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How Can I Improve The Math Performance Of Intermediate Students Using Game-Based Learning

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HOW CAN I IMPROVE THE MATH PERFORMANCE OF INTERMEDIATE STUDENTS USING GAME-BASED LEARNING

By

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CHAPTER ONE

Introduction

Since the beginning of intellectual time, humans have created and engaged in games whether it be to prove braun, wits, or religious affiliation (Kapp, 2012). The Mesoamerica ball game played by many ancient civilizations, including the Olmecs and Aztecs, was not just a pastime of trying to shoot a ball through a hoop on the wall, but a religious experience (Voorhies, 2013). The first documentation of the Olympics is dated back to 776 BC, and was also discovered to be related to religious festivals; however, more recently, the games are viewed as a competition of strength, speed, and endurance between various sovereign nations (Wenn, 2007). Game-based simulation has also been used in training military personnel to prepare for real conflicts in which they may be involved (Kapp, 2012). All of these games have evolved into something new, appearing in various cultures and societies for reasons such as leisure, work, religion, or skill development. What if games were used for educational purposes too? What would it look like if we embedded the human nature of game playing into our schools?

In this chapter, I explain what game-based learning is, outline some effects, tie in my personal understanding, and describe what my research capstone project will be. My thesis will explore possible outcomes to the question, *How can I improve the math performance of intermediate students using game-based learning?* Game-based learning is one approach that teachers may take when introducing, learning, or reviewing math skills at an intermediate grade level. My research and project will provide information to further the field of game-based

learning, as well as provide a website for educators to use in assisting with their own game-based learning techniques.

Personal Experience

When I was a child, my mother would set the timer for baking cookies or cooking dinner. Within that time frame, my mother, two sisters, and I would rush around the house doing as many chores in the least amount of time. We would challenge ourselves to get more done than the previous day or week. Looking back now, my mother was a genius to get her children to *want* to do chores. She fed off our competitive and playful side to get a desirable outcome - a clean house. After dinner the whole family would go outside to play softball or downstairs to play ping-pong in the winter time. While both situations vary in desired outcome, these family-oriented games helped me grow in skill. Because this game play was instilled in me as a child to accomplish a chore or to bond in a fun way, I attempt to recreate this family-oriented setting within my classroom. To manage my classroom setting as fun and engaging, all while achieving a desired outcome is the premise of my teaching philosophy.

To acquire such a setting, I have instilled a game-based learning philosophy of teaching through my five years of elementary education experience. My first game-based instruction happened when I was student teaching. A coworker suggested using “Homeworkopoly” to inspire our students to complete their homework, which was an issue in the fourth grade classroom in which I was student teaching. This is essentially a Monopoly game where students get to select a token for themselves, and get to roll a dice for every piece of homework they complete. They may earn prizes or extra turns as they move about the board. The percentage of students completing the homework in this fourth grade room went up to 100% for most days.

The students wanted to engage in this game, compete with other students, and earn prizes. After seeing this example of positive gamification in the classroom, I was curious about what other areas of learning could be game-based.

I experimented with student games over time. Similar to a reader's workshop, I installed a guided math workshop in my classroom where students would spend fifteen minutes at each station. Math facts, at my seat, teacher time, and hands on were the four components, and stations focused on skill building. For the math fact and hands on experience, I incorporated games as often as I could. I was finding that students could not wait to get to that station, would try to repeat that section, and would ask me if they could play the games later throughout the week. Like myself cleaning the house as a child, my students were wanting to practice their typically undesirable math facts. From there, I broadened my game-based learning usage in multiple categories. We often engaged in jeopardy reviews, used fact cards as questions to any board game, and even had the students design a board game themselves.

Through this exploration of using game-based learning, I expanded my philosophy to incorporate digital games. When hands-on games include digital manipulatives, the students seemed to be even more eager to engage in learning new skills. I compiled a list of digital activities that they could engage in on their own. When we went to the computer lab to play these digital games, there were fewer behavior issues in the lab. My students were fully engaged with what was happening on the screen in front of them and less worried about each other.

I currently teach in a high poverty school with students who are well below grade level. My experience with this population has furthered my viewpoint on game-based learning. Most of my students do not want to take risks for fear of appearing unintelligent. However, most of my

students are competitive and respond positively to food rewards. When there is an immediate prize for participation/winning, they become engaged in the game. My students also have enough background knowledge on how to play games that they know they can not always win. This takes the fear of losing away from them individually. They may not like to lose, but they understand that it comes with the game. The low-risk, high-reward environment that I bring to the classroom is what game-based learning incorporates. I see fewer negative behaviors from my students on days when we are playing games. There may be multiple factors that play into this scenario that I will discuss in the next chapters. The students who previously hated coming to my classroom and would put up any argument to avoid coming to my room are now walking in the door asking if we get to play a game today. These very frequent statements let me know that these students enjoy game-based learning. I provide pre and post tests to determine what academic skills the students gain over the course of the couple week units, and they always go up in percentage of academic material known. This tells me that something in my game-based learning teaching philosophy is working. I want to research it, share the information, and create a project to ensure other educators can also use my shared philosophy on teaching.

What is game-based learning?

There are many different elements incorporated in game-based education. I will explain what some of those variables are and what it may look like in a classroom setting. Game-based learning is a branch off the play-based instruction concept (Kapp, 2012). Quite literally, students are using play, but not in the imaginative, open-ended perspective of the typical play-based structure. Game-based resources must have explicit rules of engagement, a conflict or obstacle to

overcome, skill or chance outcomes, and a reward. There must also be a point or objective to the game, which can also be synonymous with overcoming the obstacle (Kapp, 2012).

Every game-based learning activity must include these aspects as well as have a large group, small group, partner, or independent audience that gains knowledge or reviews an academic skill (Kapp, 2012). The sole skill may be the focus, or the game may incorporate many various skills revolving around one topic, such as practicing angles, triangles, types of lines and other skills under the theme of geometry curriculum standards. To be constructive game-based learning, the student must learn as much or more than what a lesson without games would teach (Kapp, 2012). Also, when thinking about the learning process of children, games typically keep children engaged longer than a simple worksheet would. It is not that the child is learning more from game-based learning than from another form of teaching; it is that his or her attention is kept on the game longer than another lesson. Especially with digital gaming becoming so profound in the lives of young adults, children are responding to the rise in technology game-based learning (Chee, 2014).

The games can take on many different modes of exhibiting the aforementioned elements. It could be as simple as writing sight words on Candyland cards and using the original game board. It could be as complex as creating an original game board, coming up with specific questions, and making one's own rules for a completely new game. Some games may incorporate digital and material resources, such as using QR code scanners to assist in game-based learning. The possibilities are endless, but they must fall under the categories of instructing or reviewing academic skills or strategies and must have the components of a game.

Impact of Game-Based Learning

Students learn very differently than they did twenty or even ten years ago. Today's education is an ever-changing, evolving development of reactions to an advancing world. So much more research is done on how people learn and what best matches each type of learning. Some students learn auditorily, visually, or kinesthetically. Using game-based learning helps connect each form of learning with high motivation and engagement levels (Kapp, 2012).

There can be some negatives to game-based instruction (Hirumi, Appleman, Rieber, & Van Eck, 2010). The teacher needs to create, find, buy or prepare all of the games used in game-based learning. This can take a large amount of time. The selection of games needs to be meaningful and productive to make a possible beneficial impact on the student, or the impact may not be beneficial. Discussing how each game is played and making sure that the conversation of *why* it is being played will also be factors in how the game-based learning affects students. There are also many variables as to what will affect the research of game-based learning that I will cover in the literature portion of my thesis.

Overview of Thesis Project

The project connected to my thesis research will be a website that I create, which will have links to a plethora of online games, resources for teachers to use for game-based instruction, and clear organization that easily breaks down the learning ranges for intermediate grade levels. Teachers will be able to select whether they want a technology game, movement game, game that can be printed, or game that can be created using an already existing board game. By breaking down the academic skill level, teachers will be able to easily select which games will match their students' needs. The games will also be broken down into the categories

of whole group instruction, independent work, small group activities, or partner games. By providing these resources for educators, I believe their own use of game-based learning will advance the educational field and provide more data pertaining to my thesis topic. I am creating this website to not only help my future teaching, but also to assist other educators who would like to use game-based learning. Instead of solely doing the action research on my own, I am finding the background knowledge and scholarly research on the effects of game-based learning in intermediate math students. By posting my website of resources, other teachers will be able to use game-based learning within their own classrooms. I see this as my way of helping them as well. My project could also help the hundreds of students who may realize that they learn best through game-based learning and discover my website to further their own academic skills in math.

