serious gaming can be used in multiple subjects to enhance learning. For example, Vos et al. (2011) conducted an experimental study that included 235 fifth and sixth graders (aged 10-12 years old) in the Netherlands. They were studying Dutch proverbs. One group was involved in creating a computer game to practice the proverbs, while the other group was only involved in playing the game. When asked to score their motivation and effort in the survey, the group that was involved in creating the game rated this higher than the group that just played the game. They concluded that "games have the potential to enhance motivation for learning, because they stimulate curiosity and interest by

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presenting learning activities in meaningful context in which the learner is in control” (p.128). However, the limitation of this study was “novelty effect.” The game was fun the first couple times, but there were not different levels of complexity for the students. Additionally, the study was only focused on students’ individual learning outcomes from the survey, there was a lack of an in-depth understanding about each student.

Shih, J., Shih, B., Shih, C., Su, & Chuang (2010) filled the research gap by conducting a comparative case in Taiwan by using observations, interviews, and gaming path analysis about four 11-year-old elementary students’ interactions with the game and analyzed the differences between their cognitive performances. They focused on the influence of collaboration styles to children's cognitive performance in a digital problem-solving game, “William Adventure.” They used the learners' task analysis which included these four elementary learners' gaming paths, behaviors and cognitive activities, individually, and collaboratively. The research results show that different collaboration models between the two teams’ strategies, can greatly influence the performances of its members. They concluded that “game technology improves student performance on algebra and mathematics problem solving, reading comprehension, spelling and decoding of grammar, and complex thinking skills including problem solving, strategic planning and self-regulation” (p. 982). However, this study only involved four students, therefore the research outcome might not be generalized (p. 992). But the significance of the study suggested that the qualitative analysis of children’s cognitive performance in digital problem-solving game has given us much

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understanding to the psychological black box, but also has made contributions to the instructional design strategies as well as the game designs for educational purposes (p. 992).

Shin, LeeAnn, Norris, and Soloway (2012) conducted a quantitative study in Michigan, about a class of the 41 second graders' (7 or 8 years old) and another second grade class of 50 students using game technology learning mathematics. These students were from two classes and used either a technology-based game or a paper-based game for 5 weeks. For the next 13 weeks, both classes used a technology-based game either two times per week, or more than three times per week. During a 4-month period, 50 second graders from three classes played a technology-based game under conditions that varied depending on their teacher's direction. The results from the two classes revealed that using a technology-based game in the classroom was beneficial to students of all ability levels in learning arithmetic skills. The researchers concluded that "computer games are significantly more effective in promoting learning motivation in comparison with paper-and-pencil drills; however, in terms of learning achievement and metacognitive awareness, the difference is not significant" (p. 553). Because the results were drawn from two classrooms with over 90 students in total, it is convincing that computer games enhance student learning.

Filsecker and Hickey (2014) conducted a multilevel analysis of the effects of external rewards on elementary students' motivation, engagement and learning in an educational game. One hundred and six fifth grade participants (56 females and 50 males) worked their way through multiple levels of the game, Quest Atlantis. During this game, the learners took on roles and made decisions that affected the virtual world. The study was conducted over a

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two-week period where the students used the program on a daily basis for 1.2 hours. The research conductors monitored the students' motivation through a rating scale, eighteen item survey (completed both before and after the activity), and by analyzing the log files generated during gameplay. The results showed that external rewards did not harm student motivation and that students in the reward group showed a much higher conceptual understanding. "These results suggest that the predicted negative consequences of external rewards may be addressed in this new generation of learning environments" (p. 136). Even though this study showed serious gaming to be highly motivational and improve conceptual understanding, it is limited in its validity as it focused on just one serious game and it only spanned a two-week time period.

To sum up, serious gaming has the potential of being an essential part in educational motivation and student achievement. This review progresses to examining the areas of student cognition, changes in motivation, and importance of learning styles when gaming.

Cognition

The second theme is about the effects of serious gaming on cognition, "Cognition is the mental process of acquiring knowledge" (Webster Dictionary, 2014). When children begin talking, they start by trying different sounds. When children learn collaboration and strategic thinking, they play games. It is one of the most natural ways of learning (Sung & Hwang, 2012). Children are naturally curious and they explore new things everyday. One way many accomplish this is through playing games.

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Owston, Wideman, Ronda, and Brown (2009) conducted a mixed-methods study about using computer game development as a pedagogical activity to motivate and engage students in curriculum-related literacy activities. Eighteen classes of fourth grade students were assigned to either an experimental or control group. Both groups studied the same curriculum unit over a 10-week period, however, in addition the experimental group developed computer games related to the unit using a game development shell. Field notes and teacher interview data indicated that game development helped improve student content retention, ability to compare and contrast information presented, utilize more and different kinds of research materials including digital resources, editing skills, and develop an insight into questioning skills. They also found, “more than eight in ten (83%) young people have a video game console at home, and a majority (56%) have two or more” (p. 980). They stated that computer gaming is more popular for young people than watching television. Therefore, implementing gaming into the educational field would be beneficial to this generation. Since the researchers used a large group of students over a lengthy ten-week period, the results are quite plausible. Collaborative educational computer games enable students to learn to work together, as well as motivating them through the use of Digital Game-Based Learning. Sung and Hwang (2012) conducted a more vigorous research that involved 93 sixth graders (age 11-12 year olds) in southern Taiwan. They divided the students into three groups of 31. There was an experimental group, control group A, and control group B. The experimental group worked in groups of three or four students as a team to complete the learning task embedded in a computer game, as well as completing a repertory grid for organizing the

