How Do Games and Competition Impact Student Motivation in the Mathematics Classroom?

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Abstract

Student motivation is essential for high levels of achievement. Particularly in science, technology, engineering, and mathematics subjects, which are often times the most difficult to motivate students. The most common form of motivation that teachers use is grades. However, many students do not see grades as a motivational factor. Is there an alternative way to motivate students in these subject? For instance, students are naturally interested in playing games. Could using games and competition in the mathematics classroom increase student motivation? The following study will attempt to discover a solution to the preceding question by examining the effects of games on students’ perceptions, comprehension of mathematical concepts, and motivation.
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Chapter 1: Introduction

Background

Motivation is essential for student achievement. According to Merriam-Webster Dictionary, motivation is defined as, “the act or process of giving someone a reason for doing something” (Merriam-Webster’s online dictionary, 2015). Why would one expect a student to do something without a reason? This is where student motivation comes into play.

In the past, student motivation was not the focus of the teaching profession. However, over time student motivation has gone from a secondary concern to one of the primary focuses for a teacher (Pintrich, 2003). According to Kusurkar et al. (2013), there is a correlation between student motivation and performance. This means that if teachers want students to perform at a higher level academically, they must find ways to motivate the students. The students need a reason to want to learn.

One way teachers try to motivate students is through grades. Yet, a large percentage of students are not driven to succeed through grades. Thus, teachers must find alternative ways to motivate students. One technique teachers have tried is using games and classroom competitions as a motivational tool.

The Problem

The objective of this study is to discover the impact of games and competition on motivation, specifically in the mathematics classroom. The most difficult courses to motivate students in are science, technology, engineering, and mathematics courses, also known as STEM
courses (Rissanen, 2014). These courses require higher levels of thinking and problem solving skills, which tend to be more difficult and less appealing to the average student.

For those who teach these subjects, creativity must be used to give students a reason to put forth effort. This is where many teachers have turned towards games and competition to motivate students. It is suspected that when games, competition, and incentives are all used in a lesson, teachers can expect their students’ best effort (Wilkins, 2012).

**Purpose of the Study and Research Questions**

The question this study is trying to answer is: how do games and competition impact student motivation in the mathematics classroom? As stated earlier, student motivation is becoming more and important to teachers. Students want a goal or a reason to perform a specific task. This is the motivation that teachers must come up with to keep students engaged in the lesson.

The study will be taking place in a mathematics classroom, which is one of the most difficult subject to find ways to motivate students (Rissanen, 2014). Mathematics requires problem solving skills that most students lack. These skills can be taught just like any type of skill. However, many students find out at a young age that mathematics is difficult and they do not have a strong belief in their own ability. Finding ways to motivate students in mathematics could help them change their perspective of their own mathematical ability.

This study will also look into specific aspects of games, competition, and their impact on student education. The first question the study will attempt to answer is how do games and competition impact students’ comprehension of mathematics concepts? The entire reason for
teaching mathematics is to enhance student comprehension of the mathematics. It will be interesting to see whether games and competition can help students learn these concepts.

Another question the study will attempt to answer is how do games affect students’ perception of their mathematics class? There is a very poor perception of mathematics among most students. This perception can lead to a lack of motivation and effort into learning different concepts that will be used in their future. It can also lead to a lack of class participation, which is important for any course. Participation includes answering questions and working through examples. By answering questions in class, students are showing that they are paying attention and following what the teacher is saying. Working through examples with the teacher is particularly important for students to understanding mathematical procedures. These procedures will help a student comprehend what a question is asking and how to approach the question.

The final question the study will attempt to answer is how does winning compared to losing a competition affect students’ performance? Anytime there is competition, there is always a winner and a loser, which gives students an opportunity to fail. This can be very demeaning to some students and forces them to shut down automatically (Self, 2009). It is important that every student feels safe in the classroom. Thus, it will be interesting to see if students feel differently about playing games when they win compared to lose.

**Conclusion**

The purpose of this study is to answer the following research question: How do games and competition impact student motivation in the mathematics classroom? Student motivation plays a large role in students’ performance. Thus, motivating students must play a major factor in teachers’ preparations. Particularly teachers who teach STEM subjects because they are the
most difficult subjects to motivate students (Rissanen, 2014). This study will take place in a mathematics classroom and the participants will be taking a high school level geometry course. The results of this study will be used to examine whether games and competition can effectively motivate students to improve their performance in the mathematics classroom.
Chapter 2: Review of Literature

Introduction

Motivating student has always been challenging for teachers. Studies have shown that the most difficult subject to motivate students are Science, Technology, Engineering, and Mathematics (STEM) courses (Rissanen, 2014). These STEM courses are becoming more and more important as technology grows. Many 21st century skills require a strong background in these subjects. These skills are extremely important for students to have the opportunity to succeed in today’s world (Qing, Lemieux, Vandermeiden, & Nathoo, 2013). As result, it is essential to increase student motivation in STEM courses to allow them to achieve their true potential.

Increasing student motivation can be difficult; however, there is evidence that games and competition may be able to peak students’ interest and motivation (Afari, Aldridge, & Fraser, 2012). These types of activities can support learning, problem solving, communication, and team work (Whitton, 2012). This review of literature examines the effects of games and competition on student motivation in the mathematics classroom.

Student Motivation

Science, Engineering, Technology, and Mathematics (STEM) courses require higher-order thinking and problem solving that students are generally uncomfortable with. Consequently, most students find these subjects to be their most challenging, which can lead to an extreme lack of motivation in these courses. One of the main reasons for why this is true is because the students do not have a strong knowledge background and these subjects are not
among their personal interests (Rissanen, 2014). As a result, this and many other factors can lead to a lack of motivation for students to achieve in these subjects.