Conclusion

Games have been used for centuries for various reasons. I introduced some information as to what game-based learning would look like in a modern classroom. There are specific criteria needed in order to be considered an academic game. There are some differing effects on various audiences, which will be discussed in the following chapters. By furthering the research regarding my teaching philosophy of game-based learning, I believe that educators will be given enough information and resources to implement game-based instruction in their own classrooms after making a research based decision. I have laid out in this chapter what game-based learning is, why it is meaningful to me, and some of the implications of using game-based learning in the classroom. Creating the website for teachers to use as a resource will strengthen the game-based learning community to further the research done by professionals. My next chapter will focus on

the specifications of game-based learning (along with supporting research), engagement with game-based learning, and technology use.

CHAPTER 2

Literature Review

Overview

In this chapter, research from multiple authors will provide supporting answers for my research question, *How can I improve the math performance of intermediate students using game-based learning?* Although no articles directly correlated with all parts of my research topic, many resources were found to support and answer my question thoroughly. I begin this chapter with a detailed explanation of what game-based learning is, how it is used, and the characteristics that make game-based learning what it is. The next portion of this chapter provides information about motivation and engagement with students when game-based learning is being used. The last section of this chapter reflects on technology use with game-based learning. More research was found on digital games than non-digital games, and the research may vary based on the mode of game-based learning.

Game-Based Learning

Game-based learning has been used for decades to compete with a more traditional teaching style. Play, used in conjunction with learning, is not a new concept in the educational field (Plass, Homer, & Kinzer, 2016). Learning occurs through everyday life, and with games and play being a part of children's lives, it is natural to use game-based learning in schools (Chee, 2014). Studies have found improved retention, increased student preferences, and higher levels of engagement when using game-based learning (Kapp, 2012). Game-based learning can be used with physical games, technology games, or gamification which uses the structure of games including rewards, badges, trophies, and other game-like elements (Wiggins, 2016).

While some authors use game-based learning and gamification synonymously, others find specific variances in structure (Wiggins, 2016). Gamification uses game elements to promote or draw in more participants to achieve a desired outcome, which may not be learning based (Wiggins, 2016). Game-based learning, which will be discussed more thoroughly in this chapter, relates to learning that has a game for its core concept, but has a learning objective or goal for the desired final outcome of knowledge or skill retention (Denham, Mayben, & Boman, 2016; Kapp, 2012). A well-designed game will help increase the learning and skill retention while engaging students for a longer period of time than traditional learning (Kapp, 2012). Students must have explicitly defined learning goals or outcomes before engaging in the learning game in order for the target goal to be met efficiently (Chee, 2014; Kapp, 2012; Plass, Homer, & Kinzer, 2016). With this knowledge, math objectives and learning targets will need to be posted in the room to receive the full benefits of using game-based learning. Because games can occur in many different forms, game-based learning is an indefinite field of research that is still growing (Plass, Homer, & Kinzer, 2016).

Game elements help define what game-based learning is, but no game needs to incorporate all components, and they may appear differently in each game (Kapp, 2012; Plass, Homer, & Kinzer, 2016). Different authors focus on various elements, but the common themes in game-based learning are having a challenge or conflict to overcome, scaffolding the learning, allowing freedom to fail, providing immediate response or feedback, and following a narrative or storyline throughout the game (Kapp, 2012; Plass, Homer, & Kinzer, 2016; Wiggins, 2016; Wu, Hsiao, Wu, Lin, & Huang, 2012). A well-designed game aims to fall into the zone of proximal development or the "state of flow," which is a term coined by Csikszantmihalyi (1990) that

means the task being asked to do falls in the exact area of challenge and engagement, but is not too difficult or boring (Plass, Homer, & Kinzer, 2016). The most effective games are designed to fall into a "state of flow" (Csikszantmihalyi, 1990) as well as include an incentive system, visually pleasing aesthetics, game mechanics, and a narrative design (Plass, Homer, & Kinzer, 2016). An incentive system is the driving force behind the motivation to continue playing the game; this may appear as a reward or desirable achievement for the player (Plass, Homer, & Kinzer, 2016). The visual aesthetics are also created by the designer to gain the most visually and auditorily pleasing environment for the player without distracting them from the main objective of the game (Plass, Homer, & Kinzer, 2016). The game mechanics are the actions in the game which result in either a learning focus or skills assessment focus (Plass, Homer, & Kinzer, 2016). The narrative design affects if the players feel a connection to the storyline and want to return to play the game at another time (Plass, Homer, & Kinzer, 2016).

Game-based learning is so complex in its own entity that it could be considered its own form of learning theory, but the fact that it varies so greatly within its own definitions and forms means that it could not fit into one mold of learning theory; thus game-based learning relies on other learning theories to justify its effectiveness (Plass, Homer, & Kinzer, 2016). Different learning pedagogy theories tie into game-based learning (Plass, Homer, & Kinzer, 2016; Wu, Hsiao, Wu, Lin, & Huang, 2012). A study conducted by Wu et al. (2012) found that learning theory based game designs are increasing, but the majority of game-based designs are not using a learning theory to tie the learning objective or goal to the activity of the game (Wu et al., 2012). Games are found to be more productive when an explicit learning theory is tied to the material being taught and the form in which it is being presented (Wu et al., 2012). When using

the constructivist theory, social or cultural real world problem solving that can be related to math will occur through social interaction while playing with other students (Wu et al., 2012). Games promote cooperation with others, which is highly effective in memory retention (Schmitz, Felicia, & Bignami, 2015). Plass, Homer, and Kinzer (2016) conducted a study in 2014 to determine the variance of individual, competitive, and cooperative play among elementary age students. The competitive and cooperative play with others had the strongest academic results with math skill retention.

Another example of a learning theory tied to game-based learning in the math field would be using cognitivism. Scaffolding the learning and using previous learning experiences to build off the current schema of the student can help elaborate on what math skills a student already knows (Wu et al., 2012). Piaget believed that play as a part of cognitive development was critical and increased with complexity as a student aged, activating the former schema that students developed over a lifetime of playing and learning (as cited in Plass, Homer, & Kinzer, 2016). The last example of a learning theory tied to game-based learning would be to consider behaviorism. The stimulus of experiencing the aesthetics of the game plus the constant feedback promotes further action from the player (Wu et al, 2012). The constant feedback with the engaging aesthetics can help a student practice math facts or skills longer than using traditional methods of learning (Kapp, 2012; Wu et al, 2012).

Another consideration to notice when discussing game-based learning with intermediate students is the emotions evoked through play. Games are often favored by students because little emotional risk is involved when failing occurs within the game-based learning (Li, Lemieux, Vandermeiden, & Nathoo, 2013). If students feel no threat in being wrong, they may take more

time solving a math problem to receive the reward from the feedback of the game. Games are also not solely about the academic content within them; rather they are about interacting with players and the game itself (Chee, 2014). This is where problem solving, making choices, cooperating, and other social skills come into the picture while playing a game. Games tend to put students into positions of power and areas of action rather than the traditional learning experience (Chee, 2014). Using movements, or even gestures, during a game can trigger different parts of the brain to increase cognitive outcomes (Plass, Homer, & Kinzer, 2016). Math games can use movement to connect a skill with an action to help the retention of that memory or skill.

My research will go more in depth later in this chapter discussing technology and digital games, but this brief paragraph introduces the use of technology with game-based learning. Computer video games software sales generate more than $10.5 billion per year (Kapp, 2012). With the video game market at an all time high, it may be surprising that according to a survey done by Wiggins (2016), more non-digital games are still used in education rather than digital. The top three reasons listed by the teachers in this survey were money, resources, and ease (Wiggins, 2016). Schmitz, Felicia, and Bignami (2015) also had three top reasons why teachers chose not to use game-based learning. Their research found that teachers reported difficulties in finding the games, lack of peer support, and lack of knowledge in using games for teaching (Schmitz, Felicia, & Bignami, 2015). To curb these setbacks, professional development should be provided to all teachers for knowledge on how to find, create, assess, and model game-based learning in their own classrooms (Denham, Mayben, & Boman, 2016). Some ideas for professional development of using game-based learning could be to edit existing games, educate

teachers on how to design technology games and have teachers teach the students how to create games themselves (Denham, Mayben, & Boman, 2016). A study done by Denham, Mayben, and Boman (2016) reported that only 74% of teachers use digital games for instructional purposes. If teachers were trained to tie standards to games being used in the classroom, more teachers may use them for instructional purposes. A study conducted by Schmitz, Felicia, and Bignami (2015) also displayed that there is a relationship between a teacher's personal information technology skills and their usage of game-based learning in the classroom. Getting teachers training on digital games could increase the usage of games, which could then increase the engagement in the classroom, sparking an increase in academics.