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learning content. Group A also worked with three to four students in a group, all participating in the computer game without using the repertory grid. Group B worked individually on the game with the repertory grid. The results showed that the experimental group did much better than either of the control groups. This shows that collaborative computer games enhance learning. However, the authors discussed the fact that it was time consuming to make the collaborative educational computer games.

Annetta, Mangrum, Holmes, Collazo, and Cheng (2009) conducted a quantitative study to examine 74 students' learning of simple machines and student engagement using a teacher-created Multiplayer Educational Gaming Application. This study used a fifth-grade (ages 10–11) forces and motion unit. The researchers collected pre-test/post-test results to determine student knowledge about simple machines. The pre-test and post-test design involved 74 students, 31 males and 43 females, who played the Dr. Friction Multiplayer Educational Gaming Application for several days in the middle of the unit. The results showed no significance between the gender factor, even though the females averaged using the computer more than their male counterparts and males played video games more than females. They also noted high student engagement and that video game technology can scaffold learning of simple machines. They suggested teachers need to meet the needs of all students and those needs have greatly changed. Having students sit and listen to a teacher lecture, compared to having students utilize some form of serious gaming is completely different. Current students have been using technology and gaming most of their young lives. Therefore, when sitting and just listening to a lecture they quickly become bored or

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antsy. Whereas, being actively involved in a serious game provides a much different learning style than a lecture. When incorporating serious gaming, classrooms would look much different from what they once did. Instead of the teacher instructing in the front of the classroom, he/she would now be considered a facilitator in a room that is set to be sociable. Researchers have found that having students collaborate with one another provides a much better learning environment. “Research literature supports the notion that game technology promotes student learning of important ideas and skills, positive motivation, persistence, curiosity, attention and attitude toward learning” (Shin et al., p. 543). In addition, “games can give children practice with hand–eye coordination, facilitate social interaction through multiplayer chat and voice-over internet protocol, and develop skills including pattern and rule generation, hypothesis testing, and generalization” according to Annetta et al. (p. 1107). Some of the skills listed by Annetta et al. are lifelong skills that students will use over and over. Just because they are taught through a game instead of through teacher instruction doesn’t make the learning any less valuable.

Collaborative educational computer games enable students to learn to work together, as well as motivating them through the use of Digital Game-Based Learning. There are also computer applications, such as Mindtools (Sung & Hwang, 2012), that have students thinking critically about organizing the content they are learning. One of the 21st century skills that the Iowa Core requires students to be able to do is think critically and creatively. Serious gaming is a great way to enhance this ability in students. One study supports this by saying, “games can help children make correct choices when they encounter life decisions

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and also train their problem-solving abilities” (Shih et al., p. 984). A good example of learning a life skill is dealing with money. When teaching students about money skills, budgeting, saving, and so on, there are serious games out there that simulate real life experiences to teach students about managing money. “Some educational theorists predict that lectures may someday be replaced by games and game technology will replace classrooms, lectures, tests, and note-taking with fun, interactive learning environments” (Annetta et al., p. 1110).

“Gaming has been known to take an important role in human activities, and is the most natural way for humans to build knowledge and skills” (Shih et al., p. 988). If this is the most natural way of learning, doesn’t it make sense to incorporate it into our curriculum? In 2007, Pinder administered a study on the effects of instructional games to improve learning, as she stated: “Relatively few studies had been conducted that examine the effects of using instructional games in the elementary classroom” (Pinder, 2007, p. 436). Ten Atlanta first-grade students were pretested on their knowledge of living versus non-living things. The students then used game board activities in the teaching lessons. When the students were given a post-test to test their knowledge, the researcher saw significant increase in the post-test scores. The researcher concluded that using instructional games influenced students’ academic performance, even when the teacher just used board games to practice the skills. Having said that, this study was very limited. Only ten students participated in the study and it only looked at pre-test to post-test scores. Since then, there have been many studies that have been conducted on gaming in classrooms, although it is

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still considered to be in its infancy. There is more research being conducted that links student achievement to gaming, as well. For example, Young et al., 2012) reviewed more than 300 video gaming studies and found varying degrees of impact based on the academic subject (e.g., more for language and less for math). They organized the studies into five categories based on K–12 subject matter: mathematics, language arts, science, social studies or history, and physical education. The next criteria was that the results had to reference one of the specified subject areas (mathematics, science, language learning, history, or physical education) and video games. Only about 10% of the 363 articles met their final criteria and were used (3 in history, 8 in math, 7 in physical education, 11 in science, and 10 in language learning). Therefore, limitations were definitely a factor in this study and the results may not be reliable.

