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THE IMPACT OF GAMIFICATION ON THE MATHEMATICS ACHIEVEMENT OF ELEMENTARY STUDENTS

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THE IMPACT OF GAMIFICATION ON THE MATHEMATICS ACHIEVEMENT OF ELEMENTARY STUDENTS

by

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ABSTRACT

THE IMPACT OF GAMIFICATION ON THE MATHEMATICS ACHIEVEMENT OF ELEMENTARY STUDENTS

By

TaMisha Kimble

This study explores the use of gamification in elementary math. Living in a Global society requires students to use technology in classes daily. Students are using technology to complete a task that is aligned to state standards. These tasks are geared to help students master grade-level skills. So often, teachers are finding that students are completing the task just to comply. Teachers are seeking problems that will help with student engagement and prepare students for mastery of grade-level skills. Teachers are looking for a problem that serves the purpose of both. Teachers are looking for programs that engage students as well as help with mastering grade-level skills.

The purpose of this study is to analyze how the use of gamification (computer-based games) could improve student achievement in math. Teachers are searching for computer applications/programs to help with mastery of skills. They are looking for different programs that will aid in the integration of technology but can also provide meaningful data to support student achievement with grade-level skills.

Gamification is still new, and different components of education are being tested as far as to validate the effectiveness of all features. There is much research over whether engagement levels increase through the use of gamified learning. What this research seeks to find is whether the use of gamified learning will help students master grade-level content skills. Despite this growing interest, there is a lack of conclusive empirical evidence on the effectiveness of DGBL due to different outcome measures for assessing effectiveness, varying methods of data collection, and inconclusive interpretation of results. This has resulted in a need for an overarching methodology for evaluating the efficacy of DGBL (All, Castellar & Looy, 2014).

This study is a quasi-experimental study that used a control group and a treatment group that was non-randomized with the use of pretest and posttest design. Quasi-experiments aim to evaluate interventions but do not use the randomization of participants included in the study (Harris, 2006). Quasi-experimental research design was used for several reasons. The research had a small number of students, and test scores were taken before and after the use of the gamification. Analysis of Covariance was used to determine if students receiving gamification in Math instruction could score higher than students not receiving gamification. Student Math IOWA post-test scores in ten categories were used as dependent variables for comparison. Student Math IOWA pre-test scores, student RTI, gender and race were used as covariates to control the possible impact these variables might have on the student post-test scores.

The finding of the Research Question 1 indicated that out of the ten skills tested there were five skills (with two indicating significant difference) from the Math IOWA showing that the students using gamifications scored higher than the students not using gamification. There is no overwhelming evidence in this study to indicate that students using gamification outscored students not using gamification. Research Question 2 asks "Do students using gamification in class master more grade level skills on IOWA than students not using gamification programs?" The findings for this research question showed no proof that students using gamification mastered more grade level skills than students not using gamification. The findings of this study showed that fourth grade students using gamification were only able to master two of the ten skills at grade level. The evidence does not support the claim that students master more grade level Math skills with the use of gamification.

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CHAPTER 1: INTRODUCTION

Gamification is a new trend of instructional strategy that is being adopted in many classes today. Parents, along with teachers, have found these activities to be quite engaging, and they look for apps that will add rigor to a child's learning (Nistor & Iacob, 2018). Each day, teachers try to find ways to build background knowledge while linking new content to students. This research helped examine if using gamification applications improves student mathematics achievement when measured by grade-level skills. One goal teachers face daily is trying to find resources to help with enhancing students' understanding of math content along with finding re-enforcement for daily teacher-led lessons. Many gamification programs provide real-time data such as time spent on the program, the number of questions answered correctly, questions that align to skills, and students' progression towards individual goals. These programs help determine how to differentiate students' lessons while providing data to support student achievement levels. Prieto Calvo, Santos Sánchez, Hernández Encinas, Moreno, Rodríguez Puebla, and Queiruga-Dios (2016) uttered the following:

> Current students were born in the Internet age, and the teaching/learning methodologies that are used with them must necessarily adapt to this reality. The fast-paced development of mobile devices and applications, increasingly powerful and versatile, has promoted their use in contexts previously reserved for the computer. This also includes the educational field, where these devices should also be considered valid learning tools.

Statement of the Problem

Students are struggling with mastery of math facts. Teachers are trying to find research-based strategies that can help students' mastery of grade-level math skills. The elementary years are crucial for setting a child on the road to a love of learning and academic success. Therefore, appropriately challenging, and motivating instruction is vital to be implemented. Examining the current teaching methods that are in place, computer-aided instruction can help classroom teachers to make more informed decisions about how to teach all students and inspire them to become lifelong learners most effectively. Much research has been done on the effectiveness of various types of technology on student achievement in math. Fengfeng (2008), for example, found that using computer games in math increases achievement in elementary students, especially when used with a cooperative learning approach. This study researched whether the use of gamification applications such as Prodigy helps to improve student mathematics achievement. One major factor that impacts a student's achievement level is his/her motivation to learn. Yucel and Koc (2011) found a strong correlation between student attitude and achievement in math of sixth through eighth-grade students. Students in the researcher's school often struggle in math, with data showing them at least a grade level behind in the subject area. Teachers struggle to find engaging activities to help student achievement. This study aimed to see if the use of gamification applications helps with student achievement of grade-level skills in math.

Teacher training and their attitudes about the integration of technology into the mathematics curriculum remain a challenge for school administrators and math teachers (Brinkerhoff, 2006; Goktas, Yildirim, & Yildirim, 2009). Teachers have reported difficulties in integrating technology into the curriculum (Li, 2007). Teachers also have repeatedly noted lack of technical support in terms of staff and even, sometimes, computers in the schools (Brinkerhoff, 2006; Goktas et al., 2009). The fact that integration problems were overlooked when computers were first introduced in school, a generation ago means that many teachers may have developed negative ideas about technology integration (Li & Ma, 2010). Teachers want proven strategies and resources to aid in teaching for student success. There are many studies on using gamification for student engagement, but very little information on gamification helps with mastery of grade-level skills. This research used IOWA basic skills assessment as a measuring tool for gamification, which has been bare to nonexistent in educational research.

Purpose of the Study

Teachers are incorporating technology into the daily activities of students. Many teachers face the issue of students not engaged in programs that are there to enhance their learning. Games like Math Blaster and Machine Incredible were introduced with great success to children, but there were also critics saying the actual games were not easily connected to the curriculum or they were too focused on the repetitive practice of a small set of skills such as addition and subtraction (Nistor & Iacob, 2018). However, these gamification programs can promote student achievement.

As Mert and Samur (2018) said:

> The use of the game in education has been a known and preferred method for a long time. Because games are played at home, on the streets, and in any environment where opportunities are available, the thinking skills are processed, and game strategies are used in education to make learning easier for the students.

This research served the purpose to see if the use of gamification during small group center rotation increases students' overall mastery of grade-level skills of mathematics in a suburban elementary school. Teachers are searching for computer applications/programs to help with mastery of skills. Students are finding themselves at computers and unable to find interest in the math components being taught. This research helped examine if teaching through games helps increase student mastery of grade-level skills in mathematics.

Theoretical Framework

This quantitative study was conducted to determine whether math students using gamification in their classes showed improved achievement of math skills. One learning theory that seemed to be most appropriate to apply to the framework is constructivism. The constructivist approach to learning is now widely accepted in the educational community (Dalgarno, 2001; Saadé & Huang, 2009). Constructivism is viewed today as the construction of knowledge occurring in the mind of the individual and within his/her perception of the world. This study was conducted through the general inductive approach to analyze the data that was collected (Thomas, 2000). The data was collected and summarized as a reflection of the Constructivist framework to determine the functionality of gamification and student achievement.

Data were collected and analyzed from the IOWA assessment to determine if students had mastered grade-level skills. Students took a pre-test and post-test using IOWA. The process of learning involved the linking/thinking of newly acquired knowledge with old, internalized knowledge. Technology has contributed to the constructivist theory by providing a wide range of technology-mediated learning resources such as simulations, microworlds, intelligent agents, adaptive systems, cognitive tools, and practice tools (Alkhori, Bűyűkkurt, & Saadé, 2011). These authors stated that the constructivist approach could be implemented into the technology-mediated learning framework via the definition of the constructive elements of the learning structures where knowledge can be created in the minds of the students via the use of technology. The purpose of this study was to analyze how the use of gamification (computer-based games) could improve student achievement in math. The quantitative research was aimed to gather data to determine if using gamification programs such as Prodigy games could help students achieve higher math scores.

Research Questions

The following research questions guided this study:

- Do students using gamification in class attain higher math achievement than those students who do not use gamification?
- Do students using gamification in-class master more grade-level skills than students not using gamification programs?

Significance of the Study

- Scarcity: Gamification is a new trend in education. There is little to no research done on gamification, improving students' mastery of skills. There are many research articles on student engagement. Researchers are searching to find out if gamification applications are significant programs for increasing student engagement. Many programs, such as Prodigy, make claims that their programs will aid in student achievement. Due to the fairly newness of the concept, there is still the how's and why's Prodigy is said to work. Research will help build foundations that can be used to help with answering questions and aiding in program future use. Above all, gamification has some disadvantages including frequency of use and the quality of the obsolete website. The literature on the most effective teaching strategy in math basics, involving procedural and conceptual mathematics, remains scarce. The research on procedural facility in computational mathematics is limited (Arslan 2010). This gap in the literature is further exacerbated by the fact that research on how to teach math (procedural), what strands of math to teach (conceptual), and when to teach what grade levels (sequential) is limited, specifically regarding students with a mathematical learning disability.

- Conflict results: As exciting as gamification is as a pedagogical tool, it is not a cure-all. Even those who embrace gamification in education are aware of its challenges (Sillaots, 2014). If applied incorrectly, gamification will not yield the desired results. The biggest debate is differentiating extrinsic and intrinsic motivation for learning. Surface associations like badges and leaderboards are effective for engaging the audience and doing so quickly, but the audience can just as easily disengage (Campbell, 2016). This reward system can also foster extrinsic learning when educators' desire is intrinsically motivated students. Campbell (2016) states, "Game designers should be very careful in their use of operant conditioning, however. While powerful, operant conditioning is not without drawbacks, which have led to videogames and gamification having what is often referred to as The Skinner Box Problem." The use of positive reinforcement can lead to extrinsic motivation, which often results in the desired behavior ceasing once reinforcement stops. Gamification, however, does not enjoy universal approval and is controversial (Hung, 2017). It has been argued that it relies on the incidental parts of games that hold players' attention (Bogost, 2015; Robertson, 2010) and that it is deceitful and coercive in that it uses exploitative reward tactics to achieve required behaviors and compliance (Bogost, 2015). Hopefully, the motivation to use it in education is to benefit the student (improved marks) rather than simply make the lecturer look good (improved pass rates).

- Contributions: This research helped determine if gamification in fourth-grade math students provides growth to aid in student success of grade-level math skills. Teachers are struggling to find different programs that will aid in the integration of technology but can also provide meaningful data to support student achievement with grade-level skills. In efforts to find a program that is inexpensive for the school, along with providing teachers with collectible data that helps determine students' success during math centers, teachers are integrating the use of Prodigy as their primary math program. It is vital to assess whether Prodigy is the tool to aid in successfully helping mastery grade-level skills while providing a program that supports learning with meaningful data. Prodigy is believed to aid in student achievement by delivering game playing mechanisms to learning, which is not widely accepted in many classes. Is it truly possible to learn grade-level math content while playing a game on the computer?

Definitions of Terms

Extrinsic Motivation - Extrinsic motivation is motivation that is stimulated by an outside source.