Motivation

The word "motivation" comes from the term "motivate," which transcribes to "*movere*" in Latin, which means "to move" (McLean, 2003). To move students in a way that they are engaged, forms of motivation need to be taken into account. There are two types of motivation: intrinsic and extrinsic (Gambrell & Morrow, 2015; Kapp, 2012; McLean, 2003; Sansone, 2003). Both will be covered in this chapter as well as how they both affect student learning and relate to boredom and engagement in educational settings. Motivation and engagement are two of the biggest factors in the enjoyment of learning for students. Being a culturally responsive teacher means considering motivation and engagement when instructing (Gambrell & Morrow, 2015).

When looking at motivation as a means of engagement, emotions have a high impact on helping or hindering learning in students (McGuire, 2015). For example, when in a situation that creates fear, anxiety, or worry, students are feeling negative stress (McGuire, 2015). Physiologically, stress creates cortisol production in the brain, which can negatively impact short

term memory and impede long term memory retention (McGuire 2015). Concurrently, students who feel positive emotions when learning, like interest, happiness, or enjoyment, will have increases in their confidence while learning (McGuire, 2015). These positive emotions are in a cycle, which then leads to increased motivation, increased learning, increased success, and with that success, the positive emotions surface again (McGuire, 2015).

Intrinsic motivation is driven from within the learner rather than outsourcing satisfaction from somewhere other than oneself (Plass, Homer, & Kinzer, 2016). The reward comes from carrying out an activity rather than from the result of the activity (Kapp, 2012). In order to feel a sense of achievement from intrinsic motivation using a goal centered approach, learning goals are more beneficial than performance goals (Sansone, 2000). Performance goals can be beneficial when students seek to demonstrate how competent they are; obtaining a joyous emotion from the success of meeting the performance goal can also boost confidence (Sansone, 2000). Performance goals focus on the extrinsic outcome of the activity rather than the learning goal, which focuses on the lesson learned from the activity itself (Kapp, 2012). According to a study done by Vansteenkiste, Lens, and Deci (2006), students with intrinsic motivational goals were able to recall and retain more information about a topic related to them than students who had an extrinsic motivational goal of achieving a high score on a test provided after the information was learned (Gambrell & Morrow, 2015).

Goals need to be a part of motivation; whether they are individual, competitive, or cooperative in format (Macklem, 2015). These types of goals can bring out a sense of control for the learner, which means the motivation is intrinsic for them (Macklem 2015). As children age, a decline in intrinsic motivation occurs related to the enjoyment in school related activities

(Sansone, 2000). Intermediate aged students do not find as much enjoyment as they used to, meaning that their emotions toward learning are becoming less positive (Sansone, 2000). With fewer positive emotions toward learning, motivation will also decrease, along with content learned and success for the student (McGuire, 2015). Giving students choices is one of the best ways to promote intrinsic and extrinsic motivation (Gambrell & Morrow, 2015; Kapp, 2012). Promoting autonomous motivation will give students the ownership they need to feel successful and knowledgeable about the topic, which will lead to participation in other educational activities (Hagger & Chatzisarantis, 2016). The positive emotion evoked from making a choice and being successful will continue the cycle of increased motivation (McGuire, 2015).

While intrinsic and extrinsic motivation have comparisons, the main difference is that extrinsic motivation relies on receiving a stimulus from something other than oneself (McLean, 2003). Behavioral theories depict extrinsic motivation as a positive stimulus, such as a reward; or a negative stimulus, like a punishment (McLean, 2003). The rewards received from extrinsic motivation can be, but are not limited to, monetary amounts, words of praise, high grades, badges, or points (Kapp, 2012). Research has shown extrinsic reward seeking motivation as negative in educational setting (Sansone, 2000). Rewards can undermine the intrinsic motivation of students by shifting the focus away from the learning goal to the performance goal (Sansone, 2000). A question that arises from extrinsic motivation is if the students are doing the activity for their own enjoyment or to enjoy the reward.

The warning when discussing game-based learning with motivation is to determine why the student is motivated to play the game. Some game-based learning uses competition as a means of extrinsic motivation. However, excessive competition can display negative effects on

students (McLean, 2003). When the game is much easier for one competitor than the other, or the only objective is to beat the other players, the reward is no longer focused on learning (McLean, 2003). Competition can decrease the number of achievers participating in the activity or game (McLean, 2003). To curb this negative effect, not only the winners should be rewarded. All players should find meaning in the learning objective goal. Linking student work to their learning goals will give the students a feeling of meaningfulness on their own (Middleton, 2014). Teachers who can use autonomy related activities (whether they are game-based or not) are seen as less controlling, which may result in greater academic achievements from students (Sansone, 2000).

Students performing one task do not need to feel only one form of motivation; both intrinsic and extrinsic motivation can occur in a student during the same task (Kapp, 2012; McLean, 2003). Both forms of motivation during the activity can help the learner reach their goal (McLean, 2003). In fact, intrinsic and extrinsic motivation should frequently coexist in students who can think complexly and critically (Sansone, 2000). Verbal rewards tend to be unexpected and promote the feeling of confidence, which can increase intrinsic motivation, even though the praise itself is extrinsic (Sansone, 2000). When learners feel that the learning goal is achievable, and they are confident they can succeed at an attempt, they are more motivated to try the task (Kapp, 2012).

Whether the student is avoiding work, being distracted, or finding difficulty in focusing on the learning occurring before them, boredom can happen. The human attention span is approximately ten minutes (McGuire, 2015). This means that any task, lesson, or object loses its appeal after only ten minutes. Boredom is the student's perception of the current environment

they are in (Macklem, 2015). When boredom occurs, students are not receiving the motivational stimulus they require to attend to a task (Macklem, 2015). When students were asked in a study conducted by Bridgeland (2006) 47% of high school dropouts declared it was because the classes themselves were uninteresting, not the content itself, but the way it was taught (Macklem, 2015).

Boredom is a difficult state of mind to change once it occurs; the best way to avoid it is to prevent it rather than trying to overcome it (Macklem, 2015). Boredom can set in within seconds, and the results are low arousal within students (Macklem, 2015). Interactive breaks or changes in the state of learning can regain attention and keep student focus longer (McGuire, 2015). When boredom occurs, it can be because the students do not feel as though they have control over their learning (Macklem, 2015). Providing more hands-on, interactive learning that provides choices for the students can help curb boredom in classrooms (Macklem, 2015). According to Csikszentmihalyi (1990), there is a determined mental state referred to as "flow" that lies between the realms of boredom and frustration for a student; the task is within the student's skill level, yet challenging enough to motivate them to continue the task if it lies within the "flow" realm (Kapp, 2012). If students are in the realm of boredom, there may be a reduction in attention to where the objective of the student is to avoid work or stimulate their brain by daydreaming, misbehaving, or focusing on other distractions (Macklem, 2015). The negative reactions students can make are being disruptive in order to provide stimulation in their environment, which can lead to disengagement and lower achievement in academics (Macklem, 2015). When negative behaviors occur in the classroom, it may be because of boredom. While teachers cannot make students motivated, they can create the surrounding, environment, and lesson needed to stimulate and nurture motivated students (McLean, 2003). A competitive

situation with game-based learning can be a good way to stimulate students when learning (McLean, 2003). The engagement increase can lead to increased success (McGuire, 2015).

Some teaching techniques to consider when trying to increase student engagement will be discussed in this portion of chapter two. Attitude toward students can greatly affect the attitude of the student (McGuire, 2015). Using a growth mindset, encouraging the student that they can succeed, rather than a fixed mindset, that they can not grow in skills, is a way to show the students have a support system (McGuire, 2015). When teachers are seen by students as controlling, the motivation in those students decreases (Macklem, 2015). A study by Wu (2013) revealed that students felt more engaged and stimulated in a small discussion group rather than a large group because they had the freedom of choice (Macklem, 2015). Interactive teaching and providing choice allows all students to participate rather than the few outspoken students who are commonly heard in the space (Cohan & Honigsfeld, 2013). Giving students some control over their learning to obtain a challenging goal is a key aspect of engagement in teaching (Kapp, 2012). Curiosity and making the activity highly interesting to the students is also a key aspect (Kapp, 2012).