There is evidence that shows that students’ academic achievement level is correlated with their mathematics ability (Abu-Hamour & Al-Hmouz, 2013). Essentially, if we want to increase students’ academic achievement, we must start by increasing their mathematics ability. However, if we want to increase their mathematics ability, we must increase student motivation.

One way to assess student motivation is through the expectancy-value theory. This theory argues that motivation is based on the student’s choice, constancy, and performance, which can be explained through self-efficacy. Self-efficacy is one’s belief in his or her ability to complete a certain task (Gasco & Villarroel, 2014). Since students view the STEM courses as being so difficult, they may have little confidence in themselves to achieve in these courses. This puts more pressure on teachers to find different ways to motivate students and show them that they can succeed in these courses.

To examine different ways of motivating students, Rissanen (2014) looked at different types of teaching styles. He found that visualizations or demonstrations are a great way to enhance motivation, but these are not a very good way of building a deeper theoretical understanding of a concept. Even though lectures are not viewed as being very interesting or creative, they are still the best way to build deeper understanding. Rissanen argues, “Lectures that emphasize theory should be as interesting and attractive as practical demo sessions” (p.3). For students to gain insight into a new concept, lectures are necessary, but once the concepts are introduced teachers need to engage students through creative instructional strategies.
One instructional strategy to further engage students is through the use of games. When games are presented, students’ motivation is increases dramatically (Afari et al., 2012). Games are something that students find enjoyable. When they are present, teachers are using the students’ personal interests to enhance their motivation (Rissanen, 2014). A way to make games even more enjoyable for students is to give out some sort of incentive for the winners or for student participation.

Incentives can be in the form of praise, grades, points, coupons, treats, etc. (Potacco, Chen, Desroches, Chisholm, & Young, 2013). In the study conducted by Wilkins (2012), he found that many students become driven by incentives. It keeps them focused and gives them a goal to aim for. Incentives can also be used as a form of reinforcement for students, both positively and negatively. A form of positive reinforcement would incorporate giving the students some sort of prize at the end of the competition. Negative reinforcement would incorporate taking something student do not enjoy away for them such as homework. These types of incentives are very useful when trying to motivate students.

In the real world, incentives are exclusively used as a form of motivation. A few examples are salaries, raises, bonuses, commissions, promotions, vacations, etc. Almost any type of job has at least one form of these incentives attached to it. In higher education, we use incentives in the form of scholarships, awards, and grades (Potacco et al., 2013). According to Potacco et al., “A well-run rewards system has the ability to encourage both workers and students to accept tasks, set goals, and invest time that they might not accept or set on their own” (p.31). As a result, students’ performance and interest towards an uninteresting task become enhanced through incentives.
Allowing student to play an active role in the classroom is another way to increase student motivation. This includes giving them specific duties and taking their opinions into account when creating lessons or activities. Giving students a role can increase their participation and motivation. Along with an increased motivation in future learning by building the students’ confidence and considering their personal inputs. This can also help build a positive learning environment for the students (Rissanen, 2014).

Student motivation is essential for high student achievement. There are many strategies for enhancing motivation, but one of the most important concepts to keep in mind is that a student will not be very motivated to perform a task that they view with low self-efficacy (Gasco & Villarroel, 2014). To help improve a student’s self-efficacy, teacher should focus on making the student feel accepted and try to incorporate the student’s interests. If this is achieved, student motivation and academic achievement should improve as a byproduct.

**Effectiveness of Games**

Students are naturally interested in games. This makes them a great way to get students attention and allow them to engage in a lesson. There is also evidence that the use of games can help make teachers’ jobs easier. Making a game may take some time, but once you begin the lesson students productivity tends to increase (Proctor & Marks, 2013). This allows for teachers to get more information to their students in a single lesson.

Proctor & Marks (2013) have also found evidence that student performance increases when participating in games. However, it is important to understand how this increased performance is nurtured. One of the most popular ways to implement games is in a team format. When a student is a part of a team they become more engaged and produce high quality work.
The team also works as a support system for students. This gives them more opportunities to receive help from other students (Afari, Aldridge, & Fraser, 2012). If a student does not understand a concept taught by the teacher, a fellow student’s explanation may help clarify misconceptions.

Working as a team can help students gain a better understand of the material through communication. Communication among students can be hard for teachers to facilitate. It turns out that games can actually help teachers support learning, problem solving, group activities, and communication (Whitton, 2012). These are essential tools that teachers need to help students meet their potential. All of these tools are considered 21st century skills. These are skills that will help prepare students for their future and games are considered to be a great means of teaching these skills (Qing, Lemieux, Vandermeiden, & Nathoo, 2013).

In addition to teaching 21st century skills, games are a great way to get students interested in future careers. Particularly, a game that allow them to simulate a job. This simulation can help them see if the job is something they would be interested in pursuing as a career. When a groups of students participated in a game that required them to play the role of a forensic scientist, many student knowledge about forensics increased. However, even more interesting, a few believed that they would like to be a forensic scientist in the future (Miller, Chang, Wang, Beier, & Klisch, 2011). Getting students ready for their future is an important part of being a teacher. If there is a way to use these types of games in the classroom, they should be taken advantage of.