Gamification in Math Instruction - Gamification is referred to as game-playing applications used to improve student engagement. Gamification in math instructions refers to using computer game-based programs to aid in the instruction of math for student growth.

Grade Level Skills – Skills assigned by the states to determine students' readiness to move to the next grade. Grade level skills are learning progressions in each content area. Mastery of skills is usually shown when students can produce a consistent demonstration, understanding, and application to transfer knowledge. Skills include content such as estimation, problem-solving, application of operations such as addition, subtraction, multiplication, and division, comparing numbers according to place value, geometry, and measurement, to name a few.

Intrinsic Motivation - Intrinsic motivation is motivation of the source of which is internal.

IOWA Test of Basic Skills (ITBS)- Nationally normed standardized tests offering educators a diagnostic looks at how students are progressing in key academic areas.

Math Achievement - Math achievement is determined by the students' math performance on the IOWA assessment.

Technology Centers – Students work on technology in small groups of no more than six students working on differentiated activities.

Use of Technology Centers – Students work on technology in small groups of no more than six students using technology devices such as desktop, laptops, Chromebooks, iPads, or other hand-held devices, which aid in practicing skills.

Summary

The elementary years are crucial for setting a child on the road to a love of learning and academic success. Therefore, appropriately challenging, and motivating instruction is essential to be implemented. Examining the current teaching methods that are in place, computer-aided instruction will help classroom teachers make more informed decisions about how to teach all students and inspire them to become lifelong learners most effectively. Much research has been done on the effectiveness of various types of technology on student achievement in math. Students in the researcher's school often struggled in math, with data showing them at least a grade level behind in the subject area. Teachers struggle to find engaging activities to help student achievement. This study aimed to see if gamification applications can help with student achievement of grade-level skills in math. The use of gamification in the class is said to motivate students as they compete with other students for advancement as they learned. Additionally, gamification encourages social interaction and feedback. All these approaches support the mastery experience, vicarious experience, and verbal persuasion.

CHAPTER 2: LITERATURE REVIEW

Along with the 21st-century digital era, the integration of technology in education has accelerated, the use of technology in classrooms has become widespread, and the integration of technology education has gained importance (Tugun, 2018). School districts are expecting teachers to incorporate technology into their daily lessons. Technology is everywhere in education: Public schools in the United States now provide at least one computer for every five students. They spend more than $3 billion per year on digital content (Herold, 2016). Students are using computers as part of their daily lessons for whole and small group instruction. Many states are now administering standardized state assessments online. In the 2015-16 school year, for the first time, more state standardized tests for the elementary and middle grades were administered via technology than by paper and pencil (Herold, 2016). Students are being assessed with the administration of high-stakes tests. Therefore, it is highly recommended that students are prepared for computer-based assessments before the actual assessment day.

Use of Technology in Classroom Teaching

To prepare students for the future and help them learn how to think, learn, and gain different perspectives, technology has to be integrated into the classroom (Eyam & Huseyin, 2014). Districts understand that for students to compete in the age of technology, they have to be prepared. The integration of technology into a school is, in many ways, like its integration into any business setting. Technology is a tool to improve productivity and practice (Thomas, 2000). In technology-implemented classes, interactive student involvement in the learning process is fostered, and learning becomes more fun and more attractive for the students (Smaldino, Russell, Heinich, & Molenda, 2005). According to data analysis results, it is found that gamification elements increased students' interests and motivation towards computer lessons and made them more active in terms of participating into lessons (Sarı & Altun, 2016).

Technology in the classroom can provide students with differentiated activities and learning opportunities. Differentiation comes in many different components and areas in elementary classrooms. By considering varied learning needs, teachers can develop personalized instruction so that all children in the classroom can learn effectively (Differentiated instruction n.d.). Teachers have no control over how many students are on their rosters or the level of students' learning abilities. This is where technology can be a benefit. Lin's study (2008) was about using technology in the classroom. The findings of this study provided further compelling evidence to support the recommendations of many national reports, such as the NCTM Professional Skills for School Mathematics (2000), to substantially increase the role of instructional technology in the contemporary mathematics classroom. A study by Olkun, Altun, and Smith (2005) suggests that it was more effective to teach mathematics by integrating mathematical content and technology to enable students to make playful mathematical discoveries (Olkun et al., 2005). Lin (2008) claimed that students believed integrating hands-on activities with physical manipulatives as well as computer resources would engage the students in their learning and lead to a better understanding of the content.

Schools are developing new visions to help students become college and/or career ready. Technology is a significant component of that trend. It is believed that when technology is used appropriately in classroom instruction, it has a very positive impact on student achievement or success (Eyam & Huseyin, 2014). Learning management systems, student information systems, and other software are also used to distribute assignments, manage schedules and communications, and track student progress (Herold, 2016). Teachers aim to find methods to integrate technology for students use as well as to grade papers and collect data. Using technology, grades are collected, assignments can be collected, data are organized for differentiation, and communication to parents, students, and other stake holders are more convenient. The state of Georgia uses the ELEOT (Effective Learning Environment Observation Tool) as a technology integration platform. In order to prepare students for the future and help them learn how to think, learn, and gain different perspectives, technology needs to be integrated into the classroom (Eyam & Huseyin, 2014). Some districts are using small group rotations or what many know as blended learning to help with teaching small numbers in ways of homogeneous groups.

The use of technology in classes has several advantages. Such advantages come in the faucet of teachers being able to differentiate activities according to students' needs. Teachers can receive immediate access to student data, and they are able to align students' learning with state grade-level skills.

Use of Technology and Student Achievement

Classrooms worldwide have implemented many forms of technology to enhance student interest and achievement (Flanagan, 2008). Research is showing today's students are using different tools to enhance learning. Their learning preferences are unique compared with students from other generations, as they have a clear desire for more active and experiential learning opportunities, which challenge the traditional lecture as the primary method of disseminating knowledge in higher education (Phillips & Trainor, 2014). Research conducted by Lei and Zhao (2007) suggested that although the amount of time spent on computers had a general effect on student academic achievement, this effect might depend on how they spent their time, with what specific technology, and on what activities. Research findings are clear that teachers must find efficient methods to use technology if they want to enhance student achievement. Fengfeng (2008), found that using computer games in math increases achievement in elementary students, especially when used with a cooperative learning approach.

Eyyam and Yaratan (2014) have clearly explored the relationship between technology integration and student learning and achievement, as described in the following:

> Additionally, it is believed that when technology is used appropriately in classroom instruction, it has a very positive impact on student achievement or success. Moreover, using technology in education or teaching helps teachers provide immediate feedback to students and motivates active student learning, collaboration, and cooperation. It also helps teachers provide individualized learning opportunities and flexibility for their students (p. 32).

Technology provides new avenues for teachers to enhance their craft. The feedback after teaching can help with immediate re-teaching that will lead to student success. Yang and Tsai (2010) described that technology integration into math improved student learning because students are provided with immediate feedback by software programs and teachers are supported with training (Mendicino, Razzaq, & Heffernan, 2009).

Gamification as an Instructional Approach

The growing use of mobile technologies presents new challenges in the field of teacher training and classroom instruction (Eyal, 2015). The use of educational games as learning tools is a promising approach due to the games' abilities to teach and the fact that they reinforce not only knowledge but also essential skills such as problem-solving, collaboration, and communication (Dicheva, Dichev, Agre, & Angelova, 2015). Incorporating elements from games into classroom scenarios is a way to provide students with opportunities to act autonomously, to display competence, and to learn in relationship to others. Game elements are a familiar language that children speak, and an additional channel through which teachers can communicate with their students (Saurabh, 2014).

Bitter and Pierson (2005) stated: “A recent meta-analysis demonstrated that students using technology had modest but positive gains in learning outcomes over those students who used no technology” (p. 107). Gamification of educational processes can be described as the successful integration of the gamification framework into the curriculum in order to improve students' motivation, academic achievement, and attitudes toward lessons (Yildirim, 2017). Playing games is an integral part of our social and mental development (Amory, Naicker, Vincent, & Adams, 1999). Students are not learning in an environment where rote learning and traditional lectures are class-based lessons. The idea of making lessons more student friendly to help with captivating young minds and creating an engaging learning environment are now considered learning focused classes. Nowadays, more educators are using gamification as part of their teaching strategies. This is due in part to the recognizing that games designed in an effective form stimulate large gains in productivity and creativity (Figueroa-Flores, 2016). Kaplan University embedded Gamification software to their LMS and ran a pilot project in one of its courses. The results included an improvement of 9% on the students’ grades and a 16% course completion improvement (NMC-Horizon Report, 2014, p.43).

Gamification and Student Learning

Gamification is the recent trend that offers to increase student engagement in learning through the inclusion of game-like features like points and badges, in non-game contexts (Looyestyn, Kernot, Boshoff, Ryan, Edney, & Maher, 2017). One would believe that when engagement time is increased, student learning would increase as well. Many students are not engaged due to certain factors such as lack of prior knowledge, teachers' style for teaching, or student differentiated learning styles. "Gamified" active learning has been shown to increase students' academic performance and engagement and help them make more social connections than standard course settings (Chen, Huang, Gribbins, & Swan, 2018). When students work on challenging tasks using game technology, their motivation to compete against and improve their own previous scores increases (Inal & Cagiltay, 2007). Games might provide feedback based on the students' correct or incorrect individual answers, on the number of correctly solved problems out of the total score, or on other factors that enable the student to either pass or fail to move on to the next level. Such feedback helps learners to evaluate whether their current performance meets established goals and to reflect on past performance (Whitehill & McDonald, 1993). Moreover, research suggests that game technology improves student performance on algebra and mathematics problem solving (McFarlane, Sparrowhawk, & Heald, 2002), reading comprehension, spelling, and decoding of grammar (Rosas et al., 2003), and complex thinking skills including problem solving, strategic planning and self-regulation (Cordova & Lepper, 1996; Ricci, Salas & Cannon-Bowers, 1996).

The Impact of Gamification on Student Math Achievement

In recent years, a growing number of studies are being conducted into the effectiveness of digital game-based learning (DGBL; All, Castellar, & Van Looy, 2014). A teaching experiment was conducted to analyze the learning effectiveness of students on the game-based learning system and the major factors affecting their learning. A questionnaire survey was used to understand the students' attitudes towards game-based learning. The results showed that the game-based learning system can enhance students' learning (Tarng, Wernhuar, Tsai, & Weichian, 2010). Even though in the past, significant research in digital game-based learning has been published, all scholars believed that digital game-based learning is better than traditional lecture instruction, producing better learning effects and higher learning motivation. Previous studies have ignored the urban-rural differences in mathematics learning effects and influences of incorporating digital games into instructional strategies for mathematics learning (Chen et al., 2014). The research also reported results that show that digital game-based learning produced better mathematics learning effects for urban and rural students compared to traditional classroom instruction. According to the research results, gamification-based teaching practices have a positive impact on student achievement and students' attitudes toward lessons (Yildirim, 2017). Some games can adapt to students differing abilities and provide progress reports for teachers to gauge students' understanding of the material, providing teachers with feedback on areas where students need additional support (Callaghan, Long, van Es, Reich, & Rutherford, 2018). Though most educational computer games supplement, not supplant, teachers' effective integration of computer games and class instruction can help students become more engaged and increase their content learning (Wouters & Van Oostendrop, 2013). Elshemy stated, "research shows the role of Gamification strategy in raising motivation among students towards education, which positively affects the raise of achievement level; so, this research applied to determine the impact of Gamification strategy on raising motivation as well as academic achievement among students of the second stage in the governorate of Muscat."