Game-based learning is a way to incorporate high engagement in learning (Kapp, 2012). Bringing in elements of fantasy or functional simulation can keep boredom at bay (Kapp, 2012). When playing games with characters (or avatars: players representing a specific student), tying in personal student likenesses can make them more interested in the activity (Sansone, 2000). Along with motivation and engagement from students, the environment and classroom climate that teachers create to promote the best motivation in students is very important (McLean, 2003). How students feel about being in the classroom matters greatly for the engagement occurring in

the space (McLean, 2003). A motivating setting comes from affirmation of worth and empowering the students to learn (McLean, 2003). When students feel they are in a safe environment, they can open up with their peers and attend to teaching strategies that are interactive (Cohan & Honigsfeld, 2013). Setting up the conditions of the classroom to promote student belief in their own ability, achievement, success, and competence is key for producing positive motivation in the classroom (McLean, 2003).

Technology in Education

Digital games are quickly becoming part of children's culture (Li, Lemieux, Vandermeiden, & Nathoo, 2013). Using a gaming structure that students are familiar with can help use a child's current schema to enhance newly learned information by connecting it to their learning history (Li, Lemieux, Vandermeiden, & Nathoo, 2013). According to Peters (2009), students get better instructional learning through social interactions and technology than lectures. Part of the reasoning for this is that technology can hold the engagement of students longer than a lecture style format (Hirumi, Appleman, Rieber, & Van Eck, 2010). Globalized education, or education that accounts for interactions with and information considering multiple perspectives, cultures, and regions is made vastly easier with the use of technology (Peters, 2009). Learning can be done from anywhere that has internet connection, including classrooms without licensed teachers, outside of classrooms, and at any time of the day (Li, Lemieux, Vandermeiden, & Nathoo, 2013; Peters, 2009). Mobile learning is a portion of the technological world related to devices that can easily travel and be used almost anywhere by an individual (Li, Lemieux, Vandermeiden, & Nathoo, 2013). Mobile devices make learning personal and sociable by using resources, such as Google docs, drive, or slide, which can be shared and collaborated on by

multiple people (Li, Lemieux, Vandermeiden, & Nathoo, 2013). One of the fastest growing fields in the technology world, however, is the creation of instructional computer games (McDonald & Hannafin, 2003).

In order to be considered an instructional digital game, it must be interactive with areas of adventure, strategy, role play, action, or massive multiplayer modes; and also be created to facilitate learning (Hirumi, Appleman, Rieber, & Van Eck, 2010). Not all games hold all of these aspects, and different games are created for various reasons (Hirumi et al., 2010). Different audiences are to be considered when creating a digital game; first person, second person, or simulation are three options (Hirumi et al., 2010.) For example, a single player arcade style game can be used effectively to increase fluency and automaticity in math facts (Hirumi et al., 2010).

Not one type of game should be solely considered as the best game for that type of learning (Hirumi et al., 2010). Digital technology has been proven as a capable tool to positively affect student learning (McDonald & Hannafin, 2003). Ninety-two percent of teachers said that the internet majorly impacts their teaching resources (Liu, Scordina, Geurtz, Navarrette, Ko & Lim, 2014). Students enjoy playing digital games unrelated to school; in fact, 97% of teens ages twelve to seventeen reported using computer games on their own time (Li, Lemieux, Vandermeiden, & Nathoo, 2013).

In the digital gaming world, healthy competition can enhance the skills of students if the student is at the skill level of answering more than 50% of the problems correctly (Hirumi et al., 2010). A study was done by Kafai (1998) to determine how preservice teachers would react to creating digital math games. After they were done designing, the teachers saw game design and math concepts as a connected and integrated learning experience. They were also able to

determine the benefits as the player and as creator of the game (Kafai, 1998; Li, Lemieux, Vandermeiden, & Nathoo, 2013). Learning can be done using technology, and it can be done with the use of game-based learning (Li, Lemieux, Vandermeiden, & Nathoo, 2013).

Academically, technology is a tool that can be used on different levels to reach multiple students. Vygotsky's concept of scaffolding, learning to meet the student and progress them at their own pace, can be tied into the use of digital games (Hirumi et al., 2010). Digital games are known to have different instructional levels of "easy, medium, and hard" or numbered levels to show the increased skill needed to pass the level (Hiumi et al., 2010). Mobile learning offers students multiple placements as they enter the digital game according to what they already know and what the learning objective is (Liu et al., 2014). In order to solve the conflict or move up a level in the digital game, new knowledge must be discovered to advance (Hirumi et al., 2010). Problem solving is one skill that is seen to increase when using digital games (Li, Lemieux, Vandermeiden, & Nathoo, 2013).

Technology, when learning can also be seen as a tool rather than a connection to other knowledges and resources (Liu et al., 2014). Students can use a tablet, smartphone, or other personal device to take a picture, record, or keep a calendar or notes in one organized place (Liu et al., 2014). A teacher may also use technology and digital games as a form of assessments (Hirumi et al., 2010). Because the game gives immediate feedback, a teacher can see the success of a student by how far the student has advanced (Hirumi et al., 2010).

Some students negatively assume that learning cannot be fun; just as some teachers carry the negative assumption that computer games cannot be used for learning (Hirumi et al., 2010). However, a study conducted by Wu (2012) determined that collaboration using mobile devices

helped increase motivation, participation, and engagement among students of all ages (Liu et al., 2014). Students also have a better attitude about learning in courses that include technology into the learning pedagogy (McDonald & Hannafin, 2014). Technology games promote the engagement piece by causing students to wonder and question what will happen next in the game (Hirumi et al,. 2010). With scaffolding occurring naturally in games, students are placed at a level according to their zone of challenge versus frustration (Hirumi et al., 2010). Keeping students' attention throughout the digital game process is determined by the design, music, conflict, and immediate feedback that the students get from playing the game (Hirumi et al., 2010). Students would rather practice rote memorization or drill practice of math facts on a digital game at their own pace because it is less boring than practicing with physical flash cards (McDonald & Hannafin, 2014). Technology has also been known to reduce student anxiety in academic areas (McDonald & Hannafin, 2014).

There are some negative aspects of incorporating technology into classroom use even though it is tied to common core and state standards. More research has been conducted in the last few years, but it is still a progressive and growing area of study (Liu et al., 2014) With technology becoming a daily use, and some schools turning to one to one devices; schools must update networks to support this increasing number of devices being run school wide (Liu et al., 2014). Some incorporation of mobile learning may breach school rules and policies about technology (Liu et al., 2014). Schools would need to adopt a new policy or update their expectations with the adoption of mobile devices in school. Technology can also be considered a distraction from non-technology related instruction (Liu et al., 2014). One way to avoid this is to educate the students before rolling out personal devices so that the students know the policies

and expectations. Another setback due to the newness of digital game-based learning is that there is a lack of games created with education in mind (Liu et al., 2014).

When considering the adoption of technology in everyday use in classrooms, a few issues need to be addressed. The problem with digital games being used in an educational setting is that game designers know little about educational values and standards, and teachers know little about game design (Hirumi et al., 2010). To bridge this gap of misunderstanding, teachers who may have never received training about game design would need to be trained during professional development opportunities (Li Lemieux, Vandermeiden, & Nathoo, 2013). Providing training on software or technology use and design could help collaboration between game designers and educators. The biggest challenge reported from teachers was the actual computer programming of a functioning game rather than what objective, goal, or aesthetic elements should be included (Li et al., 2013). Another negative aspect about technology is that teachers find it difficult to switch their own mindset and teaching pedagogy from a more traditional sense to incorporating technology practices (Hamilton, 2015). They tend to require a connection to standards prior to incorporating or finding their own connection to standards (Li et al., 2013). Other teachers see the technology use or digital game-based learning as a reward that needs to be earned rather than a tool used for learning and teaching purposes (Li et al., 2013). A way to change that mindset is to recognize that computers can add positive effects, but it all comes down to how the teachers use the technology (McDonald & Hannafin, 2014). If teachers are capable of slowly integrating technology into their lessons, it will not seem overwhelming, and their resources will accrue over time (Hamilton, 2015).

Conclusion

Concluding my literature review on game-based learning, I have analyzed three critical points from the research done. The first is that game-based learning most definitely has a positive effect on motivation and engagement within students of all ages (including intermediate students). The second observation from my research is that student engagement has a correlation to the attention span, skill retention, and positive increase of academic work. The last analytic point is that technology and digital games include more game-based characteristics to obtain more attention and engagement from students; therefore making digital games more enjoyable than traditional teaching practices. With this information on game-based interactive learning with intermediate students, I progress on to the methodology of game-based learning. I will also provide research on the methods of website development and functionality to describe the website project I will be creating.