Although there are many good things that can come from implementing games into the classroom, there are also a few downsides to using games. Most teachers agree that games are
easy to use, and make the teachers’ jobs easier. However, Proctor & Marks (2013) found evidence that many teachers believe that they are not very useful in the classroom. When they looked into why teachers are not finding them useful they found that almost all of these teachers also found it difficult to use games in the classroom (Proctor & Marks, 2013). After listing many positives that games can facilitate, it is essential that teachers feel comfortable using them in their classes. One of the biggest reasons they find it difficult to implement the games into the classroom is because a very safe environment must be present for students to thrive. Without a supportive and safe environment students will not be motivated by games (Whitton, 2012).

Games are a great way to support students learning because it is something that interests those (Qing et al., 2013). Catering to students interests it a great way to motivate them and allow them to perform at the best of their ability. When using games, students learn through practice, failure, reflection, and repetition. It also allows students to safely receive constructive feedback as long as a safe atmosphere has been created. One of the most important thing for teacher to keep in mind when implementing games is to be sure the students are learning from the game, not with the game (Whitton, 2012). By learning from the game, students are learning how to work as a team and be respectful to the competition. Along with that, when students learn from the game they should be picking up on concepts and procedures while they play. This will allow them to commit these ideas to memory, which they will be able to recall in the future.

**Competition**

American classrooms are competitive in nature based on the set up of education system (Jameson, 2007). Students are graded in each individual class, they are given a class rank when they graduate, and there are awards and scholarships given to the students that perform the best.
Although it applies more pressure to students, competition is not a bad thing. There is evidence that competition in the classroom can promote community and learning (Olitsky, 2011). The way that American society is set up forces Americans to be very competitive if they want to be successful. No matter what goals American students set out to achieve, they will face many challenges in the form of competition along the way.

Since competition is so prevalent in American society, teachers need to foster students into a safe competitive environment early in their lives. However, this is not easy to do. There is evidence that a competitive classroom environment can hinder the education for some students (Olitsky, 2011). Not all students want to compete and anytime competition is involved, there is an opportunity for failure. When some students are put into competitive situations, they shut down automatically (Self, 2009). There also has to be a loser when competition is involved in the classroom and students are face with opportunities to embarrass themselves (Olitsky, 2011). This is something that can hinder a student’s education for years, but teachers must prevent this at all cost. Students must learn to compete because it is something they will face throughout their lives.

There are a lot of positives that can come from competition if it is used correctly. Similar to implementing games, one of the most popular forms of implementing competition is through teams (Self, 2009). This takes a lot of the pressure off the students as an individual. If the team does not win, then they whole team loses and it is not a single individual’s fault. This also incorporates the use of teamwork, which is a 21st century skill. These skills are essential for students to learn to prepare them to succeed in the future.
Evidence suggests that when students are in a large class, over 28 students, they want to compete (Eseryel, Law, Ifenthaler, Xun, & Miller, 2014). It is important to keep this in mind when teachers have large classes because competition can be a way to build rapport with students and engage them in activities. In a study performed by Olitsky (2011), she found that teams are a great way to implement competition because students are not based solely on “smartness.” She also found that when students are on a team they do not perceive one student as being the best. They see themselves as all being equals. Another thing that Olitsky found was that when a student makes an incorrect statement, although students may laugh or make jokes, it is all in a supportive manner. They are not making fun of the students answer, they are simply trying to make the competition more enjoyable.

Another great way to incorporate competition is to have the students focus on competing against themselves rather than their peers (Self, 2009). Instead of trying to do better than another student in the class, students can try to do better on the upcoming test than their previous test. This gives students something to compete for without anyone else losing. It is a safe way to motivate students and have them try to bring their grades up. This concept could also be used when students are in teams. Rather than trying to beat the other team, they can focus trying to achieve a goal set by the teacher. The competition would be trying to achieve the milestone the teacher has set forth for the student.

Competition also helps build student relationships in the classroom. In a study performed by Wilkins (2012), where he studied twenty-eight eighth grade students, he found that boys and girls interact more when there is competition involved. This is a great way for teachers to create a humbling atmosphere in the classroom. He also found that the using competition that involves
incentives promotes very high levels of student motivation. When competition and incentives are presented together, teachers can expect to see their students’ best effort (Wilkins, 2012).

As stated earlier, American classrooms are competitive by nature (Jameson, 2007). There is evidence that students with high competitive attitudes are positively correlated with higher test scores (Eseryel et al., 2014). If teachers incorporate competition in a positive manner, student achievement and test scores could increase as a result. Students would like to outperform their peers, but work with them at the same time. Teachers should try to incorporate as much team competition as possible to allow students competitive sides to come out while still nurturing a positive environment (Bratti, Checchi, & Filippin, 2011).

**Summary**

When students graduate high school, they will be thrown into a world of competition. Whether it is trying to find a job or trying to getting a raise at work; they will be faced with competition on a daily basis. It is important that teachers incorporate competition into their lessons since it may be even more important to their future than the actual subject they are teaching them. Not only that, competition increases student test scores and student to student interaction while they are still in school (Eseryel et al., 2014; Wilkins, 2012). Although there are a few negatives associated with the use of games and competition in the classroom, if implemented correctly, they can play a large role in enhancing student motivation and academic achievement.
Chapter 3: Methodology

Introduction

The study was conducted to determine if games and competition in the mathematics classroom impact student motivation. The study took place over 26 school days with the researcher role as a teacher-researcher throughout the study. Data were gathered using periodical surveys and pre- and post-tests. The data were analyzed quantitatively using the student’s t-test for both the surveys and tests.