Mixed-method research was carried out with 29 students in a secondary school in the southern Malaysian state of Johor. The findings showed that game elements helped change the perspective of students when it came to learning with the help of technology, especially game elements. Most students related to badges as a motivational push to strife harder in learning as it can be used as a qualitative form of reward, as opposed to points and leader board (Sanmugam, et al. 2016).

> Researchers noticed the impact of low motivation on academic achievement among students through assessment tools and, most importantly, examinations results; to make sure thereof, researchers have made a questionnaire, to analyze learners' needs, where it showed that students mostly tend to applied materials and can't absorb large amounts of knowledge & information during an educational class, so they prefer learning through activities mostly characterized by interaction and movement, and that their concentration increases when technology is used, they learn and interact in a better manner when using teaching methods characterized by fun and entertainment than traditional methods such as discussion and dialogue. Through these findings resulting from questionnaire analysis, researchers found that students' motivation increases when using teaching methods characterized by fun and entertainment where their classroom interaction, attention and self-confidence increase, so teaching ways must be chosen to be attractive to learners and characterized by motivation and challenge through the innovations of technology (Elshemy, 2017).

Although video games can often have a negative connotation, evidence suggests that gaming can be beneficial. There are many reasons why gaming in education can be useful (Griffiths, 2002):

- Videogames attract participation by individuals across many demographic boundaries (e.g., age, gender, ethnicity, educational status).

- Videogames can assist children in setting goals, ensuring goal rehearsal, providing feedback, reinforcement, and maintaining records of behavioral change.
- Videogames can be useful because they allow the researcher to measure performance on a very wide variety of tasks, and can be easily changed, standardized and understood.
- Videogames can be used when examining individual characteristics such as self-esteem, self-concept, goal setting, and individual differences.
- Videogames are fun and stimulating for participants.

Video games also reinforce to players that it is okay to be wrong and to try and try again. Sir Ken Robinson discusses in his TED talk, “How Schools Kill Creativity,” that the educational system has stigmatized mistakes (Robinson, 2006).

Summary

Understanding whether gamification is effective is also a pertinent practical issue. A remarkably large number of firms now provide gamification services, and investments are being made into gamification related efforts (Hamari, Koivisto, & Sarsa, 2014). The supplement for online learning is now shifting to engagement, along with achievement while learning online. Gamification is still new, and different components of education are being tested as far as to validate the effectiveness of all components. There is much research over whether engagement levels increase through the use of gamified learning. What this research sought to find is whether the use of gamified learning helps students master grade level content skills. Despite this growing interest, there is a lack of sound empirical evidence on the effectiveness of DGBL due to different outcome measures for assessing effectiveness, varying methods of data collection, and inconclusive or difficult to interpret results. This has resulted in a need for an overarching methodology for assessing the effectiveness of DGBL (All et al., 2014). Achievement motivation is an important component for academic success in all levels of education, from primary school, through high school, and finally, the undergraduate stage (Elshemy, 2017).

CHAPTER 3: METHODOLOGY

The purpose of this study was to analyze how the use of gamification (computer-based games) could improve student achievement in math. This quantitative research aimed to gather data to determine if using gamification programs such as Prodigy games could help students achieve higher math scores.

Research Questions

The following research questions guided this study:

- Do students using gamification in class attain higher math achievement than those students who do not use gamification?
- Do students using gamification in-class master more grade-level skills than students not using gamification programs?

Research Context/Setting

The participants of this study were students in an elementary school in a suburban county east of Atlanta. Students enrolled in the school ranged from prekindergarten to fifth grade. This was a Title I school, with over 85% of the students receiving free or reduced lunch. Fourteen percent of the students received services through the Early Intervention Program (EIP), while 11% of the students received academic support through the Special Education program. Three percent of the students identified as being English Language Learners (ELL). Four percent of the students received Gifted Education services. This school was labeled a low-performing school three years ago due to achievement gaps and low performing scores in math. The school district was just labeled a poverty district by recent research done by Rutgers University. This research took place in third through fifth-grade math classes.

Research Design

This is a quasi-experimental study that used a control group and a treatment group that was non-randomized with the use of pretest and posttest design. Quasi-experiments are studies that aim to evaluate interventions but do not use randomization of participants included in the study (Harris, 2006). Quasi-experimental research design was used for several reasons; the research had a small number of students, and test scores were taken before and after the use of gamification. This research was done in an educational setting.

Although philosophical ideas remain largely hidden in research, they still influence the practice of research and, therefore, need to be identified (Creswell, 2009). This examination also follows Creswell's post-positive philosophical worldview, also known as the scientific method (Creswell, 2009). Studies using the post-positivist approach hold a deterministic philosophy (Creswell, 2009). Teachers' beliefs form a mosaic of visions, some complementary, others conflicting (Levin & Wadmany, 2006). Educators recognize the importance of teaching with technology, yet doing it is often hampered by external (first-order) and internal (second order) factors (Ertmer, Addison, Lane, Ross, & Woods, 1999).

Participants

The participants of this study consisted of two groups, the experimental group and the control group in the quasi-experimental design. The experimental group and the control group are set up for comparative purposes. The experimental group was students that were receiving gamification as part of their math instruction. control group did not receive gamification through Prodigy games as their instruction. Both groups received math instruction from the same teacher each day.

The Experimental Group

The experimental group of this study consisted of 20 or more fourth-grade math students all being taught by the same teacher. The teacher was a female veteran teacher that had taught fourth and fifth-grade math. She had a Specialist in Curriculum and Instruction and was Gifted endorsed. She used Research-Based Instructional Strategies such as Concrete Representation of the abstract, manipulatives, collaborative groups, and interactive notebooks to enhance students' learning.

The Control Group

The research used a control group of 20 or more students that received the same classroom instructions as the experimental group. These students were grouped according to gender, social-economic status, and pre-test scores. Both the control group and the experimental group had the same amount of small group teacher-led instructions, along with other segments of instructions using technology. The control group had come from group B, which was the second-period class. This helped to ensure that all students were receiving the same level of instruction both on the computer and by the teacher. -The same fourth fourth-grade teacher taught both groups of students. The control group did not use game-based learning. The control group also took the Iowa Test of Basic Skills during the first nine weeks of school and the last nine weeks of school.

Data were collected through skill-based pre-and post-tests from IOWA/ITBS. Skills vary among states, and skills are more aligned across states within the ITBS. The ITBS test is administered in many different states. The test evaluates a student's educational progress. Some of the skills include sections on vocabulary, reading, spelling, grammar, word usage, math, social studies, science, maps, reference, and word recognition for students in grades 3-8. In this study, only the student math scores were used. The participants in this research were fourth-grade students that were either Tier 1, Tier 2, or Tier 3. They all received math instruction from a general education veteran teacher with more than five years' experience, but some used gamification as part of their instructional session, and some did not. The teacher aligned standard based questions from the game application with the learning that took place in class.

Grade level skills/skills for fourth grade consist of six skills covering whole numbers, place value, and rounding in computations, eight skills covering multiplication and division of whole numbers, three skills covering fraction equivalence, three skills covering operations with fractions, four skills covering fractions and decimals, three skills covering geometry, and eight skills covering measurement. Grade level skills are grouped according to student learning readiness. These skills are often listed as skills or content on game applications and are assessed on the IOWA and aligned with Georgia Skills of Excellence according to grade-level skills/skills. As grade level class instruction is covered in class students in both groups, the control group and the experimental group were also covering those skills using technology. The teachers assigned tasks as skills were being covered weekly in class. Each student had the same skills, with variation only in the application being used. Prodigy gives students the opportunity to play games and challenges peers from level to level as they answer questions related to content assigned by the teacher or the program.

Data Collection Procedures

Data in this study consisted of student pre and post-test scores from the IOWA and Prodigy. Data from gamification application Prodigy included skills covered as well as student achievement on pre and post-test. Student achievement was also collected from IOWA with grade-level content. Collected data indicated students' national rankings from pre and posttest in the different components such as computation and mathematics.

The students received math for 90 minutes a day with whole group and small group instructional time. During whole group instruction, the teacher goes over curriculum topics that are being covered in all fourth-grade classes along with reteaching skills for all students. Small group instructions can vary, but the skills will be the same. Students were given permission forms to receive permission before data were collected. Parents were notified of the forms to help expedite the collection of the forms. Once forms were received over a 14-day cycle, students were given a pre-test to help with initiating data collection.

Instruments

This quantitative research study used several instruments to gather the data needed for the research. Data were collected from the IOWA/ITBS database. Data included student scale scores from the computation section on the mathematics portion of the test. For this research, math achievement was based on student performance. All test results were retrieved from the Illuminate platform. This platform houses data for the county for all students. The data consist of End-of-Grade data, benchmark data, ITBS data, and teacher assessment data. The county tries to make all data easily accessible for teachers to aid in this effort.

Data Extraction

The first stage of the data collection took place after students completed the pre-test. Teachers had login reports to monitor students' time on the program. The researcher used a spreadsheet to report data collected for later comparison with the post-test. The spreadsheet consisted of each student's total mathematical score, computation score, number sense and operation score, measurement score, geometry score, algebra patterns score, data analysis, and cognitive level scores were entered into the data collection tool. These scores were input into a teacher created a spreadsheet for data comparison. The same information was collected at the post-test stage of research. The data scores consisted of National Percent Ranking (NPR), measured from 0 to 100, and the Development Standard Scores (SS). The mathematics session of the test consisted of 55 problems.

Data analysis was done at the beginning and the end of the research. The beginning data were collected from the pretest in which all students took part. The pre/posttest data were collected from the IOWA/ITBS (Iowa Test of Basic Skills). The pretest was administered in August within the first month of school. All students took this assessment. The assessment was given in a secure environment on the computer. Teachers can receive the data within 24 hours of the test being administered. Students were given teacher-led instructions on grade level skills daily. Each week students received at least three hours of whole group instructional time, with the remaining math blocks being in small group rotations. Small group rotations consisted of 30 minutes a week for each group and a maximum of an hour a week. Small groups had a minimum of 30 minutes a week in class on the computer. Class time usually consisted of 60 minutes to 90 minutes. Many of these students also received instructional lessons during morning tutorials from the teacher. Thirty of these students did not use Prodigy as an instructional tool. They received small group instruction from another site, such as Pearsonsuccess.net. Pearsonsuccess is the math program provided by the county from Envision, the producers of the students' math books. The program comes in hard book resources as well as digital. During the Spring, all students took part in the posttest with data being collected from IOWA.

Data Analysis

Statistical procedures for comparing the two categories (Experimental Group and the Control Group) of student achievement were done using the Analysis of Co-variance (ANCOVA). The post-test scores of the Experimental Group and the Control Group were compared to see if they make any significant difference between them. The control variables for the research were gender, age, race, response to intervention, and student pre-test scores. ANCOVA measures the difference

between two variables by examining their mean scores. By using control variables in the statistical procedures, variation due to the impact of these control variables during the comparison was minimized.

To answer the second research question, the percentage of students mastering math skills was calculated by skill and group. The Experimental Group was compared with the Control Group by skill and by percentage to determine which group of students mastered more math skills.

Limitations

Limitations of this research came with students' use of technology. Students usually have a set amount of time to use technology. Administrators often change schedules within a year as far as students having small groups daily often result in students having small groups 2 to 3 times a week. This would not only change the time of using online programs such as Prodigy but the amount of small group instructional time.

Summary

Prodigy is stated to engage students using game-based learning. The methodology behind this quantitative research aimed to see if students' achievement levels increased to master grade-level skills in math. Prodigy has components to help with learner differentiation according to the skills needed to be learned. The research design is to eliminate limitations to the minimum to help with the fidelity and reliability of the research. Statistical procedures for comparing the two categories of student achievement were done using the Analysis of Co-variance (ANCOVA). Data collection was completed using pre and post-test data from Prodigy, IOWA, and Pearsonsuccessnet.