Educational gaming does not automatically ensure substantial achievement or high motivational results. “Rather, educational games need to be designed and researched with careful attention to contemporary learning theories, including customization of task difficulty to the learner’s capabilities, metacognitive reflection on the learning taking place, and consideration of the rich situated interaction among learner, game environment, and classroom environment” (Young et al. p. 68). Teachers are required by the Iowa Core to teach to grade-level mandated standards. Since this is such a large part of Iowa education, it would be important for teachers to make sure that the serious games they use/create are relevant to the standards they need to be covering. “Therefore, it has become an important and challenging issue to develop educational computer games by taking effective learning

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strategies or educational theories into account” (Hwang, Sung, Hung, Huang, & Tsai, 2012, p. 631).

Students benefit more from taking part in the development of programs, as they work collaboratively with others. Baytak and Land (2011) conducted a qualitative study focusing on how fifth-grade girls respond to programming via a computer-game design approach. Even though six fifth-grade girls (and four boys), age 10-11 years, participated in the study, the focus was centered on the girls’ results as they are less experienced with programming. The children were asked to design educational games for younger students (second graders, age 7-8 years) to learn about environmental science. Thus, the girls were placed into roles of authentic game designers, creating software for a specified audience and purpose. Only one girl had any experience designing games or animations with the Scratch program, which is what they used for this project. The project took place over 18 class sessions: 10 sessions for game design and 8 sessions for testing and interviews. All of the participants were able to create playable games and incorporate gaming characteristics. The researchers concluded “Designing games that reflected ownership of ideas, sharing those with others, and playing others’ games served to create a culture that supported conversations and practices around computing and gaming” (p. 251). When elementary students are engaged in programming the game, they are able to develop 21st Century skills.

Kafai and Burke (2015) conducted a study about the divide between gaming for the sake of gaming and gaming for the sake of schooling. They focused more on effectively breaking down as children employ academic content knowledge skills such as computer

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science, mathematics, or arts. They found that when elementary students were involved in creating viable games that are intended first and foremost for their peers rather than their teachers, their motivation was higher (p. 318). As students progress through school, they could learn more and more about serious gaming and programming, starting with playing, to coding, to creating their own games.

“Researchers have also pointed out that games are an important part of the development of children’s cognition and social processes. Children are able to establish abstract thinking and further develop higher-level cognitive functions through interaction with others in educational computer games” (Hwang et al., p. 627). “Games are not just played, they are talked about, read about, ‘cheated’, fantasized about, altered and become models for every day life and for the formation of subjectivity and intersubjectivity” (Annetta et al. p. 1112). Games are much more than entertainment like they once were. They are becoming a way of educating us throughout life!

Gaming on the Internet with open-ended problems has already influenced children for a generation. These children and adolescents are known as “digital natives”. “Instead of learning through explicit linear instruction (e.g., by reading a manual first), many children and youth problem-solve through trial and error, recursively collecting evidence which they test through experimentation” (Granic, Lobel, & Engels, 2013, p. 67). Digital natives are people who are brought up during the digital age, and are familiar with computers and Internet from a young age. These natives are so much more willing to jump right into trying something new. They don’t mind if they fail, because they will just try again. Older

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generations tend to be more wary about new things. Since our students are quick to engage in new phenomena, we need to provide innovative methods, because traditional methods are not working with this generation.

“Today’s world and today’s students are vastly different than the way they were a few decades ago. The world is changing to accommodate the new way of life but K-12 educational systems have been very resistive to change and still use traditional instructional methods in the classroom” (Petkov & Rogers, 2011, p.8). Students become bored when taught in the same way, lecture and text reading, that have been around for decades. Students of the Net Generation need to be taught in a different way to motivate them to learn.

Motivation

Motivation is the general desire or willingness of someone to do something (Webster Dictionary, 2014). “Cognitive theorists have suggested that rewards are detrimental for individuals’ intrinsic motivation and subsequent engagement by undermining their perception of competence and autonomy and/or by deviating the perceived source of motivation to external causes” (Filsecker & Hickey, 2014, p. 140). Another study stated that children develop a theory of intelligence according to the praise they receive. If they’re praised for their traits rather than their efforts, they believe intelligence is fixed and cannot be improved. Whereas, if they’re praised for their effort, they believe intelligence can be improved through effort and time. “We propose that video games are an ideal training ground for acquiring an incremental theory of intelligence because they provide players concrete, immediate feedback regarding specific efforts players have made” (Granic, Lobel,

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& Engels, 2013, p. 70). Specific feedback is more meaningful to students than general positive feedback. With specific feedback the student knows exactly what they did in order to receive that feedback. Serious gaming provides that immediate feedback throughout the game.