Participants

This study was conducted in a rural school district in southeastern Ohio. The elementary, middle school, and high school are located in the same building, and the research was conducted in the high school. The Ohio Department of Education high school report card for the 2013-2014 school year shows that there were 376 students enrolled during that time (Ohio Department of Education, 2014). Of these 376 students, 98.0% were considered white, non-Hispanic and no students were considered English Language Learners. Furthermore, 20.5% of the student body was considered to have learning disabilities, and 55.3% was economically disadvantaged (Ohio Department of Education, 2014).

The study was conducted by a pre-service teacher during his professional internship. The teacher-researcher was in the high school the entire year and had developed rapport with the students before the study is conducted. The teacher-researcher assumed full control of the classes by the time of the study. The supporting teacher was not be involved in the study.
The study took place in four geometry classes. The classes total 68 students. The class distribution of the students is 1 freshman, 55 sophomores, 8 juniors, and 4 seniors. There are 29 females and 39 males. Also, 18 of the 68 students have Individual Education Plans and 9 of the students are taking the class for the second or third time. The students’ mathematical ability is very wide. A few of the sophomores and the one freshman have excellent problem solving skills and mathematical reasoning. However, there are also several students that struggle with basic mathematical procedures such as addition, subtraction, multiplication, division, and one or two step algebra problems. These struggles in mathematics have resulted in failing mathematics courses in the past, including geometry.

**Instruments**

**Surveys**

The teacher-researcher gave the students surveys three times over the course of the study. The surveys contained two or seven Likert-Scale questions, 1-very low, 2-low, 3-average, 4-high, 5-very high or 1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5-strongly agree. The first survey, the pre-survey, was given before the study began. This survey included questions that asked the students their current feeling towards the class, their current motivation in class, and their opinions on games and competition. The second survey was a post-survey for the first 13 days of the study. It was given on the 13th day of the study and contained only two questions related to student enjoyment and motivation over the past 13 days. There was also a third survey, which was a post-survey for the second 13 days of the study. This survey asked the same questions as the pre-survey.
**Pre- and Post- Test**

Along with the surveys, I also gave the students a pre-test and a post-test for each unit. Each pre-test and the post-test used the exact same questions and grading scale with a total of 60 points. The students took the first pre-test on day 1 before any material was covered and the first post-test on day 13 once all of the material was covered. The following day, day 14, the students took the second pre-test before any of the material on similarity was covered and the second post-test on day 26, the last day of data collection, once all of the material was covered.

The purpose of the pre-test and post-test is to compare how much the students learned over the course of the unit. The pre-tests gave a base line for how much of the information the students have learned in the past about transformations or similarity. When analyzing these scores I used the difference of the students’ first post-test and first pre-test compared to the difference of the students’ second post-test and second pre-test.

**Research Design**

The study took place over a 26 school day period. Although it only took 26 school days, it began on January 16, 2015 and concluded on March 10, 2015 due to school cancelations. This 26 day period was broken into two separate units. Unit one covered transformations and took place over the first 13 days. During this time, there was no form of games or competition implemented into any lesson. The classroom procedures over this unit contained direct instruction, group work, and discovery learning activities. Unit two covered similarity and took place over the second half of the 26 days. The classroom procedures over this time was similar. However, every lesson incorporated games and competition in some form or another. These games incorporated individual, small team, large team, and whole class competition. During this
unit, each class participated in one 13 day competition as a team. Each class competed against the other three classes. They achieved points everyday based on their performance in different types of games and competitions. They were rewarded for achieving the most points each day, as well as, overall points on the day of a quiz or test. The team that had the most points after the 13 days were rewarded with pie on Friday, March 13 to celebrate pi day.

**Surveys**

The sample size for the surveys consisted of all 68 students. After the first unit of the study was completed, day 13, the students took the second survey. This survey contained two of the questions from the pre-survey about enjoyment and motivation. The purpose of this survey was to determine if the students’ motivation levels change from unit one to unit two. Once unit one was completed, day 26, the students took a post-survey. This survey asked the same questions as the pre-survey. However, the questions were re-worded to take into account specific time and past tense. This survey asked the students to reflect on the current unit they just completed with respect to enjoyment and motivation.

**Pre- and Post- Tests**

Due to illnesses that resulted in a large number of absences during the study only 58 students’ test scores factored into the data collection of this study. The purpose of the pre-test and post-test is to compare how much the students learned over the course of the unit. The pre-tests gave a base line for how much of the information the students have learned in the past about transformations or similarity. When analyzing these scores I used the difference of the students’ first post-test and first pre-test compared to the difference of the students’ second post-test and second pre-test.
Data Analysis

For both the surveys and the pre-and post-tests, the data were analyzed using the student’s t-test. According to Caprette (2012), the student’s t-test is used to compare two sets of quantitative data. For both of these cases, the data were represented as a quantitative value which could be compared using the student’s t-test.

Surveys

The survey results expressed a quantitative value from 1 to 5 from the Likert Scale. As stated earlier, I collected three surveys during this study. I have compared the results of the students’ first survey and third survey, as well as, the second survey and third survey. The results have been tested for statistical significance at 90%, 95%, and 99% significance levels.

Pre- and Post- Tests

Both sets of pre-tests and post-tests were graded on a 60 point scale. I evaluated the students test scores by subtracting each students’ first pre-test score from his or her first post-test score and I compared these scores to each students’ second pre-test score subtracted from this or her second post-test score. The results have been tested for statistical significance at a 99% significance level.