CHAPTER 4: FINDINGS

Data collected in this study were analyzed statistically, and the findings of the analyses were reported in the following order: (1) student demographic analysis by descriptive statistics, (2) teacher demographic analysis by descriptive statistics, (3) student math score analysis by ANCOVA, and (4) student attainment of grade-level achievement by descriptive statistics. Analyses (1) and (2) are intended to provide a descriptive background of the students and teachers participating in this study. Analysis (3) is intended to provide the answer for research question 1, and analysis (4) is intended to provide the answer for research question 2.

Student Demographics Analysis

RTI. Student demographic analysis includes student demographic data of RTI, Gender, Age, and Race. There was a total of 53 students in the study, with 94% classified as RTI level 1 students and 6% as RTI level 2 students. Level 2 students received interventions for deficiencies that caused them to achieve below grade level in the content areas of Reading or Math. The findings of statistical analysis are displayed in the table below (see Table 1).

Table 1
Demographic Analysis - RTI

RTI Level	Frequency	Percent	Cumulative Percent
1	50	94.3	94.3
2	3	5.7	100.0
Total	53	100.0	

Gender. The gender demographic data were analyzed. The result of the analysis showed that 23 out of the 53 students were males making up 43.4% of the population. This leaves 30 out of the 53 students being females making up 56.6%. Table 2 shows the findings of the statistical analysis of gender.

Table 2
Demographic Analysis-Gender

	Frequency	Percent	Cumulative Percent
Male	23	43.4	43.4
Female	30	56.6	100.0
Total	53	100.0	

Age. Demographic reports indicated that 47 (88.7%) out of the 53 students were nine years old when data were collected. There were 6 (5.7%) out of the 53 students being ten years old. The results are reported in Table 3.

Table 3

Demographic Analysis-Age

Age	Frequency	Percent	Cumulative Percent
9	47	88.7	88.7
10	6	11.3	100.0
Total	53	100.0	

Race. Descriptive data analysis reported that 50 out of the 53 students in the study fell under the Black race, which is 94.3% of the population. White students made up 3.8% of the population, with 2 out of the 53 students. There was a small percentage of other races, with 1 out of the 53 students holding 1.9%. These findings are displayed in Table 4.

Table 4

Demographic Analysis-Race

Race	Frequency	Percent	Cumulative Percent
Black	50	94.3	94.3
White	2	3.8	98.1
Other	1	1.9	100.0
Total	53	100.0	

All the student demographics variables, RTI, Gender, Age, and Race, were used in the Analysis of Covariance as covariates to control their possible impact on the student math scores.

Teacher Demographic Analysis

Data on the teachers' demographic background regarding age, race, education qualifications, and teaching experience were collected. The two teachers who teach in each of these two classes were black, and one was 52 years old, and the other was 47 years old. There was no difference in racial background, and their ages were close, one in the late forties and the other in early fifties. Therefore, it was determined that teachers' race and age, in this case, would not create a significant impact on student math scores and were, therefore, excluded in the statistical analysis of ANCOVA.

A correlational analysis was performed to determine the relationship between teacher education qualifications and student math achievement. The outcome of the Analysis indicated that $r = 0.012$ with a significance level of 0.499. The teacher from School 1 had an Educational Specialist degree in Curriculum and Instruction. The teacher from School 2 had a bachelor's degree in Early Childhood Education. Another correlational analysis was performed to determine the relationship between teacher teaching experience and student math achievement. The teacher from School 1 had taught elementary Math for over 13 years in third through fourth grades. She had taught elementary Math for over 13 years in grades 3 to 4. Teacher 2 had taught second through fourth grades for over 23 years. The outcome of the Analysis indicated that r =0.073 with a significance level of 0.439. Since both correlational analyses showed no significant relationship, it was determined that teachers' educational qualifications and teaching experiences would not be included in the Analysis of Covariance procedures in this study.

Student Math Scores Analyses

Math scores in this study consisted of 10 different subsets as follows:

1. Number Sense and Operations (Number): refers to the relationship of numbers and how they relate to different operations; understands concepts such as fact families and inverse operations with numbers.
2. Algebra Patterns/ Connections (Alg): explores numerical problems; solves problems with patterns; solves equations and inequalities, as well as modeling with expressions.
3. Data Analysis/Probability/Statistics (Data): interprets data and makes predictions.
4. Geometry (Geom): solves problems related to perimeter, area and volume.
5. Measurement (Measure): estimates measurement along with using appropriate units and tools.
6. Conceptual Understanding (Concept): recognizes lines, angles, and identifies different types of lines and angles.
7. Essential Competencies (Competency): refers to knowing fact fluency and recognizes algebra patterns.
8. Extended Reasoning (Reasoning): refers to having the ability to justify correctness of answers.

9. Compute with Whole Numbers (Compute): refers to adding and subtracting with and without regrouping, dividing with and without remainders, multiplying with and without regrouping,
10. Mathematics (Math): refers to the composite score of mathematics problems that do not involve computation using addition, subtraction, division, or multiplication.

Analysis of Covariance (ANCOVA) was used as the method of analysis, taking the data of each subset to be analyzed independently. In each subset, the math posttest score was the dependent variable, the school was the independent variable, and the covariates were the math pretest scores, student RTI, Gender, Age, and Race. The covariates were included in the analysis as control variables to minimize the possible impact these variables might have on the posttest scores. The mean score of 70 was used to determine if the students master the grade level of math achievement.

Number Sense and Operations (Number)

Analysis of Covariance (ANCOVA) was used as the method of Analysis, taking the posttest scores of Number as the dependent variable and school as the independent variable. The covariates were the pretest scores of Number Sense and Operations, student RTI, Gender, Age, and Race. The covariates were included in the analysis as control variables to minimize the possible impact these variables might have on the posttest scores of Number Sense and Operations.

The result of the analysis indicated that students in School 1 (with gamification) had a mean score of 68.74 (S.D.=22.43). Students in School 2 (without gamification) had a mean score of 76.19 (S.D.=12.48). The mean scores determined that students in School 1 did not achieve mastery of Number Sense and Operations achievement, while students in School 2 showed mastery. The results of the ANCOVA indicated that there was no significant difference in the Number Sense and Operations scores ($F(1, 46)=1.337$, $p>.05$) between the students in School 1 (with gamification) and the students in School 2 (without Gamification; See Table 5).

Table 5

Analysis of Covariance (ANCOVA) – Number

Dependent Variable: Number2 (Post-test)						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7728.190[a]	6	1288.032	5.939	.000	.437
Intercept	466.879	1	466.879	2.153	.149	.045
RTI	23.837	1	23.837	.110	.742	.002
Age	139.976	1	139.976	.645	.426	.014
Gender	.143	1	.143	.001	.980	.000
Race	12.919	1	12.919	.060	.808	.001
Number1 (Pre-test)	5888.357	1	5888.357	27.150	.000	.371
School	289.945	1	289.945	1.337	.254	.028
Error	9976.490	46	216.880			
Total	295489.000	53				
Corrected Total	17704.679	52				

a. R Squared = .437 (Adjusted R Squared = .363)

Algebra Patterns/ Connections (Alg)

Analysis of Covariance (ANCOVA) was used as the method of analysis, taking the posttest scores of Algebra as the dependent variable and school as the independent variable. The covariates were the pretest scores of Algebra, student RTI, Gender, Age, and Race. The covariates were included in the analysis as control variables to minimize the possible impact these variables might have on the posttest scores of Algebra.

The result of the analysis indicated that students in School 1 (with gamification) had a mean score of 75.22 (S.D.=19.56). Students in School 2 (without gamification) had a mean score of 74.35 (S.D.=16.72). The mean scores showed that students in School 1 and School 2 mastered the skill level of Algebra Patterns/Connections. The result of the ANCOVA indicated that there was no significant difference in the Algebra Patterns/Connections scores ($F(1, 46)=0.293$, $p>.05$) between students in School 1 (with gamification) and the students in School 2 (without Gamification; See Table 6).

Table 6

Analysis of Covariance (ANCOVA) -- Algebra

Dependent Variable: Alg2 (Post-test)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4882.640[a]	6	813.773	3.102	.012	.288
Intercept	405.826	1	405.826	1.547	.220	.033
RTI	.680	1	.680	.003	.960	.000
Age	109.843	1	109.843	.419	.521	.009
Gender	18.362	1	18.362	.070	.793	.002
Race	26.606	1	26.606	.101	.752	.002
Alg1 (Pre-test)	3635.596	1	3635.596	13.860	.001	.232
School	76.906	1	76.906	.293	.591	.006
Error	12066.077	46	262.306			
Total	313426.000	53				
Corrected Total	16948.717	52				

a. R Squared = .288 (Adjusted R Squared = .195)

Data Analysis/Probability/Statistics (Data)

Analysis of Covariance (ANCOVA) was used as the method of analysis, taking the posttest scores of Data Analysis/Probability/Statistics (Data) as the dependent variable and school as the independent variable. Covariates were the pretest scores of Data, student RTI, Gender, Age, and Race. The covariates were included in the analysis as control variables to minimize the possible impact these variables might have on the posttest scores of data.

The result of the analysis indicated that students in School 1 (with gamification) had a mean score of 63.22 (S.D.=20.18). Students in School 2 (without gamification) had a mean score of 56.81 (S.D.=16.71). Students in School 1 and School 2 did not show mastery of data analysis skills for fourth grade. Results of the ANCOVA indicated that there was no significant difference in the Data Analysis/Probability/Statistics scores ($F(1, 46)=1.07$, $p>.05$) between students in School 1 (with gamification) and the students in School 2 (without Gamification; See Table 7).

Table 7

Analysis of Covariance (ANCOVA) – Data

Dependent Variable: Data2 (Post-test)						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3733.176[a]	6	622.196	1.990	.086	.206
Intercept	297.104	1	297.104	.950	.335	.020
RTI	617.487	1	617.487	1.975	.167	.041
Age	112.002	1	112.002	.358	.552	.008
Gender	43.029	1	43.029	.138	.712	.003
Race	50.378	1	50.378	.161	.690	.003
Data1 (Pre-test)	2916.481	1	2916.481	9.328	.004	.169
School	334.538	1	334.538	1.070	.306	.023
Error	14382.522	46	312.664			
Total	209396.000	53				
Corrected Total	18115.698	52				

a. R Squared = .206 (Adjusted R Squared = .103)

Geometry (Geom)

Analysis of Covariance (ANCOVA) was used as the method of Analysis, taking the posttest scores of Geometry as the dependent variable and school as the independent variable. The covariates were the pretest scores of Geometry, student RTI, Gender, Age, and Race. The covariates were included in the analysis as control variables to minimize the possible impact these variables might have on the posttest scores of Geometry.

The results of the Analysis indicated that students in School 1 (with gamification) had a mean score of 60.15 (S.D.=19.18). Students in School 2 (without gamification) had a mean score of 53.31 (S.D.=16.19). Students in School 1 and School 2 reported mean scores below 70, indicating they did not show mastery of grade-level skills. The result of the ANCOVA indicated that students in School 1 (with gamification) scored significantly higher in Geometry than students in School 2 [without Gamification; $F(1, 46) = 6.078$, $p < .05$; See Table 8]. However, the effect size of the significant difference reported by the partial Eta Squared remains small (.117; See Table 8).