CHAPTER 3

Methods

Overview

My research question, *How can I improve the math performance of intermediate students using game-based learning?* This question requires that teachers use game-based learning to develop an answer. My project is a website that can be a resource for teachers to use in promoting game-based learning within their own classrooms. One of the most common reasons given for teachers to have limited knowledge or use of game-based learning is the lack of resources or guidelines provided to create or use game-based learning (Denham, Mayben, & Boman, 2016; Kapp, 2012; Schmitz, Felicia, & Bignami, 2015). My capstone project addresses this common reason for limited use of game-based learning in classrooms by supplying teachers with multiple resources to use with game-based math instruction.

Project Description

The project connected to my thesis research is a website I created, which has links to a plethora of online games and resources for teachers to use for game-based instruction. It is organized in such a way that easily breaks down the learning ranges for intermediate grade levels using the Minnesota State Math Standards. The intermediate math topics are numbers and operation, algebra, geometry, measurement, and data analysis. Teachers can select whether they want a technology game, movement game, game that can be printed, or game that can be created using an existing board game. By breaking down the academic skill level, teachers are able to easily select which games match their students' needs. The games are also categorized by whole group instruction, independent work, small group, or partner games. By providing these

resources for educators, I believe their own use of game-based learning will advance the educational field and provide more data pertaining to my thesis topic. I created this website to not only help my future teaching, but also to assist other educators who would like to use game-based learning. Instead of solely doing the action research on my own, I found the background knowledge and scholarly research on the effects of game-based learning in intermediate math students. By posting my website of resources, other teachers are able to use game-based learning within their own classrooms.

Project Background

Denham et al. (2016) conducted a survey where 74% of teachers reported using digital games for instruction. A website's design greatly affects the traffic and usage of the website. If teachers feel the website is an easily accessible, functioning tool for instruction, they are more likely to have their students use the website (Ng, 2014). I conducted research on what makes an educational website the most functional to determine how my website would be designed.

There are three main areas to explore when creating an educational website; web usability, web accessibility, and web navigation (Ng, 2014). The usability refers to how user friendly the design is laid out. This can be broken down into the components of instructional strategy (in my website it is game-based learning) and teaching material and learning tools (my website will have educational resource links within the organized math standards) (Ng, 2014). When creating a website with multiple resources, it is best to incorporate new paging rather than scrolling on the website unless reading for content comprehension (*Research-based web design & usability guidelines,* 2006). Linking within the website should be effective by using clearly defined text rather than images linked to a new page or website (*Research-based web design &*

usability guidelines, 2006). Following these educational website guidelines can bring more traffic to the website, which means more teachers are exposing their students to the content in my website.

Web accessibility refers to how the website runs on computers and mobile devices throughout the day. Teachers must be able to easily find the website during search engine hits.Being able to find the website from search engine hits is also important to bring people to the website (Ng, 2014). Web navigation also has a part in accessibility as well. A study conducted by Ng (2014) reported that teachers have the ultimate say in whether a website is a strong academic choice for their instruction. The website must include all academic content and aesthetically pleasing designs to sway a teacher on wanting to use the website with their students (Ng, 2014). Connecting the standards and using visually appealing designs helps attract the target audience of teachers looking to find websites they think their students will also enjoy (Ng, 2014). When finding a website that is navigable, teachers look for a defined menu, tabs, and a search bar (Pittsley & Memmot, 2012). Hsu (2006) conducted a study that found children prefer websites that are designed from the right top to the bottom left (mimicking English reading). The color preference varied depending on gender, age, and interests, but designs with a linear format were found more favorable by children aged 10-13 (Hsu, 2006). By compiling this information and incorporating it into my created website, I have designed an educational website based on the research of a highly functioning educational website.

Data Implications

Academically, technology is a tool that can be used on different levels to reach multiple students. Vygotsky's concept of scaffolding learning to meet the students and progress them at their own pace can be tied into the use of digital games (Hirumi et al., 2010). Digital games are known to have different instructional levels of "easy, medium, and hard" or numbered levels to show the increased skill needed to pass the level (Hiumi et al., 2010). Mobile learning offers students multiple placements as they enter the digital game according to what they already know and what the learning objective is (Liu et al., 2014). In order to solve the conflict or move up a level in the digital game, new knowledge must be discovered to advance (Hirumi et al., 2010). Problem solving is one skill that is seen to increase when using digital games (Li, Lemieux, Vandermeiden, & Nathoo, 2013).

According to Russell, Bebell, O'Dwyer, and O'Connor (2003) teacher preparation and professional development has an impact on whether or not teachers are effectively using technology in a student instructional setting. Email, teacher research for background knowledge, or using a district technology system for grades, attendance, etc. is not included in the following data results. Newer teachers (teaching fewer than six years) feel more comfortable than senior teachers when using technology; however, senior teachers use technology more frequently with students. The reasons found by Russell et al. (2003) were that newer teachers focus most of their time on learning classroom management techniques, the curriculum and standards, and becoming familiar with the assessments required by the school or district. My website will be an easy access tool for senior and new teachers to use in promoting technology use and game-based learning in the classroom.

Participants

My intended audience is teachers of intermediate students; however, my website is child user friendly because teachers are instructing their students to use a game listed under a specific standard provided on the website menu. While teachers and students are both using the website, this is solely a resource for teachers to use to implement game-based learning for intermediate math instruction. The games are individual, multiplayer, or whole group based. The specific participants and setting of this project are not explicitly defined considering a website can reach worldwide. Because my standards are limited to a Minnesota focus, I can reasonably estimate that teachers in Minnesota are more apt to use my website than educators elsewhere. The school where I am currently employed is most likely the first to use this website. My school has approximately 700 students. Of those 700, approximately 250 are intermediate students in fourth or fifth grade. My school is approximately 35% black, 30% Asian, 15% Caucasian, 10% Hispanic, and 10% mixed race. There are eight classroom teachers in the intermediate grade levels who are using my website to incorporate game-based learning.

Assessment

In order to determine the functionality and effectiveness of this website in assisting teachers with finding game-based learning resources, I will provide a survey with the following questions to answer in confidence. Using the feedback from the survey, I will update the links to what teachers find most helpful and engaging for their students' math instruction time. I will also continue to link games that I continue to find and take suggestions from other teachers who use the website.

Conclusion

Chapter 3 reflects on the website project I created for the use of teachers and students. Games will be linked to the website and organized according to what grade level, skill, and standard they are connected. My audience is intended to be any teacher instructing intermediate math students where Minnesota state math standards are taught. The research behind this project was conducted in my literature review, which details why technology incorporation in education is important, engaging, and useful for academic growth among students. One of the most common reasons why teachers do not use more games in their instruction is the lack of support they feel from colleagues and administration to find the resources that fit their curriculum or standards required to be taught. With this project, teachers have many resources listed in one common place to reference for their math instruction.

Chapter 4 discusses which standards will be used on the website. The games chosen will also be discussed with the connection to the standard. Because this is an online project, I do not know the entire audience I am reaching, but I organized the website in a way that is friendly for students to use independently, but designed as a resource provided for teachers to use with their own teaching.

Chapter 4

Conclusion

Overview

To conclude my capstone thesis on *how I can improve the math performance of intermediate students using game-based learning,* chapter four will include the project characteristics, reexamine implications from the research, explain limitations and next steps, and give insight as to how this capstone project provided benefits to me and the teaching profession. My capstone project was to create a website that listed the Minnesota state standards broken down by intermediate (fourth or fifth) grade levels. Under each of these general standards (algebra, number and operations, geometry and measurement, and data analysis) I linked multiple resources and games for students to practice the standard skill. I generally found at least five to ten games for each standard. With these games provided, teachers can use them free of charge to implement game-based learning in their classroom.

Through the research I found for my literature review, it is clear that game-based learning will enhance student motivation and engagement. There is concern of directly linking game-based learning with improved academics due to variables adjusting the factors. However, there is a link between time-on-task or engagement and improved academics. Thus, the improved engagement in students due to game-based learning has shown positive effects on academics.

The limitations with my specific project revolve around money, website upkeep, and the mobilization of technology. It cost nearly three hundred dollars to purchase the website name and design rights through a website builder. This website will be running for two years with this funding, but I will need to continually upkeep the website functionality and check the workability of each site I have linked. After the paid two year span, I will determine if continuation will be beneficial. Another setback with my website is that most of the games linked need Adobe Flash Player for usability, which most mobile devices do not support.