Summary

The purpose of this study was to examine the effects of games and competition on student motivation in the mathematics classroom. It was conducted over a 26 day period, which included 13 days without any games use in any lesson and 13 consecutive days of one big competition that incorporated several games and individual competitions into every lesson. Data
were collected using student surveys and pre- and post-tests for the two separate units. The data from both the surveys and the pre- and post-tests were analyzed using the student’s t-test, which were tested for statistical significance at 90%, 95%, and 99% significance levels.
Chapter 4: Data Analysis and Results

Introduction

The results of the study are presented in this chapter, which is structured to reveal the results of the surveys and then the pre- and post-tests. The surveys consisted of a pre-survey, a post-survey for the first unit, and a post-survey for the second unit. Following the results of the surveys, the pre- and post-test data will be discussed. The students took a pre-test and a post-test for both of the units. These results will be examined by comparing the results of each of the pre-tests, each of the post-tests, and the difference between the first post- and pre-test and the difference between the second post- and pre-test. As a reminder to the reader, the research question was how do games and competition impact student motivation in the mathematics classroom?

Surveys

In this section, the researcher presents the findings of the surveys. In total, the students completed three surveys. A pre-survey and two post-surveys. The post-survey for the first unit will be referred to as post-survey 1, while the post-survey for the second unit will be referred to as post-survey 2. The pre-survey can be seen in appendix A, post-survey 1 can be seen in appendix B, and post-survey 2 can be seen in appendix C.

The results of the each of the surveys will be discussed one survey at a time. Then the results from the pre-survey and post-survey 1 will both be compared to the results from post-survey 2. Recall from Chapter 3, the surveys used seven Likert-Scale questions, 1-very low, 2-low, 3-average, 4-high, 5-very high or 1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5-strongly agree. The means and medians of these surveys can be seen below in Table 1.
Table 1

<table>
<thead>
<tr>
<th>Survey Data</th>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-Survey</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>3.09</td>
<td>2.90</td>
<td>3.75</td>
<td>3.35</td>
<td>3.38</td>
<td>3.54</td>
<td>3.37</td>
</tr>
<tr>
<td>Median</td>
<td></td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Post-Survey 1</td>
<td></td>
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</tr>
<tr>
<td>Mean</td>
<td></td>
<td>3.16</td>
<td>3.33</td>
<td>4</td>
<td></td>
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</tr>
<tr>
<td>Median</td>
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<td>3</td>
<td>4</td>
<td></td>
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<tr>
<td></td>
<td>Post-Survey 2</td>
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</tr>
<tr>
<td>Mean</td>
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</tr>
</tbody>
</table>

By examining the results of the first survey, the mean and median response suggest that the average student response was average/neutral for questions 1, 2, 4, and 5. These four questions address how much students enjoy geometry, their motivation in geometry, and their outlook on competition. The average student responses for questions 3, 6, and 7 were high/agree. This is very intriguing because all three of these questions were centered on games. These questions were asked before any games were played in class, which suggests that students have a naturally positive outlook on games.

When looking at the results of the second survey, both of the means rise slightly. However, now the median of question two rises to a 4, which shows that the average students’ current motivation level in geometry is high. There is no clear reason for why the students’ enjoyment and motivation levels increased. The only evidence that could be found was that the researcher had not been teaching before the study took place. Thus, his teaching style could have enhanced the students’ motivation levels. In particular, one student wrote on his or her post-survey, “The way [he] teaches really helps.” This may have played a role in students’ feelings.
about the class during the first unit. However, the results of post-survey 2 show even higher increases.

Examining the results of post-survey 2 shows an increase in the mean for every question and the median of every response is high/agree. These sharp increases show evidence that students enjoy play games in school, games enhance their motivation, and that games help them learn the material. In fact, by using a t-test, there is evidence that the students’ enjoyment for the second unit was higher than the first unit with over 90% confidence. The p-value for this test was equal to 0.080, which allows us to reject the null hypothesis that the means are equal. In addition to that, it is also statistically significance that the students motivation increased when playing games with over 95% confidence. The p-value for this test was equal to 0.027, which also allows us to reject the null hypothesis that the means are equal.

The t-test was used in comparing all of the other questions as well. Many of the other test showed some indication that the second unit increased the students responses to the survey questions. Unfortunately, none of the other results were statistically significant. However, the means and medians do suggest that the students’ outlook on all of the questions increased after post-survey 2.

**Pre- and Post-Test**

In this section, the research presents the findings of the pre-test and post-test. The students that took part in this study took two separate pre-tests and post-tests. Pre-test 1 was taken on day one of the study. This pre-test, was identical to post-test 1, which the students took on day 13 of the study. On day 14, the students completed pre-test 2, which was the exact same
test as post-test 2 taken on day 26. Test 1 can be seen in appendix D while test 2 can be seen in appendix E.

The results of the pre- and post-tests will be discussed by comparing the results of pre-test 1 and pre-test 2. Then, the results of post-test 1 and post-test 2 will be compared to one another. Finally, the differences between the post and pre scores for each test will be compared to test for statistical significance between the scores. Both tests were out of a total of 60 points. The results for the pre- and post-tests can be seen below in Table 2.