“In comparison with traditional teaching, educational computer games are able to provide a more interesting learning environment for acquiring knowledge” (Hwang et al., p. 632). Traditional teaching methods are not motivating our digital natives today. Serious games should be used in conjunction with good teaching practices to engage and motivate today’s students. “For a serious game to be appealing, the fun and engagement needs to be in the forefront with the education aspect well integrated with the gameplay and narrative” (Petkov & Rogers, 2011, p. 9). Keeping this balance will enhance the learning of the topic, while motivating the students to participate. This leads me to believe that there will continue to be a need for teachers. They just need to modify how they teach. Petkov and Rogers (2011) also believe, “that serious games need to be integrated with the existing curriculum, instead of being just an addition” (p. 12). Integrating serious gaming helps students ingrain their existing knowledge about the curriculum even deeper and allows them to explore it even further. “Games create opportunities for situated learning by providing immersive and motivating contexts for players to engage in a wide variety of activities and to develop and practice the skills necessary to be successful in those activities” (Owston et al., p. 980).

When looking to add serious games into their math curriculum for example, teachers choose the “design and development of a computer game that could be utilized as an

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adaptable tool for the educational process. The purpose of the particular game would be to support the teaching of elementary and middle school mathematics, as a complementary learning tool that could enhance students' motivation and engagement with the subject" (Katmada, Mavridis, & Tsiatsos, 2014, p. 237). The research that Katmada et al. conducted included 153 third through fifth graders (aged 8-11 years old) from Greece. They were studying math concepts. Teachers were able to input concepts for students to practice and master. The game consists of nine challenges that the educator can fill up with questions, according to the course content. The players have one hundred seconds for each question and five lives. They lose a life for each mistake. Students stated the game helped them understand difficult concepts, it was entertaining, is a more innovative approach to the learning process, and is a useful tool in the revision of the lesson taught. The researchers found "computer games can increase students' math achievement and promote positive attitudes towards mathematics" (p. 233). Once the games align with the curriculum, the hard part is over. Students can utilize the games to enhance their learning. The storyline in the game however created some limitation because it was geared toward younger kids and was limited on challenges.

Can serious gaming be used in for a specific content area, such as physical education?

Hansen and Sanders (2008) did a study involving six fifth grade students' experiences participating in active gaming during physical education classes for eight weeks. Qualitative data of interviews, journal entries, and observational field notes were collected and analyzed. Their findings suggest that, "active gaming can be used in 21st century physical education

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classes to increase children's physical activity levels" (p. 34). These findings were supported by the work of Vernadakis, Papastergiou, Zetou, and Antoniou (2015), who studied the effects of exergaming on sixty-six elementary students (36 males and 30 females) from southern Greece. The students were randomly divided into three groups of 22 children each. They used one as a control group and the other two were experimental groups. The control group did not receive any structured object control (OC) skills training program, while the two experimental groups utilized an X-Box game twice a week for 8 weeks, 30 minutes per session. They discovered that "exergames are appealing to children and could be effective in helping them improve their motor skill acquisition and develop motivation for physical activity" (p. 93). These games support students by providing positive feedback from emotional enjoyment and successful achievement. This may encourage children to try new experiences. I think that exergames would be a fun interactive way for students to be able to enjoy physical education.

Shewmake, Merrie, and Calleja (2015) conducted a study that looked at using Xbox Kinect gaming systems as a supplemental tool within a physical education setting as well. The purpose of this study was to examine third and fourth grade students' perceived enjoyment and exertion levels using exergaming in relation to traditional physical education. The participants included 148 third and fourth grade elementary students, 71 third graders (34 female, 37 male) and 77 fourth graders (36 female, 41 male). Each student completed two surveys (10 items each): one after a traditional Physical Education lesson and one after participating in a lesson taught in an exergaming lab. In the exergaming lab, students

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competed in track and field activities of the Kinect Sports video game. In the traditional gym setting, students participated in obstacle course relays consisting of running, jumping, and hurdling activities. The results indicated that students enjoyed the exergame significantly more than the traditional gym activity. However, the students felt they worked harder in the gym. With these results, the regular physical education class provided a better physical workout. However, you need to consider whether the students are more willing to engage with the exergaming, as they may participate in this activity more frequently. This study was limited since they only surveyed each position once. The results may be dependent on the activity that is offered. With children and adolescents growing up in this technology advanced world, many of them don't play outside or get the exercise that people once did. In fact, "children are becoming unhealthier throughout each generation. Over the last three decades, the obesity rate has nearly tripled, rising to over 9 million obese children and adolescents" (Shewmake, et al., p. 143). With exergames, video game developers are trying to help with this growing epidemic of non-activity by creating serious games with movement. I find this to be an excellent addition to gaming and plan to incorporate some of it into my classroom as brain breaks.