I have learned about website design through this capstone project, which will ultimately help my personal professional growth. I am staying up to date with the Minnesota State standards, along with what resources support each of the standards. The benefit to the educational community could be vast. If my website resource accessibility reaches its fullest potential, countless schools throughout Minnesota or beyond can use this list of free resources. This benefits teachers by spending less time finding resources, and students by having a broad list of game-based learning resources to improve engagement.

Project Characteristics

I created my website during June and July of 2017 using the website creator, Wix.com. My website, gamebaseded.com, is designed with teachers in mind. The teacher will visit my homepage (Figure A), and click on a standard strand on the top bar menu. Algebra, number and operations, geometry and measurement, and data analysis are available to choose from. The website users are directed to a page where they will click on a button that says either, “Fourth Grade” or “Fifth Grade” (Figure B). Then they are directed to a page will the algebra, number and operations, geometry and measurement, or data analysis Minnesota State Standards listed.

(Figure C.1 and C.2). Underneath each Minnesota State Standard, there are names of the games listed. These names are linked to the website they are owned by. When a student clicks on a link, the game will appear in a new website window. (Figure D). The images shown in the appendix display the setup of my website. The research I conducted on effective websites emphasized easy readability, ensuring the usage on multiple mobile devices, a non-distracting layout with precise wording, and functional linking within the text (Ng, 2014, *Research-based web design & usability guidelines,* 2006). My website meets all of these listed qualifications.

I tested every link within my website to ensure that it loads a new window with the corresponding game. I had multiple colleagues also test the navigation of the website before it was published to determine the accessibility. I had a selection of five students use the website to discover games to predict student engagement. From my peer review process, no errors were found, but suggestions were made to improve the functionality of the website. Font size was enlarged and images were added to improve the aesthetic design of the website. I also learned through the design and review process that it is very easy to create a website when using a website builder. My research on website design helped me create the final product.

The implementation plan will proceed in September of 2017. My fifth grade classroom will be introduced to this website through my modeling of how to use the website for game-based instruction skills. I will start by playing a multiplication game from the number and operation standard. My fifth grade students will likely be able to play this basic multiplication game with little difficulty. This will pique their interests, keep them engaged, and promote the confidence to want to play the game independently. I will then let them play any basic multiplication game independently during computer lab time in September. By the end of

October, my students will be familiar with the website menu and be able to navigate to specific standards listed to play the games linked under the standard. I will use informal observation when my students are using the website during computer lab time. I will also have the students fill out an anonymous survey with questions regarding the usage, accessibility, and enjoyment from the website. I will also administer a survey to the fourth and fifth grade educators in my building, along with taking any comments or questions into consideration from outside my building users.

The reason I am confident this website will be effective with my students is because of past experience coupled with hours of research I have spent proving game-based learning to be a beneficial form of learning. In the past, my students were more engaged and enjoyed the learning process when game-based learning was involved. My students would enter my classroom and ask if they got to play a game that day. This excitement from the students over game-based learning is what drove me to further my research in the game-based learning field of study. My students will spend more on-task time practicing math skills, and teachers promoting my website will understand the benefits when they see the engagement from the students. Scores and skills will eventually improve from the prolonged practice time on standard skills.

Implications and Research

My philosophy in education has always been to incorporate games into the lessons, which is why this capstone topic was meaningful to my career. There are many positive attributes about my project, as well as various issues that made this project difficult to formulate. Starting with the implications of my research and project development, the consensus of using games among researchers had positive effects on engagement and motivation. These two topics were then

linked to better performances on academic work (Kapp, 2012; McGuire, 2015). When compared to lectures, students get better instructional learning through social interactions and technology (Peters, 2009). Game-based learning can easily incorporate technology, which, in the case of my website, is technology based. Because technology holds engagement longer than lecture format (Hirumi, Appleman, Rieber, & Van Eck, 2010), my website is a tool that can be used for longer periods of engagement during instruction. Studies have found improved retention, increased student preferences, and higher levels of engagement when using game-based learning (Kapp, 2012). Game-based learning can be used with physical games, technology games, or gamification which uses the structure of games including rewards, badges, trophies, and other game-like elements (Wiggins, 2016). Gamebaseded.com, my website project, encompasses all of these positive gaming attributes. Plass, Homer, and Kinzer (2016) conducted a study in 2014 to determine the variance of individual, competitive, and cooperative play among elementary age students. The competitive and cooperative play with others had the strongest academic results with math skill retention. These are a few main reasons why my website can help improve engagement, cooperative play, and academic skills.

A study done by Denham, Mayben, and Boman (2016) reported that only 74% of teachers use digital games for instructional purposes. If teachers were trained to tie standards to games being used in the classroom, more teachers may use them for instructional purposes. However, the top reasons why teachers don't use game-based learning are funding, difficulty in finding games tied to learning standards, and lack of knowledge in using games for teaching (Schmitz, Felicia, & Bignami, 2015; Wiggins, 2016). My website addresses the major concerns of teachers by being completely free to use, tieing in all Minnesota math state standards for

intermediate grades, and linking corresponding games to reduce teacher anxiety about finding valuable game-based learning tools.

Another consideration to notice when discussing game-based learning with intermediate students is the emotions evoked through play. Games are often favored by students because little emotional risk is involved when failing occurs within the game-based learning (Li, Lemieux, Vandermeiden, & Nathoo, 2013). Students would rather practice rote memorization or drill practice of math facts on a digital game at their own pace because it is less boring than practicing with physical flash cards (McDonald & Hannafin, 2014). Technology has also been known to reduce student anxiety in academic areas (McDonald & Hannafin, 2014). By providing choice to the students on what games to play for each standard, intrinsic and extrinsic motivation is promoted (Gambrell & Morrow, 2015; Kapp, 2012). With my sound research on game-based learning and technology in the classroom, I can confidently say that my website, gamebaseded.com, promotes engagement, motivation, and improved academic skills.

Limitations of Project

Some of the difficulties with creating this website project were my lack of computer design skills, the number of games available, and the usability of the website from various mobile devices. I used WIX.com, which was ranked as one of the top ten website creators of 2017. (site) I bought a two year membership fee for using the web creator, as well as a fee for owning the URL name of gamebaseded.com. WIX.com helped with my lack of computer design skills, but still took time to adjust to the learning. I read through multiple resources to determine how a website is best designed and what the layout of an educational website should entail. When linking games to the standards on my website, I only selected games and resources that

were listed as free and did not require a password or subscription. This allows any teacher to be able to use a game without needing to dig further into the internet. This also means that I was unable to link many viable resources because of the security put in place by the owner. The games and resources I have listed are not the final list of what is potentially out there.

Next Steps

With my website published, gamebaseded.com, is a functioning website. As the website popularity and usage grows, the Google search engine will eventually recommend my site more frequently to game-based education searches. I will also promote my website by sending emails of notification to colleagues and other professionals within Minnesota or states that follow similar standards to that of the Minnesota math standards. I will be looking into technology grants that may apply to the upkeep and renewal of my website before July 9, 2019, the end date of my website contract. Another tool I can use to assist in the monetary realm is to attempt to provide advertising space for compensation. I would put the compensation into the funding of continuing the contract for gamebaseded.com. My website will also need future checks to determine if all links are working, and to add to the plethora of games already linked to each Minnesota state standard. Keeping up with email communication, suggestions, and surveys are also critical to the positive running of gamebaseded.com.

Benefit to the Profession

Through my research and Google searches, I could not find any website that compiled the top referenced website games into one location. I also could not find a website that listed functioning links to math games associated with the Minnesota state standards. I have created this tool for teachers to introduce to their students in order to enhance the engagement and

motivation among their fourth and fifth grade students. My website project is a tool that I will be using in the future, along with other teachers in my school. The benefits, as previously mentioned in my research portion, are increased engagement and academic skills, along with less anxiety and stress for both teachers and students (McDonald & Hannafin, 2014; Kapp, 2012; McGuire, 2015). The teachers no longer need to scour the internet for various sites that have games associated with the Minnesota state standards. My website compiled a running list of games from nearly thirty websites and sorted them according to what standard they met. This takes away stress from the teachers. The majority of students would rather spend time on game-based learning than in a lecture style setting anyway (McDonald & Hannafin, 2014). With the research backing my website, teachers and students have easy, free access to a multitude of resources promoting game-based learning on my website, gamebaseded.com.

Personal Growth

My philosophy on education has always incorporated game-based learning; however, doing the hours of research and creating a website have furthered my own beliefs in the benefits of using game-based learning in the classroom to advance motivation, engagement, and academic capabilities. I can speak to a higher level of awareness when discussing game-based learning theories and how this can positively impact students.