Table 2

<table>
<thead>
<tr>
<th>Pre-and Post-Tests Data</th>
<th>Pre-Test 1</th>
<th>Post-Test 1</th>
<th>Post-Test 1 – Pre-Test 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>10.70</td>
<td>47.21</td>
<td>36.51</td>
</tr>
<tr>
<td>Median</td>
<td>9</td>
<td>50</td>
<td>41</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pre-Test 2</th>
<th>Pre-Test 2</th>
<th>Post-Test 2 – Pre-Test 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>7.75</td>
<td>51.33</td>
</tr>
<tr>
<td>Median</td>
<td>7</td>
<td>52</td>
</tr>
</tbody>
</table>

The results of pre-test 1 were very low, which was expected because the students hadn’t learned any of the material. However, the scores for pre-test 2 were even lower than pre-test 1. This shows that the students had more knowledge about the material covered in unit 1 compared to unit 2. Thus, one would imagine the material would be easier for the students to learn in unit 1 because they had some background knowledge. The results of the post-tests do not show the share the same information.

By looking at the results of post-test 1, the students did very well. With a mean of 47.21 and a median of 50, a majority of the student got over an 80% on the test. However, the results
of post-test 2 exceeded that of post-test 1, with a mean of 51.33 and a median score of 52. What make this even more intriguing is that the pre-test score for test 2 were lower than that of test 1. Thus, the researcher decided to examine the differences between the pre- and post-tests.

The differences of the pre- and post-tests show some interesting results. The mean and median differences of test 1 were 36.51 and 41. While the mean and median differences for test 2 were 43.57 and 44. This is over a 7 point increase for the average students score and a 3 point increase for the median score for test 2 compared to test 1. For the 60 point test, that is roughly an 11% increase in the mean and a 5% increase in the median.

To test for significance in these scores, the researcher used a 2 sample t-test. The results of the test show statistical significance. The p-value of the study was 0.0002, which allows us to reject the null hypothesis that the means are equal with over 99% confidence. This shows that the difference between post-test 2 and pre-test 2 is greater than the difference between post-test 1 and pre-test 1. These scores suggest that the students were able to learn more mathematics content during unit 2 compared to unit 1.

**Summary**

In this study, students complete three surveys, as well as, a pre-test and post-test for each unit. The surveys given were the pre-survey, post-survey 1, and post-survey 2. The mean responses of the students increased with every survey the students completed. The pre-survey results gave insight that the students had a naturally positive outlook on playing games in class. While post survey 1 and 2 shown statistically significant evidence that the students enjoyed their geometry better during the second unit, when they were participating in games and competition every day. There was also statistically significant evidence found when comparing the student
responses from the pre-survey and post-survey 2 with regards to an increase in motivation when playing games in geometry.

When examining the students pre- and post-test scores, more statistically significant evidence was found from this study. Pre-test 1 scores were higher than pre-test 2, and post-test 1 scores were lower than post-test 2. In addition to that, when the difference between pre- and post-test 1 were compared to pre- and post-test 2, there was statistically significant evidence that the test 2, scores were higher with over 99% confidence. Test 2 was the test given before and after the unit that incorporated games and competition into every lesson. The pre- and post-test results, along with the survey results show very strong evidence that games and competition increase student motivation in the mathematics classroom.
Chapter 5: Conclusions

Introduction

In this chapter, the findings from chapter 4 will be discussed. This chapter will attempt to answer all of the questions that were proposed as the purpose of this study. Recall from chapter 1 that the research question was how do games and competition impact student motivation in the mathematics classroom? This question will be the central topic of discussion. However, we will try to answer the other three questions proposed in chapter 1 as we discuss the significance of the results from chapter 4. As a reminder, these three questions are: How do games and competition impact students’ comprehension of mathematics? How do games affect students’ perception of their mathematics class? How does winning compared to losing a competition affect students’ performance?

Findings

Student Motivation

The purpose of this study was to answer the following question: How do games and competition impact student motivation in the mathematics classroom? After examining the results of the data collected, there is statistically significant evidence that student motivation increased as a result of games and competition incorporated into mathematics lessons. According to the surveys collected, student opinions about games, competition, and the effects of the motivation all increased from the beginning of the study to the end of the study. In addition to that, the survey’s reported that student enjoyment increased substantially from the unit without games to the unit where games were used in every lesson.
To answer the research question specifically, students were asked to assess their feelings toward the following statement before the study began and once the study was completed: My motivation increases when I play games in school. This is question 5 from the pre-survey and post-survey 2, which can be seen in appendix A and C. The mean and median of this question in the pre-survey was 3.38 and 3, where 3 is neutral and 4 is agree. While in post-survey 2, the mean and median were 3.86 and 4. Before the study began, the student were neutral or unsure whether games increased their motivation. However, once the study was complete and they had just finished learning through games, the student consensus was that games increased their motivation.

In this particular study, the results of the pre- and post-tests also indicate that student motivation increases from the implementation of games and competition. Pre- and post-test 1 were given before and after the first unit. During this unit, no games or competition of any kind were incorporated into any lesson or activity. Pre- and post-test 2 were given before and after the second unit of the study. For this unit, each geometry class was in competition with one another for the whole unit. In addition to that, there was a game implemented into every lesson to allow the students to gain points for the competition. According to the t test that was used to test the data of the pre- and post-tests, the scores from test 2 were greater than the scores from test 1 with over 99% confidence. This is evidence that the students’ academic performance increased during the second unit in comparison to the first unit. According to Kursurkar, et al. (2013), there is a correlation between student motivation and academic performance. Thus, from the results of the pre- and post-tests, there is evidence that student motivation increased from using games and competition during the second unit.
Comprehension of Mathematics Concepts

Along with the research question, chapter 1 introduced three separate questions about the effects of games, competition, and their impact on education. The first of these three questions was how do games and completion impact students’ comprehension of mathematics concepts? Based on the results of the pre- and post-test, there was significant evidence that students’ comprehension of mathematics concepts increased substantially when games and competitions were involved in this particular study. The test score when the games were involved were statistically significant at over a 99% confidence level.