Table 8

Analysis of Covariance (ANCOVA) – Geometry

Dependent Variable: Geometry2 (Post-test)						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6381.499[a]	6	1063.583	4.721	.001	.381
Intercept	2512.985	1	2512.985	11.155	.002	.195
Geometry1 (Pre-test)	2638.912	1	2638.912	11.714	.001	.203
RTI	862.819	1	862.819	3.830	.056	.077
Age	1790.406	1	1790.406	7.947	.007	.147
Race	.034	1	.034	.000	.990	.000
Gender	587.090	1	587.090	2.606	.113	.054
School	1369.388	1	1369.388	6.078	.017	.117
Error	10363.218	46	225.287			
Total	187690.000	53				
Corrected Total	16744.717	52				

a. R Squared = .381 (Adjusted R Squared = .300)

Measurement (Measure)

Analysis of Covariance (ANCOVA) was used as the method of analysis, taking the posttest scores of Measurement as the dependent variable and school as the independent variable. The covariates were the pretest scores of Measurement, student RTI, Gender, Age, and Race. The covariates were included in the analysis as control variables to minimize the possible impact these variables might have on the posttest scores of Measurement.

The result of the analysis indicated that students in School 1 (with gamification) had a mean score of 38.89 (S.D.=17.43). Students in School 2 (without gamification) had a mean score of 46.85 (S.D.=16.86). Students in School 1 and School 2 reported a score below 70, which determined that they were not able to master grade-level skills in Measurement. The result of the ANCOVA indicated that there was no significant difference in the Measurement scores (F (1, 46) =1.219, p>.05) between students in School 1 (with gamification) and the students in School 2 (without Gamification; See Table 9)

Table 9

Analysis of Covariance (ANCOVA) – Measurement

Dependent Variable: Measurement2 (Post-test)						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3588.031[a]	6	598.005	2.245	.055	.226
Intercept	152.538	1	152.538	.573	.453	.012
RTI	313.567	1	313.567	1.177	.284	.025
Age	12.936	1	12.936	.049	.827	.001
Gender	27.245	1	27.245	.102	.751	.002
Race	15.735	1	15.735	.059	.809	.001
Measurement 1 (Pre-test)	1951.940	1	1951.940	7.327	.010	.137
School	324.854	1	324.854	1.219	.275	.026
Error	12254.686	46	266.406			
Total	112896.000	53				
Corrected Total	15842.717	52				

a. R Squared = .226 (Adjusted R Squared = .126)

Conceptual Understanding (Concept)

Analysis of Covariance (ANCOVA) was used as the method of analysis, taking the posttest scores of Conceptual Understanding as the dependent variable and school as the independent variable. The covariates were the pretest scores of Conceptual Understanding, student RTI, Gender, Age, and Race. The covariates were included in the analysis as control variables to minimize the possible impact these variables might have on the posttest scores of Conceptual Understanding.

The result of the analysis indicated that students in School 1 (with gamification) had a mean score of 61.19 (S.D.=19.107), which is below the mastery score of 70. Students in School 2 (without gamification) had a mean score of 69.38 (S.D.=14.921), which is below the mastery score of 70. The result of the ANVCOVA indicated that there was no significant difference in the Conceptual Understanding scores ($F(1, 46)=2.400$, $p>.05$) between students in School 1 (with gamification) and the students in School 2 (without Gamification; See Table 10)

Table 10

Analysis of Covariance (ANCOVA) – Concept

Dependent Variable: Concept2 (Post-test)						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6227.045[a]	6	1037.841	4.911	.001	.390
Intercept	6.878	1	6.878	.033	.858	.001
RTI	8.874	1	8.874	.042	.839	.001
Age	20.491	1	20.491	.097	.757	.002
Gender	.021	1	.021	.000	.992	.000
Race	.001	1	.001	.000	.999	.000
Concept1 (Pre-test)	4792.450	1	4792.450	22.676	.000	.330
School	507.200	1	507.200	2.400	.128	.050
Error	9721.672	46	211.341			
Total	241306.000	53				
Corrected Total	15948.717	52				

a. R Squared = .390 (Adjusted R Squared = .311)

Essential Competencies (Competency)

Analysis of Covariance (ANCOVA) was used as the method of analysis, taking the posttest scores of Essential Competencies as the dependent variable and school as the independent variable. The covariates were the pretest scores of Essential Competencies, student RTI, Gender, Age, and Race. The covariates were included in the analysis as control variables to minimize the possible impact these variables might have on the posttest scores of Essential Competencies.

The result of the analysis indicated that students in School 1 (with gamification) had a mean score of 74.63(S.D.=23.233). Students in School 2 (without gamification) had a mean score of 72.50(S.D.=13.828). School 1 and School 2 data show student mastery of grade-level skill of Essential Competency for fourth grade. The result of the ANCOVA indicated that there was no significant difference in the Essential Competencies scores ($F(1, 46)=.754$, $p>.05$) between students in School 1 (with gamification) and the students in School 2 (without Gamification; See Table 11).

Table 11

Analysis of Covariance (ANCOVA) – Competencies

Dependent Variable: Competency2 (Post-test)						
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	8939.892[a]	6	1489.982	6.899	.000	.474
Intercept	3770.228	1	3770.228	17.457	.000	.275
RTI	325.490	1	325.490	1.507	.226	.032
Age	2979.531	1	2979.531	13.796	.001	.231
Gender	651.123	1	651.123	3.015	.089	.062
Race	86.432	1	86.432	.400	.530	.009
Competency1 (Pre-test)	5075.219	1	5075.219	23.499	.000	.338
School	162.808	1	162.808	.754	.390	.016
Error	9934.976	46	215.978			
Total	305856.000	53				
Corrected Total	18874.868	52				

a. R Squared = .474 (Adjusted R Squared = .405)

Extended Reasoning (Reasoning)

Analysis of Covariance (ANCOVA) was used as the method of analysis, taking the posttest scores of Reasoning as the dependent variable and school as the independent variable. The covariates were the pretest scores of Reasoning, student RTI, Gender, Age, and race. The covariates were included in the analysis as control variables to minimize the possible impact these variables might have on the posttest scores of Reasoning.

The result of the analysis indicated that students in School 1 (with gamification) had a mean score of 54 (S.D.=18.57). Students in School 2 (without gamification) had a mean score of 46.15 (S.D.=13.59). Students in School 1 and School 2 scored below 70, indicating mastery level of 70 was not achieved. The result of the ANCOVA suggests that students in School 1 (with gamification) scored significantly higher in Extended Reasoning than students in School 2 (without Gamification; $F(1, 46) = 7.449$, $p < .01$). The effect size (.139) of the significant difference is small (See Table 12).

Table 12

Analysis of Covariance (ANCOVA) – Reasoning

Dependent Variable: Reasoning2 (Post-test)

Dependent Variable: Reasoning2						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4007.119[a]	6	667.853	2.957	.016	.278
Intercept	163.279	1	163.279	.723	.400	.015
RTI	312.987	1	312.987	1.386	.245	.029
Age	27.169	1	27.169	.120	.730	.003
Sex	194.313	1	194.313	.860	.358	.018
Race	131.377	1	131.377	.582	.450	.012
Reasoning1	2355.319	1	2355.319	10.430	.002	.185
School	1682.096	1	1682.096	7.449	.009	.139
Error	10387.673	46	225.819			

Total	147696.000	53
Corrected Total	14394.792	52

a. R Squared = .278 (Adjusted R Squared = .184)

Compute with Whole Numbers (Compute)

Analysis of Covariance (ANCOVA) was used as the method of analysis, taking the posttest scores of Compute with Whole Numbers as the dependent variable and school as the independent variable. The covariates were the pretest scores of Computing with whole Numbers, student RTI, Gender, Age, and Race. The covariates were included in the analysis as control variables to minimize the possible impact these variables might have on the posttest scores of Computing with Whole numbers.

The result of the analysis indicated that students in School 1 (with Gamification) had a mean score of 59.19 (S.D.=21.40). Students in School 2 (without Gamification) had a mean score of 61.98 (S.D.=16.276). The mastery level of 70 was not achieved by students of either school for Computing of Whole numbers. The result of the ANCOVA indicated that there was no significant difference in the Compute with Whole Numbers scores ($F(1, 46)=.975$, $p>.05$) between students in School 1 (with Gamification) and the students in School 2 (without Gamification; See Table 13)

Table 13
Tests of Between-Subjects Effects

Dependent Variable: Compute2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	8167.280[a]	6	1361.213	6.167	.000	.463
Intercept	142.213	1	142.213	.644	.427	.015
RTI	504.305	1	504.305	2.285	.138	.050
Age	159.881	1	159.881	.724	.399	.017
Sex	194.020	1	194.020	.879	.354	.020
Race	28.077	1	28.077	.127	.723	.003
Compute1	7913.246	1	7913.246	35.851	.000	.455
School	215.241	1	215.241	.975	.329	.022
Error	9491.200	43	220.726			
Total	200792.000	50				
Corrected Total	17658.480	49				

a. R Squared = .463 (Adjusted R Squared = .388)

Mathematics (Math)

Analysis of Covariance (ANCOVA) was used as the method of analysis, taking the posttest scores of Math as the dependent variable and school as the independent variable. The covariates were the pretest scores of Math, student RTI, Gender, Age, and Race. The covariates were included in the analysis as control variables to minimize the possible impact these variables might have on the posttest scores of Math.

The result of the analysis indicated that students in School 1 (with Gamification) had a mean score of 61.19 (S.D.=16.625). Students in School 2 (without Gamification) had a mean score of 62.55 (S.D.=10.288). Students in both schools did not show mastery of grade-level skills of Mathematics for fourth grade. The result of the ANCOVA indicated that there was no significant difference in the Mathematics scores ($F(1, 46)=.195$, $p>.05$) between students in School 1 (with Gamification) and the students in School 2 (without Gamification; See Table 14).

Table 14

Analysis of Covariance (ANCOVA) – Mathematics

Dependent Variable: Math2 (Post-test)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4517.630[a]	6	752.938	6.688	.000	.471
Intercept	778.921	1	778.921	6.919	.012	.133
RTI	155.673	1	155.673	1.383	.246	.030
Age	350.958	1	350.958	3.117	.084	.065
Gender	7.979	1	7.979	.071	.791	.002
Race	.762	1	.762	.007	.935	.000
Math1 (Pre-test)	3449.053	1	3449.053	30.637	.000	.405
School	21.954	1	21.954	.195	.661	.004
Error	5066.062	45	112.579			
Total	208976.000	52				
Corrected Total	9583.692	51				

a. R Squared = .471 (Adjusted R Squared = .401)

Data analysis from ANCOVA shows no significant difference ($p=.254$) for Number Sense and Operations between School 1 that used Gamification and School 2 that did not use Gamification. The results indicated that implementing Gamification for Number Sense was not deemed useful for higher scores. Students in School 2 were reported to have a higher mean score of 76.19 as compared to students in School 1 with a mean score of 68.74. The skill of Algebra Patterns was analyzed, and the results indicated there was no significant difference ($p=.591$) between the school that used Gamification and the school that did not implement Gamification with fourth grade math students. Results of the ANCOVA for Data Analysis/Probability Statistics scores indicated that there was no significant difference between School 1 and school 2 (p=.306). However, students in School 1 showed higher scores than students in School 2 that did not implement Gamification. In Geometry, students in School 1 performed significantly better than students in School 2, showing that Gamification was taking effect. In Measurement, no significant difference was detected in scores between students in School 1 and students in School 2. Students in School 2 were reported to achieve higher scores than students at School 1. The ANCOVA data for Conceptual understanding showed no significant difference (p=.128) between students in School 1 and School 2. This would indicate that Gamification was not useful in helping students in School 1. In Competency, there was no significant difference shown between the posttest scores of students in School 1 and those in School 2. This would indicate that Gamification was not helpful to students in School 1. For the skill of Extended Reasoning, the mean scores of students in School 1 showed significantly higher (p=.009) than those of the students in School 2. In Compute with Whole Numbers, a higher achievement score of 61.98 was reported in School 2, and 59.19 was reported in School 1. There was no significant difference (p=.329) in the Computer scores between students in School 1 and School 2. In the skill of Mathematics, no significant difference was detected between the scores of students in School 1 and School 2. Students in School 2 were reported to have a higher mean score in math than students in School 1 (See Table 15).