When looking ahead to what will happen next with my capstone project of the website, I have to take into account a few items. I only bought a two year membership fee for the website to be up and running. I will need to determine by July 9, 2019 whether or not I want to continue running my website. If there are any maintenance issues along the way, I am the sole owner of the website, which means I would need to fix any problems or be responsible for upkeep. The

upkeep includes checking whether the games continue to work, adding new resources to the standard lists, and renewing my web address should I choose to continue the work. I also need to respond to any emails directed to gamebaseded@gmail.com, which is the email account I set up to be affiliated with the website rather than use my personal email account. The responses I aquire from teachers or students using the website will help drive my decisions in the future.

Final Thoughts

In conclusion of this chapter and capstone research project on *how I can improve the math performance of intermediate students using game-based learning,* I will review my main points on the benefits of using game-based learning during math instruction. The information I researched strongly suggests that game-based learning promotes higher levels of engagement and motivation in students than when game-based learning is not used. The higher level of engagement with the math skill practice then led to higher academic skills achievement. The website project I created, gamebaseded.com, will have a two year trial run to assist teachers in their game-based instruction approach. After the two years are completed, I will determine based on feedback and website effectiveness, if I will continue the contract. Although the capstone website project has benefited my professional growth as well as the educational field, there were limitations in setup and usability. I know this website will help me with my game-based instruction in the upcoming years, and have found through conversation that this website has assisted others in their game-based instruction as well.

Appendix

Figure A

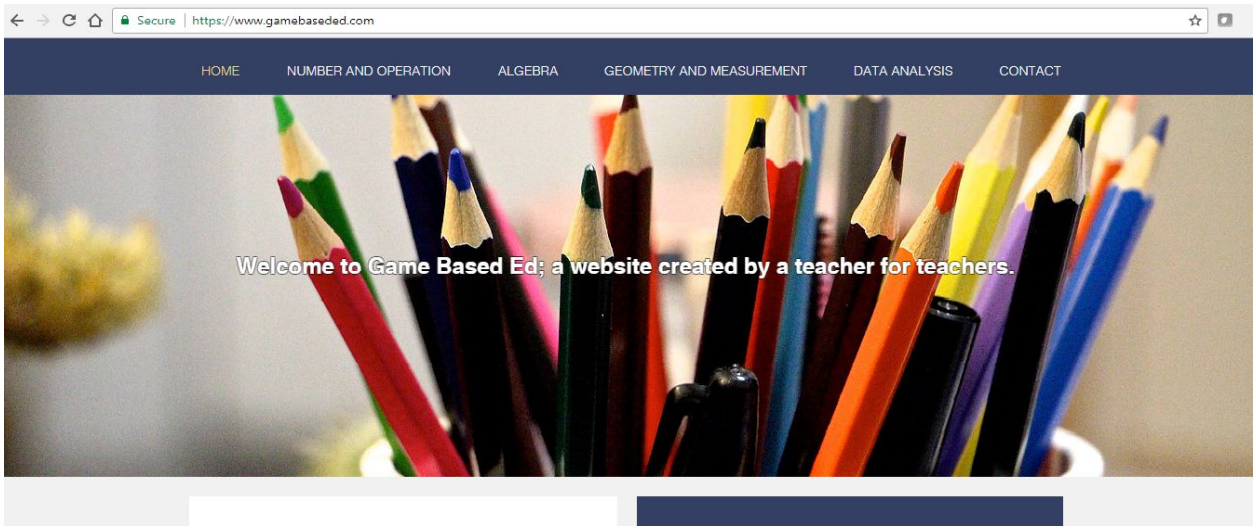
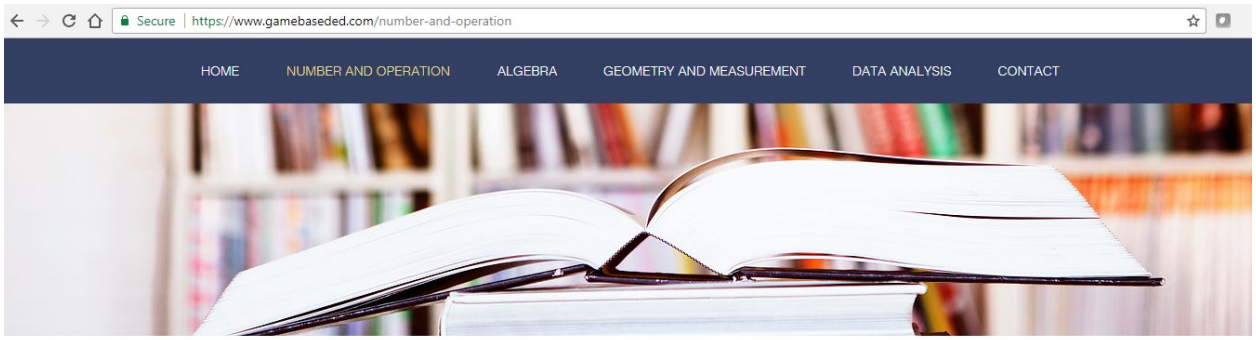


Figure B



Fourth Grade

Fifth Grade

Figure C.1

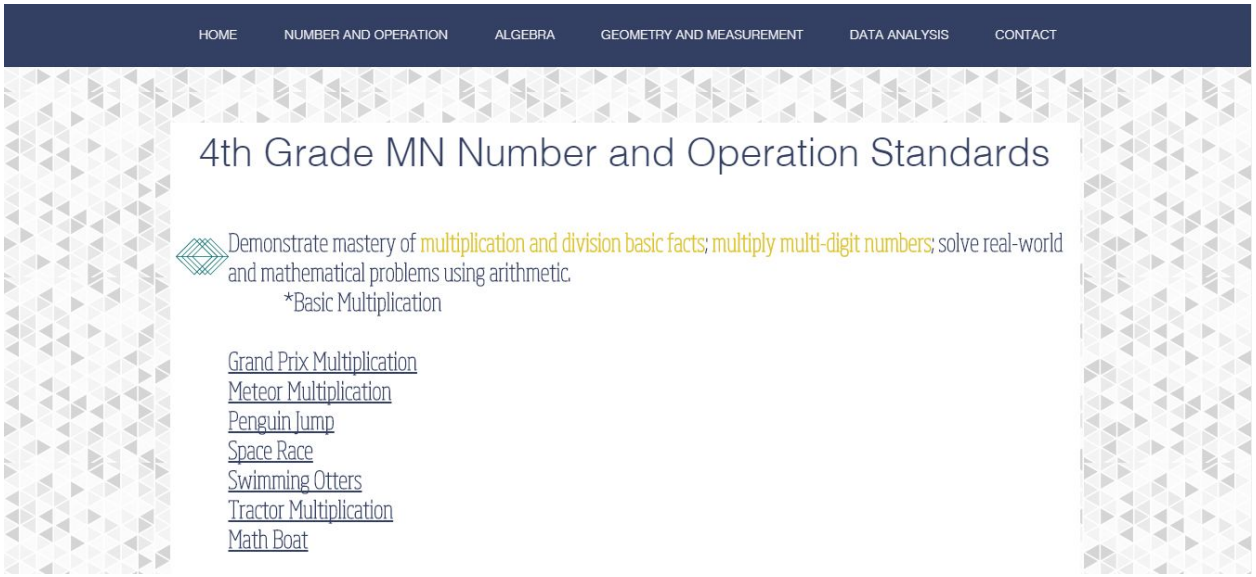
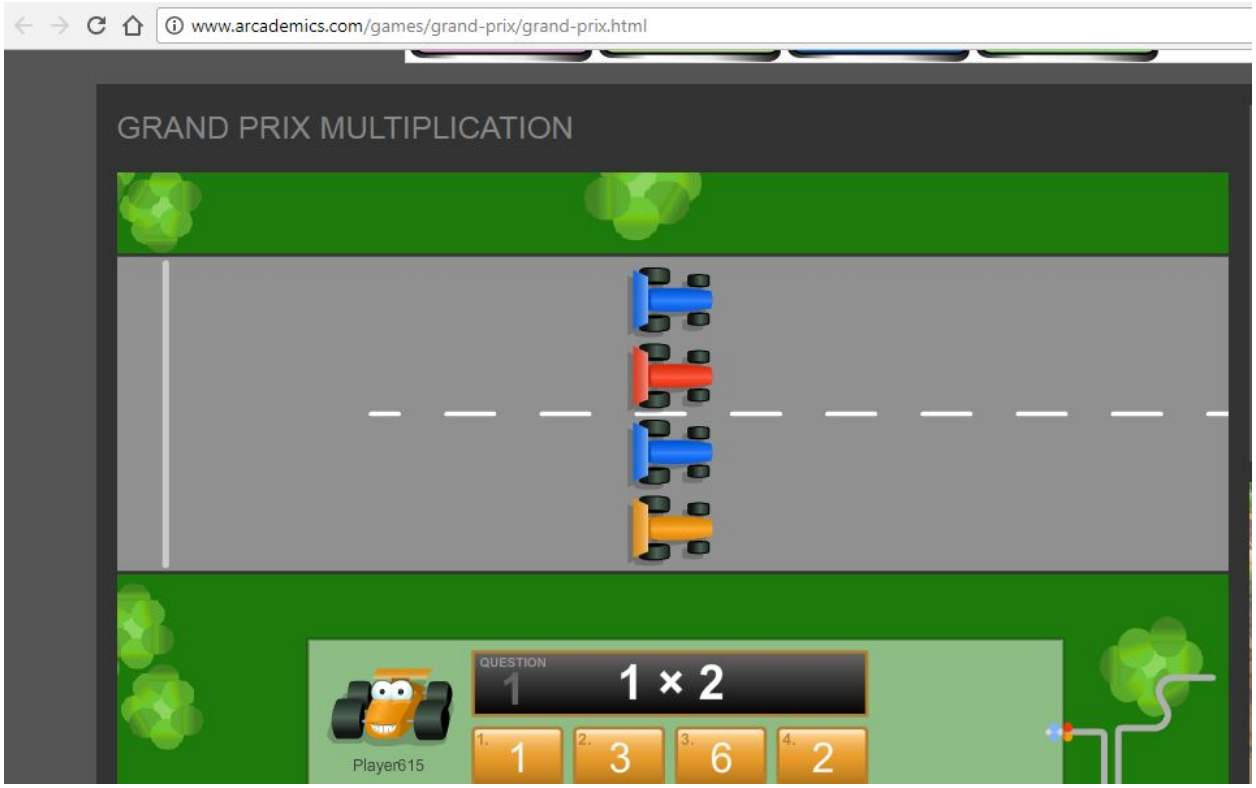