In addition to test scores, the researcher was also able to notice a large number of students who began to gain confidence in their mathematics ability. In chapter 3, the research discussed the make-up of the participants of this study. Although there were a few students with excellent problem solving skills and mathematically reasoning, the majority of the students struggled with even the most basic mathematical procedures. In fact, several students struggles had resulted in failing mathematics courses in the past, including geometry for some.

However, when the material from unit 2 was being taught, the researcher noticed an overall stronger comprehension of mathematically concepts. More homework was turned in than the previous unit, the quiz scores were higher, and the test scores were higher. Also, the students’ recollection of topics that were discussed were far greater than any other point the researcher had seen from the students the whole school year. All of this, along with the evidence from the pre- and post-test, suggests that games and competition had a positive effect on students’ comprehension of mathematics concepts in this study.
**Student Perception**

The second research question presented in chapter 1 was how do games affect students’ perception of their mathematics class? To discuss this question, the results of question 1 from all three surveys will be used. This question asked the student to rate how much they have enjoyed geometry, 1-very low, 2-low, 3-average, 4-high, 5-very high. Although this question does not directly ask the students their perception of geometry, it is assumed that their level of enjoyment is a reflection of their perception.

According to the pre-survey, which was given on the first day of the study, the mean response was 3.09 and median response was 3. By the end of the first unit, which implemented no games in any form, the mean response rose slightly to 3.16 and the median remained 3. Finally, after the second unit, which implemented games and competition into every lesson, the mean rose to 3.68 while the median rose to 4. This is a considerable increase. In fact, after an analysis of the data using a t-test, it is statistically significant with over 90% confidence that the students’ enjoyment during unit 2 is higher than unit 1. Although 90% is not an extremely large percentage, it is still enough evidence to show that the students perception about geometry increase when they were participating in games.

**Winning and Losing**

In chapter 2, some research suggested that games and competition can be harmful to student because there must be a winner and a loser. In fact, the opportunity for losing can cause some students to shut down automatically (Self, 2009). Thus, as the final question of this study, the following question was proposed: How does winning compared to losing a competition affect
students’ performance? To examine this question, question 7 of the pre-survey and post-survey 2, along with the results of the pre- and post-test will be discussed.

Question 7 of the pre-survey and post-survey 2 asked the students if they think games are still enjoyable even if they do not win, 1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5-strongly agree. According to the pre-survey results, the mean response to this question was 3.37 and the median was 4. Since the median was 4, this means that over half of the student agreed with this question before playing any games in geometry. The results of post-survey 2 showed a slight increase in the mean, 3.61, while the median remained 4. The increase in the mean implies that after playing games in unit 2, students began to agree that they enjoy playing games even if they do not win. However, the results of post-survey 2 show that there were a total of 10 out 68 student who answered with a 1 or 2 to this question, which suggests that there are a few students that do not enjoy playing games if they do not win.

However, the results of the pre-and post-test would suggest otherwise. After analyzing the data with a t test, there is statistical significance with over 99% confidence that the students test scores after unit 2 were an improvement from unit 1. During unit 2, four separate geometry classes competed against one another for all 13 days. At the end of the unit, one class was named the winners of the competition. Of the 58 students that took the test, only 11 of them were from the class that won the competition. This implies that 47 of these student technically lost the competition. Nevertheless, these student test scores factored into the t-test results, which provides statistical significance that the students’ test scores were an improvement when games and competitions were incorporated into the lessons. Therefore, there is no evidence that winning compared to losing affects students’ performance.
Conclusion

The results of this study support the research question and had positive implications on student motivation. The surveys given provide evidence that the students enjoyed geometry and their motivation increased when playing games in school. While the pre- and post-test provided statistically significant evidence that students test scores increased after games and competition were incorporated into every lesson. Both the survey results and test scores were used to conclude that games and competition had a positive effect on students’ comprehension of mathematics concepts and positively affect student perception of mathematics classes. The results were also able to conclude that there was no evidence that losing a game or competition affects the students’ performance. Finally, based on all of evidence from this study, there is substantial evidence to support that the games and competition used in this study had a positive impact on student motivation in mathematics.
References


design experience. *Journal Of Research On Technology In Education (International Society For Technology In Education)*, 45(4), 309-337.


Appendix A: Pre-Survey

Answer the following questions on a scale from 1 to 5.

(1) Very Low, (2) Low, (3) Average, (4) High, (5) Very High

1. Rate how much you have enjoyed Geometry this year.

   1  2  3  4  5

2. What is your current level of motivation in Geometry?

   1  2  3  4  5

(1) Strongly Disagree (2) Disagree (3) Neutral/Sometimes (4) Agree (5) Strongly Agree

3. I enjoy playing games in school.

   1  2  3  4  5

4. I enjoy competing in school.

   1  2  3  4  5

5. My motivation increases when I play games in school.

   1  2  3  4  5

6. Playing games in school helps me learn the material.

   1  2  3  4  5

7. I still think games are enjoyable if I do not win.

   1  2  3  4  5
Appendix B: Post-Survey 1

Answer the following questions on a scale from 1 to 5.

(1) Very Low, (2) Low, (3) Average, (4) High, (5) Very High

1. Rate how much you have enjoyed Geometry this chapter.
   1  2  3  4  5

2. What is your current level of motivation in Geometry?
   1  2  3  4  5
Appendix C: Post-Survey 2

Answer the following questions on a scale from 1 to 5.