Gaming based learning can also be beneficial for young learners. "Games can contribute to the educational realm since it can intrigue learners' motivation and promote active participation to learners. The competitiveness and risk-taking fun of digital games can increase students' motivation and are useful tools to increase problem-solving ability" (Shih et al., p. 991). Kartal & Terziyan (2015) conducted a study of game-like phonological

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awareness software for kindergarten students. The 20 participants of the study came from two kindergarten classrooms in a public elementary school in Istanbul. These students were from socioeconomically disadvantaged families. They were divided into two equal groups. The experimental group used the software three times a week for nine weeks, while the control group played unrelated math games. The children in the experimental group scored significantly higher on the post-test in phoneme segmentation, letter-name, and letter-sound knowledge than those in the control group. The experimental group also showed significant gains for six other subskills when their pre- and post-test scores were compared. The researchers agree that not only did the program help them score higher, but “interactional features, individualized pace, immediate feedback, and user control can have positive effects also on motivation” (p. 522). Students don’t all learn at the same pace, which sometimes can cause students to become discouraged or feel bad about themselves. Having the serious gaming implemented so that students can work at their own pace could help with self-esteem issues.

However, in the case study Ke (2008) completed on computer gaming for math use, he discovered “there was no significant effect of computer gaming on students’ cognitive test performance or metacognitive awareness development” (p. 1609). Ke studied educational computer games in a summer math program in rural Pennsylvania to facilitate 4th and 5th graders’ cognitive math achievement, metacognitive awareness, and positive attitudes toward math learning. Fifteen students participated in 10 two-hour sessions. ASTRA EAGLE is the program they utilized and it works on a variety of math skills. Ke concluded that attitudes

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improved throughout the five weeks, but didn't improve their scores significantly. He also discovered through think-aloud protocol that not all computer math drill games engage children in committed learning. Quite a few current researchers shy away from drill and practice games and have claimed them as not equally effective in improving learning and skills in comparison to other game genres." (p. 1613

Petkov & Rogers, (2011) said, "educational methods that have worked on past generations of students are not as effective for today's technology-dependent generation. Students need to be motivated for the students to want to learn in school." (p. 8)? Teaching the students in a way that relates to their fast paced life would be one way to relate with this generation of digital natives. Chen and Tsai (2012) found that, "many researchers and scholars believe that integrating teaching and augmented reality enhances student learning performance and motivation" (p. 643). Chen and Tsai conducted a study on implementing an interactive augmented reality system for teaching library instruction in elementary schools. The participants in their study consisted of 116 third graders (61 males and 55 females) in Taipei, Taiwan. Seventy-one students were assigned to the experimental group and the remaining 45 students comprised the control group. The experimental group participated in a two-hour library instruction activity using the augmented reality system, while the control group received librarian instruction for the two-hour period. Both groups were taught the same content, just via different methods. Their results showed that both learning modes generated equivalent learning performance, regardless of gender difference. However, the learning satisfaction of the experimental group learners was higher than that of the control

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group learners. Therefore, analytical results indicate that using the augmented reality for library instruction can enhance learner motivation.

But, there are additional things to consider according to Ke (2008): first, playing games does not appeal to every student. Second, game playing may distract students' attention from the learning goals and they may not extract the intended knowledge. Finally, if game designers focus on learning objectives, will they sacrifice the gaming aspect along the way? I agree with the author that game play may work for some kids and not for others, just as all auditory or all visual learning does not work for everyone. Iten and Petko (2016) stated that few studies have examined how learning motivation and learning gains are related. Therefore, they conducted a study looking at whether having fun playing a game is a predictor of learning success? The study took place in Switzerland utilizing 74 children, (41 girls and 33 boys) ranging from 10 to 13 years of age from five primary schools. The participants played the learning game 'AWWARE' (which was developed for this study) for 30 minutes. The researchers found "the students' expectation was that the learning game would be easy and instructive. The level of actual enjoyment of the game had a smaller influence than expected" (p. 151). In other words, students' are influenced by the expectations of usefulness and the ease of use rather than enjoyment. "The results lead to the conclusion that other factors, such as explicit learning tasks, instruction and support inherent in the game or supplemented by teachers, may be more decisive than the experience of fun during the game" (p.151). If our education system is turning towards an individual educational paced plan for students to learn at their own pace and in a way that is best for

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them, then gaming may work for some and not for others. As teachers, we need to help children find their best way of learning and allow them to excel at their own pace.

Katmada, Mavridis, & Tsiatsos (2014) showed that, “effective use of computer games for educational purposes has been reported in various subject areas, such as geography, computer science, health education, mathematics, and sciences” (p. 232). Their research included 153 third through fifth graders (aged 8-11 years old) from Greece. They focused on math concepts and developed a program that teachers were able to input concepts for students to practice and master. The game consists of nine challenges that the educator can fill with questions, according to the course content they are teaching. The players have one hundred seconds for each question and five lives. They lose a life for each mistake. They concluded that students found the game entertaining as well as an innovative approach to the learning process, which helped them understand the difficult concepts taught in the lesson. Therefore, this shows gaming helps students achieve higher scores and positive attitudes towards learning. In addition, research in cognitive psychology suggests it may improve test-taking performance. “Such serious games can not only improve the motivation levels of students for taking a test, but can also improve their overall cognition, which results in better test performance” (Dennis et al., p. 226). Therefore, serious gaming has the potential to be used throughout content areas in schools.