Figure C.2

Figure D


www.arcademics.com/games/grand-prix/grand-prix.html
GRAND PRIX MULTIPLICATION
QUESTION
1
1 × 2
1. 1
2. 3
3. 6
4. 2
Player615

Resources

Chee, Y. S. (2014). Intentional learning with educational games: A Deweyan reconstruction. *Australian Journal of Education, 58*(1), 59-73.

Cohan, A., & Honigsfeld, A., (2013). *Breaking the Mold of Education: Innovative and Successful Practices for Student Engagement, Empowerment, and Motivation.* Lanham: Rowman & Littlefield Education.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York, NY: Harper and Row.

Denham, A. R., Mayben, R., & Boman, T. (2016). Integrating game-based learning initiative: increasing the usage of game-based learning within K-12 classrooms through professional learning groups. *TechTrends,60*(1), 70-76.

Research-based web design & usability guidelines. (2006). Washington, D.C.: U.S. Dept. of Health and Human Services.

Gambrell, L., & Morrow, L. (2015). *Best Practices in Literacy Instruction.* New York, NY: The Guilford Press.

Hagger, M. S., & Chatzisarantis, N. L. D. (2016). The trans-contextual model of autonomous motivation in education: Conceptual and empirical issues and meta-analysis. *Review of Educational Research, 86*(2), 360-407.

Harris, C. (2014). Make a game out of learning: Quest-based education lets kids embrace their own mastery. *School Library Journal*.

Hirumi, A., Appelman, B., Rieber, L., & Van Eck, R. (2010) Preparing Instructional Designers

for Game-Based Learning: Part 1. *TechTrends, 54*(3), 27-37.

Hsu, Y. (2006). Better educational website interface design: The implications from gender‐specific preferences in graduate students. *British Journal of Educational Technology, 37*(2), 233-242.

Kafai, Y. B. (2006). Playing and Making Games for Learning: Instructionist and Constructionist Perspectives for Game Studies. *Games and Culture, 1*(1), 36-40.

Kafai, Y. B., Franke, M. L., Shih, J. C., & Ching, C. C. (1998). Game design as an interactive learning environment for fostering students' and teachers' mathematical inquiry. *International Journal of Computers for Mathematical Learning*, 3(2), 149-184

Kapp, K. (2012). *The Gamification of Learning and Instruction: Game-Based Methods and Strategies for Training and Education.* San Francisco, CA: Pfeiffer.

Kim, B. (2015). Gamification in education and libraries. *Library Technology Reports,* 51 (2). 20.

Li, Q., Lemieux, C., Vandermeiden, E., & Nathoo, S. (2013). Are you ready to teach secondary mathematics in the 21st century? A study of preservice teachers digital game design experience. *Journal of Research on Technology in Education,* 45 (4), 309+

Lie, M., Rosenblum, J.A., Horton, L., & Kang, J. (2014). Designing science learning with game-based approaches. *Computers in the Schools,* 31 (1-2), 84-102.

Liu, M., Scondino, R., Geurtz, R., Navarrete, C., Ko, Y., & Lim, M. (2014). A look at research on mobile learning in k-12 education from 2007 to the present. *Journal of Research on Technology in Education, 46 (4), 325+.*

Macklem, G. L., (2015). *Boredom in the classroom: Addressing student motivation, self-regulation, and engagement in learning.* Cham: Springer.

McDonald, K. K., & Hannafin, R.D. (2003). Using web-based computer games to meet the demands of today's high-stakes testing: a mixed method inquiry. *Journal of Research on Technology in Education,* 35 (4), 459+

McGuire, S. Y. (2015). *Teach Students How to Learn : Strategies you can incorporate into any course to improve student metacognition, study skills, and motivation.* Herndon, US: Stylus Publishing.

McLean, A. (2003). *The motivated school.* London: Paul Chapman.

Middleton, M. & Perks, K. (2016). *Motivation to learn: Transforming classroom culture to support student achievement.* Thousand Oaks, California: Corwin.

Ng, W.-S. (2014). Critical design factors of developing a high-quality educational website: perspectives of pre-service teachers. *Issues in Informing Science & Information Technology, 11, 101+.*

Peters, L. (2009). *Global education: Using technology to bring the world to your students*. Eugene, OR: International Society for Technology in Education.

Pittsley, K.A. & Memmott, S. (2012). Improving Independent Student Navigation of Complex Educational Web Sites: An Analysis of Two Navigation Design Changes in LibGuides. *Information Technology & Libraries 31 (3), 52-64.*

Plass, J., Homer, B., & Kinzer, C. (2015) Foundations of Game-Based Learning, *Educational Psychologist, 50*(4), 258-283.

Russel, M., Bebell, D., O'Dwyer, L. & O'Connor, K. (2003). Examining teacher technology use: Implications for preservice and inservice teacher preparation. *Journal of Teacher Education, 54 (4), 297+.*

Sansone, C., & Harackiewicz, J. M. (Eds.). (2000). Educational Psychology: Intrinsic and extrinsic motivation: the search for optimal motivation and performance (1). San Diego, ES: Academic Press.

Schmitz, B., Felicia, P., & Bignami, F. (2015). Acceptance and use of game-based learning in vocational education and training: an international survey. *International Journal of Game-Based Learning, 5*(4).

Vesel, J., & robillard, T. (2013). Teaching mathematics vocabulary with an interactive signing math dictionary. *Journal of Research on Technology in Education, 45 (4), 361+*.

Voorhies, B. (2013). The deep prehistory of indian gaming: possible late archaic period game boards at the tlacuachero shellmound, Chiapas, Mexico. *Latin American Antiquity, 24*(1), 98-115.

Wenn, S. R., & Schaus, G. P. (2007). *Onward to the olympics : Historical perspectives on the olympic games*. Waterloo: Wilfrid Laurier University Press.

Wiggins, B. (2016). An overview and study on the use of games, simulations, and gamification in higher education. *International Journal of Game-Based Learning. 6* (1).

Wright, M. (2017). *Paradox of the Learning Game.* Philadelphia, PA: Design Meets Mind.

Wu, W., Hsiao, H., Wu, P., Lin, C., & Huang, S. (2012). Investigating the learning – theory foundations of game-based learning: A meta-analysis. *Journal of Computer Assisted Learning, 28* (3), 265-279.