Table 15

Student Mean Scores in School 1 and School 2 with Significance of Differences

Significant Difference Skill	School 1 (with Gamification)	S.D.	School 2 (without Gamification)	S.D.	Significant Difference p
Number	68.74	22.43	76.19	12.48	.254
Algebra	75.22	19.56	74.35	16.72	.591
Data	63.22	20.18	56.81	16.71	.306
Geometry	60.15	19.18	53.31	16.19	.017
Measurement	38.89	17.43	46.85	16.86	.275
Concept	61.19	19.107	69.38	14.921	.128
Competencies	74.63	23.233	72.50	13.828	.390
Reasoning	54.00	18.57	46.15	13.59	.009
Compute	59.19	21.40	61.96	16.276	.329
Mathematics	61.19	16.625	62.65	10.288	.661

Student Attainment of Grade Level Achievement

A score of 70 was used as a criterion to determine student attainment of grade-level achievement and mastery of skills. Students scoring at 70 and above were considered as achieving at grade level with mastery of skills. Students scoring below 70 were considered as not achieving at grade level without mastery of skills. All ten subsets of mathematics skills were used when analyzing data for student attainment of grade-level achievement. The student posttest achievement scores of each of the ten skills were averaged. The means of each mathematics skill of students in School 1 (with Gamification) and students in School 2 (without Gamification) were calculated. Each of the mean scores of skills was compared with the criterion 70 to determine if students of School 1 and School 2 were achieving at grade level in a mathematics skill. In the skill of Number and Operations, School 2 had a mean score of 76.19, and School 1 had a mean score of 68.74. This shows that students in the school using Gamification did not master the skill. The data from the analysis showed that students in both schools scored above 70 on Algebra, which determined student attainment of Grade Level achievement with School 1, 75.22, and School 2, 74.35. There were similar results for Competency, with data reported for School 1 (74.63) being slightly higher than School 2 (72.50). Students from School 1 did not show mastery for Numbers, Data, Geometry, Measurement, Concept, Reasoning, Compute, and Mathematics. The data from School 2 showed no mastery for Data, Geometry, Measurement, Concept, Reasoning, Compute, and Mathematics. (See Table 16).

Table 16

Mathematics Mean Scores by School and by Skill

Skill	**School 1 (with Gamification)**	**Grade Level**	**School 2 (without Gamification)**	**Grade Level**
Number	68.74	N	76.19	A
Algebra	75.22	A	74.35	A
Data	63.22	N	56.81	N
Geometry	60.15	N	53.31	N
Measurement	38.89	N	46.85	N
Concept	61.19	N	69.38	N
Competencies	74.63	A	72.50	A
Reasoning	54.00	N	46.15	N
Compute	59.19	N	61.96	N
Mathematics	61.19	N	62.65	N

N.B. A = Achieving at grade level
N = Not achieving at grade level

Summary

The purpose of this study was to examine if fourth-grade student's math achievement would increase and if students would show mastery of grade-level skills with the use of Gamification in math instructions. Data were gathered from School 1, which used Gamification, and School 2, which did not use Gamification. The findings of the study did not prove that the use of Gamification showed a significant difference in the ten skills measured. Two skills, Geometry, and Reasoning showed a significant difference between School 1 and School 2, with

School 1 achieving higher than School 2. Above all, students in School 1 scored higher than students in School 2 in five skills (Algebra, Data, Geometry, Competency, and Reasoning). However, students in School 2 scored higher than students in School 1 in the other five skills (Number, Measurement, Conceptualization, Computation, and Math).

In determining the grade level skill attainment, students in School 1 were only able to achieve in two skills (Algebra and Competency). On the other hand, students in School 2 were able to attain grade level skill in three skills (Number, Algebra, and Competency). Overall, students in both schools were not able to attain the grade level skill in most of the ITBS mathematics test areas.

CHAPTER 5: CONCLUSION

This chapter focused on providing a summary of the major findings of the study, discussing what the findings suggest, giving an overview for further research, and offering recommendations for educational practitioners. The chapter also highlighted the special contributions of the findings of this study. The findings indicated if the use of gamification would help students attain higher math achievement on IOWA and the mastery of grade-level skills. The data reported were gathered from Fall and Spring student assessments.

Content learning blocks have taken on a new look in this global society. Students are assessed formally and informally throughout the year to determine their learning growth. This quantitative research was conducted to assess the effect of employing gamification in fourth-grade math classes. To assess the effect of the ten skills from the Mathematics component of the IOWA test were used. The skills Number Sense and Operations, Algebra Patterns/ Connections, Data Analysis/Probability/Statistics, Geometry, Measurement, Conceptual Understanding, Essential Competencies, Extended Reasoning, Compute with Whole Numbers, and Mathematics are all the skills that can be assessed through gamification on the IOWA.

Research Questions

- Do students using gamification in class attain higher math achievement on IOWA than those students who do not use Gamification?
- Do students using gamification in-class master more grade-level skills on IOWA than students not using gamification programs?

Summary of Major Findings

The population for this study consisted of 53 students. This study originated with 33 students from School 1 with pretest data. Between pretest and posttest, six students withdrew from the school, which left 27 students by -post-testing of IOWA assessment. There were 26 students from School 2 with pretest and posttest data. There were 50 students that belonged to Tier 1, and 3 belonged to Tier 2. Demographic Analysis for gender consisted of 23 male students and 30 female students. These fourth-grade students combined for a total of 47 (88.7%) students in age 9 and 6 (11.3%) students in age 10. The race of the students consisted of 50 black students, two white, and 1 student identified as other. The two schools mirrored sufficiently in demographics as they were within a 5-mile radius of one another. The teacher at School 1, which used gamification, had 13 years of teaching experience versus the one at School 2 with 23 years of teaching experience. The teacher using gamification had earned an Education Specialist Degree in Curriculum and Instruction, whereas the teacher not using gamification had earned a bachelor's degree in early childhood education.

Research Question 1 asked if using gamification in a fourth-grade math class on the IOWA would help students to attain higher math achievement. The findings of the study indicated that out of the ten skills tested, there were five skills from the Math IOWA showing that the students using gamification scored higher than the students not using gamification. These five areas were Algebra, Data, Geometry, Competencies, and Reasoning. However, in these five areas, only Geometry and Reasoning showed significant differences between the two groups of students. In the other five areas: Numbering, Measuring, Conceptualization, Compute, and Math, students in School 2, which did not use gamification, even scored higher than students in School 1, which used gamification. There is no overwhelming evidence in this study to indicate that students using gamification outscored students not using gamification.

Research Question 2 asked, "Do students using gamification in-class master more grade-level skills on IOWA than students not using gamification programs?" The findings for this research question showed no proof that students using gamification mastered more grade-level skills than students not using gamification. Students in School 1 were able to master two skills at the grade level: Algebra and Competencies. Students in School 2 were able to master three skills at the grade level: Algebra, Competencies, and Numbering. When students work on challenging tasks using game technology, their motivation to compete against and improve their own previous scores increases (Inal & Cagiltay, 2007). The findings of this study showed that fourth-grade students using gamification were only able to master two of the ten skills at grade level. The evidence does not support the claim that students master more grade-level Math skills with the use of gamification.

Discussion

This research was used to investigate if the use of Gamification could help enhance the fourth-grade students' achievement in IOWA math scores. Students have the ability to learn. Teachers are looking for tools to use to enhance student learning and mastery of grade-level skills within an academic school year. Gamification is the recent trend that offers to increase student engagement in learning through the inclusion of game-like features like points and badges in non-game contexts (Looyestyn et al., 2017). Desired outcomes would show that the use of gamification increased student engagement by providing higher achievement scores and mastery of more grade-level skills than students not using gamification. Gamification of educational processes can be described as the successful integration of the gamification framework into the curriculum in order to improve students' motivation, academic achievement, and attitudes toward lessons (Yildirim, 2017). Chen et al. (2018) stated, “Gamified active learning has been shown to increase students’ academic performance and engagement and help them make more social connections than standard course settings.” However, the findings of this study did not indicate that students receiving gamification scored significantly higher than students not receiving gamification in most math areas tested. Only in the areas of Geometry and Reasoning that students receiving gamification scored significantly higher than students not receiving gamification. This research, different from some of the previous studies, did not focus on student engagement or motivation. Fengfeng (2008) also found that using computer games in math increased the achievement of elementary students, especially when they were used with a cooperative learning approach. The findings of this study disagreed with the findings in Fengfeng's research.

Bitter and Pierson (2005) stated: "A recent meta-analysis demonstrated that students using technology had modest but positive gains in learning outcomes over those students who used no technology" (p. 107). This study compared two groups of students using some form of technology. Gamification was able to show a high impact on student achievement in two of the ten math skills tested. Students were able to show mastery of grade-level math skills in two of the ten math skills tested.

Gamification was used in this study to determine if students using gamification would yield higher mastery of skills and achieve more grade-level skills than students not receiving gamification. Kaplan University embedded Gamification software to their LMS and ran a pilot project in one of its courses. The results included an improvement of 9% on the students' grades and a 16% course completion improvement (NMC-Horizon Report, 2014, p.43). In this study, students from School 2 were able to attain grade-level skills in 3 areas, whereas students in School 1 were only able to attain grade-level skills in 2 areas. This study was not designed to examine pre- and post-test results. Neither was it intended to investigate course completion outcomes. Further research could follow the pre- and post- and course completion directions.

Moreover, research suggests that game technology improves student performance on algebra and mathematics problem solving (McFarlane et al., 2002), reading comprehension, spelling, and decoding of grammar (Rosas et al., 2003), and complex thinking skills, including problem-solving, strategic planning, and self-regulation (Cordova & Lepper, 1996; Ricci et al., 1996). The findings of the research by McFarlane et al. (2002) align with the results from this research showing improvement in student performance in the area of algebra. The study by Olkun et al. (2005) suggests that it was more effective to teach mathematics by integrating mathematical content and technology in a manner that enables students to make playful mathematical discoveries (Olkun et al., 2005). The use of gamification is considered playful mathematical discoveries. Teachers provide students with the opportunity to learn while playing. This statement would be validated by a study done by Lin (2008), which stated that students believed that integrating hands-on activities with physical manipulatives as well as computer resources would engage the students in their learning and lead to a better understanding of the content. The idea that students are using skills that create an atmosphere where they are learning in a manner that is associated with the integration of technology provides a connection to gamification being sufficient for students' learning. It is believed that when technology is used appropriately in classroom instruction, it has a very positive impact on student achievement or success (Eyam & Huseyin, 2014). Any gains made in achievement is considered a success. In this study, students showed small but significant gains. The gains helped create a foundation for future learning. Even though the gains were only shown in two of the ten math areas, they serve as solid evidence that gamification works in helping students achieve better.

Previous research has stated that game-based learning has higher effects on math academic achievement. According to the research results, gamification-based teaching practices have a positive impact on student achievement and students' attitudes toward lessons (Yildirim, 2017). The findings of this research only indicated that gamification-based teaching practices could have an impact on fourth-grade students' math scores in IOWA in two areas, Geometry and Reasoning. It is possible that game-based learning would have been enhanced with teaching aids such as student conferences on their progress as the task in the program was completed. Unfortunately, teachers monitoring the progress of students during the research periods was not part of the scope of this study. When teachers monitor the learning process, learning conferences between students and teachers should take place. Teacher and student conferences could provide the student with feedback that can lead to improved motivation and self-awareness of mistakes and self-correction.