The gaming aspect of a program is vital as one study reported. Tüzün, Yılmaz-Soylu, Karakus, Inal, & Kizilkaya (2009) designed a three-dimensional educational game for elementary students focused on geography. The participants in their study were from Turkey

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and included 24 children (12 males and 12 females) in the fourth and fifth grades. The game concentrated on world continents and countries and the students played it for an hour once a week for three weeks. The effects of the game environment on students' achievement and motivation were examined through both quantitative and qualitative methods. Only 13 students attended all three sessions, therefore the results were based on their performance. The pre and post achievement tests analysis showed that students made significant learning gains in the game-based learning environment. "When comparing the motivation of students who learned in the game-based learning environment to those who learned in a traditional school environment, the researchers found that students demonstrated statistically significant higher levels of intrinsic motivation in the game-based environment" (p. 70). Results also showed that, "poor performing students benefited the most from the game environment while the performance of good performing students did not deteriorate. It was concluded that computer games could promote motivation, especially for at-risk students or for students with motivational problem" (Tuzun et al., p. 70). "When faced with failure, players are highly motivated to return to the task of winning, and they are "relentlessly optimistic" about reaching their goals" (Granic et al., p. 75). As humans, we are competitive, even if it's just against ourselves. Gaming allows us the opportunity to lose and jump right back in and try again. When teaching in the traditional way, students get discouraged and don't have the same attitude of wanting to try again. With gaming, there is a certain determination that people get internally that makes them want to defeat/conquer it. "More specifically, computer games promote active learning and the development of various skills, while they

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retain their entertainment and appealing qualities” (Katmada et al., p. 231).

Learning Styles

Learning style is an individual’s unique approach to learning based on strengths, weaknesses, and preferences (Webster Dictionary, 2014). Researchers have studied learning styles and various issues related to them to better understand the model of learning and the learning dispositions or preferences of students. “Educators have indicated that teachers and course designers need to pay attention to students’ learning styles and design teaching and learning interventions accordingly” (Hwang et al., p. 625). Today’s classrooms do not look the same as they once did. Teachers are rarely standing in front of a class lecturing to all the students. The reason is because studies have found that students do better in small groups with peers of like abilities. This allows those that are ready to move on to do so. “As one way to address individualized materials, educators have integrated technology in games that enable students to manage the acquisition of new information based on their prior knowledge and experience, learning progress, learning style, preferences and needs” (Hwang et al., p. 637). The increase in motivation created by games and their ability to encourage cooperation help develop independent, yet social individuals. “Humans are competitive beings by nature, and competition is what motivates people to learn and excel. This is part of the reason why play has been such a successful learning mechanism” (Annetta et al., p. 1095). I agree with this statement as you can see children’s competitive nature in many of the things they do.

Kebritchi, Hirumi, & Bai, (2010) “examined the effects of a computer game on students' mathematics achievement and motivation, and the role of prior mathematics

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knowledge, computer skill, and English language skill on their achievement and motivation as they played the game” (427). The participants included 193 students and 10 teachers. The teachers and their classes were randomly assigned to experimental and control groups. The experimental groups utilized online teaching modules and games over an 18-week semester. They dedicated 30 minutes of class time for the gaming aspect each week. After examining all the data, the researchers concluded, “Instructional games create a new learning culture that better corresponds with students' habits and interests, and more importantly, instructional games are thought to be effective tools for teaching difficult and complex procedures because they (a) use action instead of explanation, (b) create personal motivation and satisfaction, (c) accommodate multiple learning styles and skills, (d) reinforce mastery skills, and (e) provide interactive and decision making context” (Kebritchi, Hirumi, & Bai, 2010, p. 429). All of these components are key in helping students be successful.

“The children entering today's elementary schools, are more conversant with technology than any previous generation.” (Shewmake et al., p. 143). Hence, why today's students are referred to as the iGeneration or digital natives. Educators are beginning to integrate technology in their classrooms by utilizing games that enable acquisition of new information based on their prior knowledge, learning styles, preferences and needs.

“Research has shown that game features including clear goal/rules, learner control, challenging tasks/feedback and repetition enable educators to create individualized learning environments wherein students are able to take more active control of their learning and improve their achievement vis-à-vis desired learning goals.” (Shin et al., p. 551). According

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to Piehler (2014), “32 percent of elementary school teachers reported using games in their classrooms. The top two reasons they gave for choosing game-based pedagogy were increasing student engagement and addressing different learning styles” (p. 2). Both of these are things that teachers are trying to focus on and improve in schools. Shih et al. (2014) pointed out that, “learners can set up their personal goal, vigorously collect information as well as monitor and evaluate possible means in the process so that their self-learning and problem-solving abilities can be increased” (p. 984).