(1) Very Low, (2) Low, (3) Average, (4) High, (5) Very High

1. Rate how much you have enjoyed Geometry this chapter.
   1 2 3 4 5

2. What is your current level of motivation in Geometry?
   1 2 3 4 5

(1) Strongly Disagree (2) Disagree (3) Neutral/Same (4) Agree (5) Strongly Agree

3. I enjoyed Geometry more when playing games.
   1 2 3 4 5

4. I enjoyed Geometry more when competing in class.
   1 2 3 4 5

5. My motivation has been higher in the last chapter than the previous chapters.
   1 2 3 4 5

6. I have learned more in this chapter than the previous chapters.
   1 2 3 4 5

7. I still enjoyed playing the games when I did not win.
   1 2 3 4 5
Appendix D: Pre- and Post-Test 1

Name ___________________________ Class ___________ Date ______________

Chapter 9 Test

Answer the questions below and SHOW YOUR WORK!

1. In the figure at the right, $\triangle A'B'C'$ is a translation image of $\triangle ABC$. What is a rule for the translation?

2. Is a rotation a rigid motion? Explain.

Find the coordinates of the vertices of each image.

3. $T_{-1,2}(MATH)$

4. $R_{x-axis}(MATH)$

5. $r_{(90^\circ),0}(MATH)$

6. $(R_{y-axis} \circ T_{0,2})(MATH)$
TRUE or FALSE

7. Find the image of the following composition of transformations: \( T_{<3,4>} \circ T_{<1,-2>} \).

\[ 
\begin{array}{cccc}
0 & 2 & 4 & \\
-2 & 0 & 2 & \\
-4 & -2 & 0 & \\
\end{array}
\]

TRUE or FALSE: The single transformation rule is \( T_{<2,2>} \).

8. Find the image of the following composition of transformations: \( R_y = -\frac{\pi}{2} \circ R_x = -\pi \).

\[ 
\begin{array}{cccc}
0 & 2 & 4 & \\
-2 & 0 & 2 & \\
-4 & -2 & 0 & \\
\end{array}
\]

TRUE or FALSE: The single transformation rule is \( R_y = -1 \).

Multiple Choice: Identify the rigid motion that maps the solid-line figure to the dashed-line figure.

9. \[ 
\begin{array}{ccc}
\rightarrow & \rightarrow & \\
\end{array}
\]

A) Translation  
B) Reflection  
C) Rotation  
D) Glide Reflection

10. \[ 
\begin{array}{ccc}
\rightarrow & \rightarrow & \\
\end{array}
\]

A) Translation  
B) Reflection  
C) Rotation  
D) Glide Reflection

11. \[ 
\begin{array}{ccc}
\rightarrow & \rightarrow & \\
\end{array}
\]

A) Translation  
B) Reflection  
C) Rotation  
D) Glide Reflection

12. \[ 
\begin{array}{ccc}
\rightarrow & \rightarrow & \\
\end{array}
\]

A) Translation  
B) Reflection  
C) Rotation  
D) Glide Reflection
Write a congruence or similarity statement for the two figures in each coordinate grid. Then write a congruence transformation or similarity transformation that maps one figure to the other.

13. [Diagram]

14. [Diagram]

15. [Diagram]

16. [Diagram]

Find the image of each point for the given dilation.

17. $A(5, -10); D_{0.4}(A)$

18. $B(-1, -2); D_{3}(B)$

19. $C(4, 6); D_{2.5}(C)$
Appendix E: Pre- and Post-Test 2

Name ___________________________ Class __________________ Date ____________

Chapter 7 Test

Answer the following questions and SHOW YOUR WORK!

Solve each proportion.

1. \( \frac{12}{x} = \frac{4}{7} \)  
2. \( \frac{x}{10} = \frac{7}{20} \)  
3. \( \frac{x}{x+5} = \frac{5}{7} \)

4. Are the polygons similar? If they are, write a similarity statement and give the scale factor. If not, explain.

![Polygon Diagram](image)

5. The scale of a map is 1 in. = 25 mi. On the map, the distance between two cities is 5.25 in. What is the actual distance?

6. \( ABCD \sim JKLM \). What is the value of \( x \)?

![Polygon Diagram](image)

7. An adult female panda weighs 200 lb. Its newborn baby weighs only \( \frac{1}{4} \) lb. What is the ratio of the weight of the adult to the weight of the baby panda?

8. An animal shelter has 104 cats and dogs. The ratio of cats to dogs is 5 : 3. How many cats are at the shelter?

9. A pie shop sold a total of 117 pies one day. The pies were apple, cherry, and blueberry. The ratio of apple pies sold to cherry pies to blueberry pies was 6 : 2 : 5. How many cherry pies were sold?
List the pairs of congruent angles and the extended proportion that relates the corresponding sides for the similar polygons.

10. $ABCD \sim WXYZ$

11. $\triangle GHI \sim \triangle KJL$

$\angle A \cong \angle W$
$\angle B \cong \square$
$\angle C \cong \square$
$\angle D \cong \square$

$\angle G \cong \square$
$\angle H \cong \square$
$\angle I \cong \square$

$\frac{AB}{WX} = \frac{BC}{XY} = \square = \square$

$\frac{GH}{KJ} = \square = \square$

Determine whether the triangles are similar. If so, write the similarity statement and name the postulate or theorem you used. If not, explain.

12.

13.

Find the geometric mean of each pair of numbers.

14. 4 and 25

15. 9 and 12

16. 2 and 8

17. 5 and 45

Find the value of $x$.

18.

19.