Another finding of the study showed that students from both School 1 and School 2 were able to master their skills in the areas of Algebra and Competencies at the fourth-grade level. I believe the math curriculum map for fourth grade at the schools could have led to the skill mastery result. Students are testing in March normally after the Algebra unit with continuous integration of Competency skills. Algebra skills such as using inverse operations and finding patterns would have been covered right before testing. Fourth-grade students complete math skills such as Number talks and Math talks that are heavily embedded in the county Curriculum map during the second semester. These skills are not easy, but one would conclude that the Algebra and Competency skills were still fresh on students' minds while they were taking the test. The timing was just right.

Implications

The way teachers are integrating technology into their daily lessons can be a game-changer if students are using gamification. Teachers could use technology integration to align with students' needs, curriculum requirements and to create and enforce ongoing remediation. The use of gamification has been used to engage students during technology integration in class. For this research, gamification was examined to determine if achievement and skills could be improved on the ITBS by employing gamification. Some students in this study showed growth in achievement, and they mastered more skills. Unfortunately, the group, in general, did not show the same results. Gamification can continue to be used for many students and in many discipline areas. Using gamification in class could help reinforce the skills being taught. Not all students could benefit from the use of gamification in the learning process.

Students use technology programs for several different reasons in elementary math. Gamification may not fix and meet all the desired needs of the students. It can be used to motivate and engage students while aligning curriculum to class instruction. For teachers or schools that desire to use gamification to increase students' mastery of skills and increase achievement scores, teachers may want to consider additional initiatives. These initiatives would include monitoring students' progress, catering skills, and aligning programs, as well as collecting data and informing students of their progress. These are components that teachers could include in daily lessons in other areas of learning, and technology rotation could be a part of this pedagogy.

Limitations

This study faced a few limitations. Limitations were in the form of not being able to study students from the same school with the same teacher, student sample size, and students withdrawing after the pretest. The researcher was not allowed to conduct a study with students receiving different instructional methods from the same class of students and the same teacher. Finding a group of students in a different school with similar demographics provided a new outlook on the research. The research ended up consisting of two groups of students in different schools with different teachers. This was not ideal. The limitation was also in finding enough students from School 2 to parallel to students in School 1. In addition to student demographic limitations, it was found that School 1 had a higher student mobility rate than School 2. Some students started the study using gamification and withdrew from School 1.

Limitations of this research also included students entering the fourth grade with gaps in their learning. Gaps show that many students leaving the third grade not achieving at the third-grade achievement levels. Student achievement differences in this study were statistically controlled to maintain a fairer way of comparison.

This study consisted of two fourth grade groups from neighboring schools. There were limitations due to the sample size. The two schools were neighboring schools with similar demographics, which helped with paralleling the data findings. The sample consisted of fourth-grade students being taught the same skills during the same period of time. Limitations included using only a limited number of students from one grade level, involving only one discipline area, and consisting of only two elementary schools. The limitations of the study make the generalization of the findings difficult.

Recommendations for Future Research

In continuation of this research for the future, there are a few recommendations that can be offered. Some of the activities of future studies can be designed to achieve greater efficiency to meet the student's needs. Some students can benefit from having self-paced lessons where others should have skills assigned according to the area(s) of need. Teachers and students would most likely benefit from using gamification as an intervention for remediation instead of letting students work at their own pace during the academic block. This would require teachers to have a role in the research instead of them only serving as facilitators for technology integration. Using gamification for acceleration and remediation would align with differentiation, which should already be embedded in this research. Students can be rotated to small groups through some form of grouping. Data from the pretest can drive the creation of the groups.

Considering using the games as a reward could be a possibility in increasing student achievement. Research has stated that gamification increases student engagement. Future research can use the engagement component paralleled with rewarding through the use of games as a reward. The amount of time the students would use the gaming features would be considered according to the amount of correct answers students' master. Now students receive game time according to the guidelines of the programs. Some programs have setting to allow games to be disabled or limited according to teacher settings. These settings were not disabled or limited during this research.

Recommendations would also include the same teacher teaching all students that are in the study. The same teacher would increase the validity of the research. Taking the teacher component out of the equation would limit the questions on the skills being taught, the length of time, and the rigor of the instruction being taught.

Further research could also consider having teachers conference with students on the data used in the research. Conferencing with students will provide them with data that can drive the analysis and encourage the students. The idea that students are aware that the teacher is monitoring their progress could help motivate the students to learn. Finally, future research in the use of gamification could be completed using the qualitative method. More research needs to be conducted to examine if the use of gamification could, indeed, help student learning. Alternating the research design could possibly yield different findings.

Recommendations for Educational Practitioners

Gamification has been shown by some researchers to improve student achievement scores and the number of skills mastered. The program clearly is not a one size fits all program. If the teachers or school would like to use the program, a recommendation would be to monitor students' progress for growth. This can be done through formative and summative assessments that should align with the pretest tool and the gamification program. The goal for monitoring is to determine if students should continue to use the program or if students should use a different program to help with improving student achievement and closing learning gaps.

The program has data that can be used to drive instruction. Teachers can and should use that data periodically. Using the breakdown of the items on the IOWA assessment along with the curriculum map, teachers can create differentiated plans for students. These maps will gauge the amount of learning time according to the level of skills, from the skills needing the most growth to skills that students have mastered. The alignment will aid in creating a guide for teachers to supervise student progress and students to self-monitor their improvement. This tool can be used to chart progress scores and student achievement.

Gamification would certainly be beneficial to students if students were able to close achievement gaps in math. Many students are building on foundations in math that are not solid. Not having a solid foundation creates barriers that would cause students not to perform well in future math classes. Georgia Standards of Excellence create Math courses as prerequisites of each other. In order for students to close gaps, they will need a teacher with strong background knowledge of Math standards as well as pedagogy for teaching Math. Teaching pedagogy would incorporate interventions such as gamification to aid in closing those gaps. Gamification would be implemented as part of the framework for instruction. Additionally, there are other components of Math that could benefit from using gamification. Fourth graders could focus on Multiplication and Division as well as Fractions. Fourth-grade students need a concrete understanding of strategies used for mastery of these skills. Concrete knowledge used to evaluate fractions along with understanding place value when multiplying and dividing whole numbers will help create a foundation that will lead strong Math learners.

Conclusion

In conclusion, teachers are using gamification in daily lessons to modernize students' learnings. Students are using devices daily as part of a growing trend in society. Not only are students using devices and programs, but teachers are also using programs such as Classdojo, PBIS apps, as well as other gamification programs to engage and motivate students to learn. With the use of teacher pedagogy and curriculum integrations, real-time data can be collected to track students' progress. Research shows that students are struggling with mastering math skills. The findings in this research show that some students using gamification show little or no progress according to posttest data.

Gamification is a program that many teachers and students will continue to use. There are several different programs that are used by students and teachers. Teachers are learning more and more about implementing gamification in lessons and using applications for building elementary skills. Teachers will have the opportunity to incorporate and utilize the application for student achievement.

The data analyzed in this study showed that students using gamification did not yield higher achievement scores than students not using gamification. When analyzing the mean scores of the ten skills that were used to collect data, there were only five skills indicating that students using gamification achieved higher mean scores than students not using gamification.

These five skills were Algebra, Data, Geometry, Competencies, and Reasoning. A significant difference was only indicated in Geometry and Reasoning. Out of these five skills, Algebra and Competencies were the only skills in which students in School 1 could master (70%) at their grade level. Students with gamification in School 1 failed to master eight out of the ten fourth grade math skills.

In summary, students using gamification were able to achieve significantly higher than students not using Gamification in only two skills, Geometry, and Reasoning. Two skills out of 10 did not provide convincing evidence that gamification could effectively increase student mathematics achievement in elementary schools. These findings are important due to the changes being made to help schools compete in a global society. Educators will have information that will guide in planning their lessons for the students. The findings of this study will help in decision making for student use of gamification for technology rotations. If the desired outcome is for student achievement and mastery of grade-level skills, teachers may consider if gamification will yield the best results. Further research could lead to valuable information guiding teachers' roles in monitoring and conferencing with students.

Teachers are struggling to find resources that will not only engage students but promote learning where students are able to master grade-level skills. Creating a foundation in Math in elementary school will help with closing achievement gaps. Researching the effects of gamification and analyzing the data has provided teachers with information to determine if the use of gaming programs could actually improve student achievement and master grade-level skills. The findings of this study could lead teachers to look for ways to cater to gamification for student achievement gains. In catering to the use of gamification, teachers would play a significant role in the implementation of the program. This preliminary study only required teachers to provide students with the time to use the program with no additional monitoring of their progress. However, the results of this study paved the way for future studies to focus on additional controls of extraneous variables to yield more detailed findings to help improve student achievement.

References

All, A., Castellar, E. P. N., & Van Looy, J. (2014). Measuring effectiveness in digital game-based learning: A methodological review. *International Journal of Serious Games*, *1*(2), 18

Amory, A., Naicker, K., Vincent, J., & Adams, C. (1999). The use of computer games as an educational tool: Identification of appropriate game types and game elements. *British Journal of Educational Technology*, *30*(4), 311-321.

Arslan, C. (2010). An investigation of anger and anger expression in terms of coping with stress and interpersonal problem-solving. *Educational Sciences: Theory and Practice*, *10*(1), 25-43.

Bitter, G. G., & Pierson, M. E. (1998). *Using technology classroom*. Viacom. New York: Pearson Edition.

Bogost, I. (2015). Why Gamification is bullshit. *The gameful world: Approaches, issues, applications*, *65*.

Brinkerhoff, J. (2006). Effects of a long-duration, professional development academy on technology skills, computer self-efficacy, and technology integration beliefs and practices. *Journal of Research on Technology in Education*, *39*(1), 22-43.

Callaghan, M. N., Long, J. J., van Es, E. A., Reich, S. M., & Rutherford, T. (2018). How teachers integrate a math computer game: Professional development use, teaching practices, and student achievement. *Journal of Computer Assisted Learning*, *34*(1), 10-19.

Campbell, A. A. (2016). *Gamification in higher education: Not a trivial pursuit*. St. Thomas University.

Chen, C. C., Huang, C., Gribbins, M., & Swan, K. (2018). Gamify online courses with tools built into your learning management system (LMS) to enhance self-determined and active learning. *Online Learning*, *22*(3), 41-54.

Chen, H. R., Jian, C. H., Lin, W. S., Yang, P. C., & Chang, H. Y. (2014, July). Design of digital game-based learning in elementary school mathematics. In *2014 7th International Conference on Ubi-Media Computing and Workshops* (pp. 322-325). IEEE.

Cordova, D. I., & Lepper, M. R. (1996). Intrinsic motivation and the process of learning: Beneficial effects of contextualization, personalization, and choice. *Journal of Educational Psychology*, *88*(4), 715.

Darling-Hammond, L. (2000). Teacher quality and student achievement. *Education Policy Analysis Archives*, *8*, 1.

David, L. (2016, January 26). Gamification in Education . *Learning Theories*. Retrieved from https://www.learning-theories.com/gamification-in-education.html.

Dicheva, D., Dichev, C., Agre, G., & Angelova, G. (2015). Gamification in education: A systematic mapping study. *Educational Technology & Society*, *18*(3), 75-89.

Elshemy, N. (2017, May). Impact of Gamification strategy on academic achievement and achievement motivation toward learning. In *Proceedings of Teaching and Education Conferences* (No. 4907055). International Institute of Social and Economic Sciences.