A research study conducted by Kiger, Herro, and Prunty (2012), looked at the use of flashcards versus gaming math apps. They split 87 Pennsylvania third grade students (ages 8-9 years old) into two groups. One group had 41 students and they practiced multiplication facts ten minutes each day over a ten-week period on an iPod. The other group had 46 students and they spent ten minutes a day practicing flashcards, for the same ten-week period. The results showed the group that practiced on the iPods scored significantly higher on the post-test. Kiger et al. suggest, “mobile gaming creates an individualized learning environment that allows students to select their own learning paths based on their prior knowledge and learning progress” (p. 69). This allows students to be successful with their learning at their own rate. Teachers often focus on the students that need extra help, rather than pushing those that are at the upper end of the class. This individualized learning environment would provide that opportunity for these students.

According to Kartal & Terziyan (2015), “The software resulting from the study would provide children in overcrowded classrooms with an opportunity to work one-on-one

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and receive immediate feedback, albeit on a computer” (p. 521). Working collaboratively with other students is also beneficial as stated in this study. “In collaboration, each individual can have better learning effectiveness. Different collaboration models, strategies, as well as atmospheres can greatly influence the performances of its members” (Shih et al., p. 983). At a Zambian school, (Jere-Folotiya et al., 2014), a study was conducted that compared data of using a phonics program, called *GraphoGame* and a control group that was taught in the traditional method. Participants included 573 kindergarten through third grade students (ages 5-9 years old). However, due to attrition, only 312 students were post-tested. A second group of students utilized the computer game for practice and a third group included the teachers utilizing the computer game and focusing their instruction as it was presented in the game. The third group showed the most significant gain. They concluded the effect of playing the game was greatest when teachers were introduced to the same information and procedure as the students.

Conclusions and Recommendations

After reviewing these research articles and considering the benefits gaming has on student achievement, learning styles, and motivation, I see that it could be beneficial for teachers to incorporate gaming activities into their curriculum. Children are exposed to interactive games at a young age. They are used to things that change and move at a fast pace. Games are no longer played just for the fun of playing, but can also be used as learning tools. There are many games that have been created that are specifically geared towards different academic skills. Children sometimes struggle being able to pay attention in schools

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that still teach in a traditional classroom format. Consequently, students need to be actively involved in their learning and gaming provides this opportunity.

“With a nearly ubiquitous Internet beaming all the world's knowledge to an expanding universe of mobile devices, the ability to learn and retain information is becoming a smaller and smaller piece of the educational pie” (Piehler, 2014, p. 1). It seems senseless to spend time memorizing information that you can quickly find on your phone, tablet, or computer. Students need to learn problem solving skills and creative and critical thinking skills rather than rote facts that can be quickly found on any computer or mobile device. Technology is an integral part of our society and students need to be exposed to it throughout their lives to ensure success in their future. Overall, the research articles showed higher student achievement and improved motivation when using gaming in the classroom.

How does gaming affect student achievement in education? Research shows the utilization of gaming in the classroom can significantly increase student mastery of skills (Annetta et al., 2009, Chen & Tsai, 2012, Dennis et al., 2013, Hwang et al., 2012, Jere-Folotiya et al. 2014, Kartal & Terziyan, 2015, Katmada et al., 2014, Kebritchi et al., 2010, Kiger et al., 2012, Pinder, 2007, Shih et al., 2010, Shin et al., 2012, Sung & Hwang, 2012, Vos et al., 2011). In the research I reviewed, it examined how implementing a gaming activity effects student achievement. The results showed increased student achievement scores in many of the studies conducted. Therefore, I believe student performance does increase when using any type of games to reinforce or teach the material. I wondered whether the reason at-risk students benefited most from the computer games is because the

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computer games were able to teach it in a way their teachers hadn't or if it allowed them the extra practice time they need.

How does gaming affect student's motivation? In most of the studies, the authors found that student's motivation was higher when using serious gaming in the classroom (Annetta et al., 2009, Chen & Tsai, 2012, Filsecker & Hickey, 2014, Granic et al., 2013, Hansen & Sanders, 2008, Hwang et al., 2012, Katmada et al., 2014, Ke, 2008, Kebritchi et al., 2010, Owston et al., 2009, Petkov & Rogers, 2011, Piehler, 2014, Shewmake et al., 2015, Tuzun et al., 2009, Vos et al., 2011). Learners' motivation and achievement were improved by the use of instructional games according to the majority of the research studies.

"Motivation, a dependent variable, was considered as both heart and outcome of the cycle because on one hand, motivation inspired the game learning activity and on the other hand, it got affected by both the game activity and the three independent variables of English language skill, prior mathematics knowledge, and computer skill" (Kebritchi et al, 2010).

However, Kebritchi et al. (2010) question the validity of the studies and whether they truly prove that motivation is not influenced by other factors. This question might be worthwhile to continuing researching by excluding other variables. Hwang et al., (2012) found that there was a difference in the positive attitude toward gaming depending on gender. Their results showed that male students tend to have a more positive attitude towards gaming than female. Other studies that were reviewed also found that motivation depends on gender, the task, socialization, and the amount of hours spent playing (Annetta et al., 2009, Chen & Tsai, 2012, Granic et al., 2013, Ke, 2008, Kebritchi et al., 2010, Owston et al., 2009, Shewmake et

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al., 2015, Tuzun et al., 2009)

How are students' learning styles enhanced by gaming in the classroom? The games are not only meant to target the curriculum that teachers are teaching, but also aim to interest students in a variety of learning styles. Teachers need to move away from the traditional teaching methods that have been used for generations to meet the needs of the students they work with today. Society and technology have changed tremendously and teachers need to adjust their teaching to meet the learning styles of their students. Current and future generations need a different approach to learning. Granic et al., stated that "91% of children between the ages of 2 and 17 play video games" (p. 66). Children are introduced to gaming applications well before they enter the school setting, so it is crucial for teachers to promote learning in a way that is natural for them. As a teacher, it is hard to give all students one-on-one attention and feedback daily. Serious gaming would allow students to receive that immediate feedback, even though it is not coming directly from me.

When comparing research studies that have been done on this topic, a study showed that the students that worked on their facts with the iPods scored considerably higher than those using paper flashcards (Kiger et al. 2012). Even when a teacher utilized board games to practice skills, students' academic performance improved (Pinder, 2007). This shows that gaming enhances student learning. However, gaming alone isn't enough to educate students, though. Teachers still need to provide information, guidance, and feedback to assist students in their gaming activity (Pinder, 2007). I believe teachers need to know the gaming programs, not only so they can assist students, but also so they know what the capabilities of

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the program are and what skills the students will be learning. This allows them to teach the skills in a way that students can transfer into the game. Gaming is meant to strengthen the student's learning of the skills that are being taught by the teacher, not replace it.

Student performance is enhanced when students are actively involved in their learning. Allowing them to work together on projects or games provides an opportunity for the students to learn from one another, which strengthens their knowledge of the skill. According to De Grove, Looy, Neys, and Jansz (2012), "if group learning is to be efficient, collaborative learning environments should not prevent or inhibit social interaction between students. Therefore, the teacher serves as a facilitator and the design of the learning environment should be as sociable as possible" (p. 88). It also increases their motivation and effort (Vos et al., 2011). Students can be wonderful teachers as they present the information in a way other students can understand. Gaming can provide competition as well as collaboration. Some students perform better in a small group, while others prefer to work alone or in a competitive nature. Gaming also provides immediate feedback, which is important in the learning process. Another important factor is teacher involvement. It is beneficial for the teacher to present material in a similar way to the games being used (Jere-Folotiya et al., 2014). Allowing students to choose an activity that best suits their learning style will strengthen their participation and motivation.

Games stimulate curiosity and interest, while presenting information to students in a meaningful way (Vos et al.). The games help them understand difficult concepts in an entertaining and innovative way (Katmada et al.). The students are in control of their

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learning and can progress at their own rate. This allows independence and creativity for each student. Gaming helps students achieve higher scores and positive attitudes towards learning (Katmada et al.).

Recommendations

Should schools consider using serious gaming to get students ready for Iowa Assessments, ACT's, and more? Standardized testing is difficult for many people, so some schools teach to the test to help their students do well on the test. Would implementing serious gaming into the curriculum help our students score better on these state required tests? As they learn and develop problem solving techniques and critical thinking skills, their scores may show improvement.

The first recommendation is about the adaptation of game-based learning across subject areas and grade levels. Young students are very capable of using digital technology, so schools need to be implementing this type of learning into the classrooms. Utilizing the apps on an iPad can actively engage students while enhancing their learning and promoting higher order thinking skills. Since the students we are currently teaching are from the iGeneration, they will benefit from this type of learning in the classroom. "It has been claimed in the last 30 years that the engaging nature of games may facilitate involvement, motivation and interest, and the retention of learned skills" (Filsecker & Hickey, 2014. p. 138). Therefore, serious gaming should be implemented into classrooms in multiple subject areas, as well as all grade levels.

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The second recommendation is about the future direction of research. This literature review has shown that gaming does enhance student achievement. Further research could be conducted to discover if digital gaming is more effective than other types of games. Most studies investigate the effect of game-based learning for a short period of time for a single subject by adopting either qualitative or quantitative approaches. It is important to adopt mixed methods to conduct the longitudinal studies about the long-term effects of the gaming-based learning. Much of the research that has been done on gaming in the classroom thus far has been done in other countries. More research needs to be done in the United States, since our curriculum and ways of teaching aren't always the same as other parts of the world.). It is important that more studies are completed to determine the true effectiveness of drill and practice games, as I believe this practice has to help students acquire the skills.

The third recommendation is about administration. Many teachers are not as comfortable with this type of learning, as they were not exposed to it throughout their life. Therefore, school districts need to provide training and time for teachers to explore the possibilities and create lessons to implement gaming, in their classrooms. Since a lot of this technology is new for many teachers, administrators need to arrange for experts to come in and work with grade levels on how to implement different programs into their existing curriculum to enhance what they are already teaching. Working at each grade level will benefit teachers more as it will be specific to their needs.

With these findings, I plan to do action research with my own students to see if what I found in this literature review is similar to what my second grade students' show. This

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review has given me insight on things that other researchers have found to make an educational difference for students.

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