Eyal, L. (2015). Taxonomy of students' use of the iPad in education: A pilot. *Interdisciplinary Journal of e-Skills and Lifelong Learning*, *11*, 67-85.

Eyyam, R., & Yaratan, H. S. (2014). Impact of use of technology in mathematics lessons on student achievement and attitudes. *Social Behavior and Personality: An International Journal*, *42*(1), 31S-42S.

Fengfeng, K. (2008). A case study of computer gaming for math: Engaged learning from gameplay? December 2008; Computers & Education 51(4):1609-1620.

Flanagan, J. L. (2008). Technology: The positive and negative effects on student achievement. *Education and Human Development Master's Theses*. 254.

Goktas, Y., Yildirim, S., & Yildirim, Z. (2009). Main barriers and possible enablers of ICTs integration into pre-service teacher education programs. *Journal of Educational Technology & Society, 12*(1), 193-204.

Griffiths, M. (2002). The Educational benefits of videogames. *Education and Health, 20* (3), 47-51.

Hall, T. (2002). *Differentiated instruction*. Wakefield, MA: National Center on Accessing the Curriculum.

Hamari, J., Koivisto, J., & Sarsa, H. (2014, January). Does gamification work? --a literature review of empirical studies on Gamification. In *2014 47th Hawaii International Conference on System Sciences (HICSS)* (pp. 3025-3034). IEEE.

Herold, B. (2016). Technology in education: An overview. *Education Week, 20*, 129-141.

Hung, A. C. Y. (2017). A critique and defense of gamification. *Journal of Interactive Online Learning*, *15*(1), 937-949.

Inal, Y., & Cagiltay, K. (2007). Flow experiences of children in an interactive social game environment. *British Journal of Educational Technology*, *38*(3), 455-464.

Johnson, T. (2014). *Grade 5 Math Teachers' Experiences with the Integration of Technology into the Curriculum* (Doctoral dissertation, Walden University, Minneapolis, Minnesota.)

Kapp, K. M. (2012). *The Gamification of learning and instruction: Game-based methods and strategies for training and education*. Hoboken, New Jersey: John Wiley & Sons.

Kirkwood, J. J., & Foster, P. N. (1999). Relating technology education to trends in elementary education. *Technology Teacher*, *59*, 7-12.

Lei, J., & Zhao, Y. (2007). Technology uses and student achievement: A longitudinal study. *Computers & Education*, *49*(2), 284-296.

Li, Q. (2007). Student and teacher views about technology: A tale of two cities. *Journal of Research on Technology in Education*, *39*(4), 377-397.

Li, Q., & Ma, X. (2010). A meta-analysis of the effects of computer technology on school students' mathematics learning. *Educational Psychology Review*, *22*(3), 215-243.

Lin, C. Y. (2008). Beliefs about using technology in the mathematics classroom: Interviews with pre-service elementary teachers. *Online Submission*, *4*(2), 135-142.

Looyestyn, J., Kernot, J., Boshoff, K., Ryan, J., Edney, S., & Maher, C. (2017). Does gamification increase engagement with online programs? A systematic review. *PloS one*, *12*(3), e0173403.

McFarlane, A., Sparrowhawk, A., & Heald, Y. (2002). *Report on the educational use of games*. TEEM (Teachers evaluating educational multimedia), Cambridge.

Mendicino, M., Razzaq, L., & Heffernan, N. T. (2009). A comparison of traditional homework to computer-supported homework. *Journal of Research on Technology in Education*, *41*(3), 331-359.

Mert, Y., & Samur, Y. (2018). Students' opinions toward game elements used in gamification application. *Turkish Online Journal of Qualitative Inquiry*, *9*(2).

New Media Consortium. (2014). *NMC Horizon Report 2014* Higher Education Edition.

Nistor, G. C., & Iacob, A. (2018). The advantages of Gamification and game-based learning and their benefits in the development of education. In *the International Scientific Conference* *eLearning and Software for Education* (Vol. 1, pp. 308-312). " Carol I" National Defence University.

Olkun, S., Altun, A., & Smith, G. (2005). Computers and 2D geometric learning of Turkish fourth and fifth graders. *British Journal of Educational Technology*, *36*(2), 317-326.

Phillips, C. R., & Trainor, J. E. (2014). Millennial students and the flipped classroom. *ASBBS Proceedings*, *21*(1), 519.

Prieto Calvo, C., Santos Sánchez, M. J., Hernández Encinas, A., Moreno, M., Rodríguez Puebla, C., & Queiruga-Dios, A. (2016). Dispositivos Móviles como instrumentos para la Adquisición de Competencias en Materias de Ciencias.

Robertson, M. (2010). Can't play, won't play. *Hide & Seek*, *6*.

Robinson, K. (2006). *How schools kill creativity. TED: Ideas worth.* Directed by TED Talks.

Rosas, R., Nussbaum, M., Cumsille, P., Marianov, V., Correa, M., Flores, P., ... & Rodriguez, P. (2003). Beyond Nintendo: design and assessment of educational video games for first and second grade students. *Computers & Education*, *40*(1), 71-94.

Sailer, M., Hense, J. U., Mayr, S. K., & Mandl, H. (2017). How Gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. *Computers in Human Behavior*, *69*, 371-380.

Sanmugam, M., Abdullah, Z., Mohamed, H., Aris, B., Zaid, N. M., & Suhadi, S. M. (2016, May). The affiliation between student achievement and elements of Gamification in learning science. In *2016 4th International Conference on Information and Communication Technology (ICoICT)* (pp. 1-4). IEEE.

Sarı, A., & Altun, T. (2016). Examination of students’ perceptions about computer lessons carried out with gamification & 91; Oyunlaştırma Yöntemi ile İşlenen Bilgisayar

Derslerinin Etkililiğine Yönelik Öğrenci Görüşlerinin İncelenmesi & 91. *Turkish Journal of Computer and Mathematics Education*, *7*(3), 553-577.

Saurabh. (2014, May 24). *Bring gamification of education to your classroom.* Retrieved from http://mindbox.in/bring-gamification-of-education-to-your-classroom/.

Sillaots, M. (2014, August). Gamification of higher education by the example of course of research methods. In *International Conference on Web-Based Learning* (pp. 106-115). Springer, Cham.

Simon. (2014, January 20). Ways to develop self-efficacy beliefs self-esteem or Confidence. *Reflectd on the mind.* Retrived from:http://reflectd.co/about/.

Sullivan, P., Mornane, A., Prain, V., Campbell, C., Deed, C., Drane, S., ... & Smith, C. (2009). Junior secondary students' perceptions of influences on their engagement with schooling. *Australian Journal of Education*, *53*(2), 176-191.

Tarng, W., & Tsai, W. (2010). The design and analysis of learning effects for a game-based learning system. *Engineering and Technology*, *61*, 336-345.

Technology in Education. (2016, February 5). An Overview - Education Week.. http://www.edweek.org/ew/issues/technology-in-education/ (accessed 11 21, 2018).

Thomas, L. (2000). *Technology integration, technology in Schools.* Retrieved from:http://nces.ed.gov/pubs2003/tech_schools/chapter7.asp (accessed 11 21, 2018).

Tugun, V. (2018). Impacts and opinions on the technology self-sufficiency of the students who are coding education in the flipped classroom adapted to the ARCS motivation model. *TEM Journal*, *7*(2), 366.

Vigdor, J. L., Ladd, H. F., & Martinez, E. (2014). Scaling the digital divide: Home computer technology and student achievement. *Economic Inquiry*, *52*(3), 1103-1119.

Whitehill, B. V., & McDonald, B. A. (1993). Improving learning persistence of military personnel by enhancing motivation in a technical training program. *Simulation & Gaming*, *24*(3), 294-313.

Wouters, P., & Van Oostendorp, H. (2013). A meta-analytic review of the role of instructional support in game-based learning. *Computers & Education*, *60*(1), 412-425.

Yang, D. C., & Tsai, Y. F. (2010). Promoting sixth graders' number sense and learning attitudes via technology-based environment. *Journal of Educational Technology & Society*, *13*(4), 112-125.

Yildirim, I. (2017). The effects of gamification-based teaching practices on student achievement and students' attitudes toward lessons. *The Internet and Higher Education*, *33*, 86-92.92.

Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps*. "O'Reilly Media, Inc."

Appendices

Appendix A: Permission Form

Date

Dear Parent or Guardian:

I am a student at Kennesaw State University. I am conducting a research project on the use of gamification in elementary math classes. This research will be used to identify if the use of game-based learning helps students to mastery grade level content in elementary math.

The study consists of me the researcher collecting assessment data from IOWA in the Spring and Fall. Students will not be asked to do anything special for the research. They will continue with daily learning. The small group center rotations will also be a part of daily routine. The research will also consist of collecting data such as if the student eats free or reduced lunch, a boy or girl, and if the student is in the Tier process. The project will be explained in terms that your child can understand, and your child will participate only if he or she is willing to do so. Only I and members of the research staff, if any will have access to information from your child. At the conclusion of the study, children's responses will be reported as group results only.

Participation in this study is voluntary. Your decision whether or not to allow your child to participate will not affect the services normally provided to your child by the Live Oak Elementary educators and staff. Your child's participation in this study will not lead to the loss of any benefits to which he or she is otherwise entitled. Even if you give your permission for your child to participate, your child is free to refuse to participate. If your child agrees to participate, he or she is free to end participation at any time. You and your child are not waiving any legal claims, rights, or remedies because of your child's participation in this research study.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of coding names and storing all data with password protected.

Should you have any questions or desire further information, please call me or email me at Kimble.tamisha@newton.k12.ga.us or *678-325-6654.. Keep this letter after tearing off (if this is to be done) and completing the bottom portion and place your consent in the Wednesday folder.*

Sincerely,
TaMisha Kimble, Instructional Coach Live Oak Elementary
Student of Kennesaw State University

Please indicate whether or not you wish to allow your child to participate in this project by checking one of the statements b*elow, signing your name and place form in the Wednesday folder to be returned to school.* Sign both copies and keep one for your records.

_____ I grant permission for my child to participate in Game-based study on elementary math students.

_____ I do not grant permission for my child to participate in Game-based study on elementary math students

_______________________________ _______________________________

Signature of Parent/Guardian Printed Parent/Guardian Name

____

Printed Name of Child Date

Appendix B: Student Assent Form

Child Assent to Participate

My name is TaMisha Kimble. I am inviting you to be in a research study using Prodigy during center rotations. You may be asked to the program during your technology center to see if you show growth in grade-level skills. Your parent(s) has given permission for you to be in this study, but you get to make the final choice. It is up to you whether you participate.

If you decide to be in the study, I will ask you to use technology during your small group rotations and focus on what you are learning during your center time.

You do not have to answer any question you do not want to answer or do anything that you do not want to do. Everything you say and do will be private, and your parents will not be told what you say or do while you are taking part in the study. When I tell other people what I learned in the study, I will not tell them your name or the name of anyone else who took part in the research study.

If anything in the study worries you or makes you uncomfortable, let me know and you can stop. No one will be upset with you if you change your mind and decide not to participate. You are free to ask questions at any time and you can talk to your parent any time you want. If you want to be in the study, sign or print your name on the line below:

____

Child's Name and Signature, Date

Check which of the following applies *(completed by person administering the assent.)*

- ☐ Child is capable of reading and understanding the assent form and has signed above as documentation of assent to take part in this study.

- ☐ Child is not capable of reading the assent form, but the information was verbally explained to him/her. The child signed above as documentation of assent to take part in this study.

____

Signature of Person Obtaining Assent, Date