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Investigating Mathematics: Using Active, Exploratory Activities to Further Math Education in an Elementary Classroom

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Abstract

Within the educational realm, students and teachers have begun to shy away from the subject of mathematics. Too often students see this content area as intimidating and solely focused on memorization techniques. However, current research (Ensign, 2012; Gabreile & Montecinos, 2001; Kyriacou, 1992; Newstead, 1998; Tomlinson& Jarvis, 2006; Valli & Buese, 2007) has shown the effectiveness of differentiated instruction, active learning techniques, investigative teaching strategies, and changing teacher roles as effective teaching tools that may address this problem. The purpose of this study was to investigate if using innovative teaching techniques impacted students' attitudes and achievement towards mathematics. The study investigates the research question: "Do innovative teaching strategies and math game reviews improve attitude and achievement in math?" This study used an action research design that called for the creation and implementation of intentional instructional techniques to impact attitude, confidence, and competencies in elementary mathematics. The design of the project included introducing math games to review and practice new math content taught in the classroom. The study took place at an elementary school with a small group of 5 fifth grade students. These participants spent 1 hour each week participating in the activities, and they were chosen to join the study based on results of a pre- assessment taken before the start of the project. Students were assessed using pre- and post-surveys compiled in order to analyze attitudes, confidences, and competencies in mathematics. Anecdotal records were transcribed with the purpose of recording progress of achievement on a weekly basis throughout the study. The pre- and post-assessments were then analyzed using t-tests assuming equal variances, and though

no statistical significance was shown, all students improved their scores for all categories. Participants averaged a 6.83% improvement among all areas monitored. With a starting mean of 21.6 out of 30 total points, 20.4 out of 40, and 9.4 out of 16 in attitudes, confidences, and competencies, and an ending mean of 23.4 out of 30 total points, 22.2 out of 40, and 11 out of 16 respectively. The p-values reported were 0.339, 0.421, and 0.109 with all p-values $p>.05$. This study concludes that the use of these active, exploratory instructional techniques and the implementation of games to foster a positive learning environment may be effective in impacting students' attitude, confidence, and achievement in mathematics. Future studies with more students over a longer period of time may yield more positive results. Additionally, the type of games and strategies used may still be important for teachers to use and are activities that could be implemented into daily classroom routines.

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Chapter 1

Introduction

Society today has shied away from the world of mathematics, especially within the educational realm. The study of mathematics has become viewed as an intimidating subject, and the result of this shift is an extreme aversion among most children as well as teachers. In a classroom, one of the most difficult challenges that a teacher faces is engaging students in the content and getting them excited about what they are learning. This challenge is heightened in the area of mathematics because sometimes it seems that the only way learning can happen is through rote memorization, which is tedious in students' eyes (Kyriacou, 1992). However, the basic skills in this subject are crucial in most areas of life. We use math daily. The creators of the National Museum of Mathematics in New York City discuss that "math is everywhere-from highway design to musical composition to roller coaster construction" (Adams, 2013, p.8). I believe that the movement toward an exploratory, investigative approach to teaching is effective in involving students in their learning. Through the incorporation of group work and activities, this movement can be implemented into the study of mathematics as well. Through the discovery activities and investigational roles in a classroom, students can experience this challenging subject in a new way. It is imperative that students are engaged in learning, and by implementing a hands-on approach, I believe that the intimidation factor behind math education will be lessened.

Chapter 2

Literature Review

I chose to research the key components that will help in the implementation of creating an active learning experience for elementary age children in mathematics. This literature review is composed of the factors I believe will engage students in the classroom, and they are: attitude, active learning, differentiated instruction, teacher role, and implication for instruction. Morphing instruction in the field of mathematics will allow for greater learning and expand knowledge for future education.

Attitude

Math is becoming viewed as a useless, intimidating subject in schools, and as a result, students are less enticed to put forth effort and adopt a role of learned helplessness. Improving reputation is crucial to encouraging positive attitudes and therefore, fostering an encouraging learning environment. This is the view of many individuals in this field, and people like Whitney decided to take action by developing math museum that encourage interactive learning. Whitney said, "This country has a national, cultural problem with its view and attitude toward mathematics…so we needed a national, cultural institution to face it" (Adams, 2013, p.9). Anxiety also plays a role in the negative attitude associated with mathematics. This anxiety has been shown to develop as early as in the elementary years, and "once formed, negative attitudes and anxiety are difficult to change and may persist into adult life, with far-reaching consequences" (Newstead, 1998, p.53). More is at stake than just a positive view of math. Because math is everywhere, students will face greater challenges when they are adults. It is crucial to change instruction because "pupils who

were exposed to a traditional approach reported more mathematical anxiety than those who were exposed to an alternative approach" (Newstead, 1998, p.53). Anxiety also leads to poor performance academically. Newstead believes, "Beyond a certain point, however, anxiety becomes debilitating in terms of performance, particularly in the case of higher mental activities and conceptual processes" (Newstead, 1998, p.54). Causes of this anxiety and poor attitudes toward mathematics is believed to originate with teacher anxiety, cultural and environmental views, and experiences at the beginning of a student's education (Newstead, 1998). I believe that a change in instruction will help to foster a new attitude toward mathematics and radiate into performance as well.

Active Learning

A movement toward active learning has taken place over the past decade, which allows for a more exploratory, inclusive atmosphere in the classroom. Active learning "can be described as the use of learning activities where pupils are given a marked degree of ownership and control over the learning activities used, where the learning experience is open-ended rather than tightly predetermined" (Kyriacou, 1992, p.310-311). The traditional teaching style of memorization and tedious worksheets prove to not be as effective. It is seen that "rote memorized rules and the manipulation of symbols with little or no meaning are harder to learn than an integrated conceptual structure" (Newstead, 1998, p.55). There are several key components that make up the active learning experience. The students need to see that the activities are purposive and have the students' interests in mind. They must also be engaging and resemble real-life experiences as well as having complexity, not repetitive practice worksheets (Kyriacou, 1992). Participation in active learning is crucial. There are practical ways to accomplish active

learning such as through "the use of concrete materials and direct experience, the use of investigative or problem oriented techniques, and the use of small group work" (Kyriacou, 1992, p.311). Students must take ownership of their learning and be interested in the topics to optimize a gain in knowledge. This type of learning has proved to be successful in many case studies that have been done. Kyriacou discovers, "[Active learning] includes greater pupil involvement and interest, encouraging pupils to communicate mathematical ideas, confidence building, and more meaningful learning" (312). An important aspect of active learning is peer involvement. This component of the active learning instruction has shown to be a successful approach in a classroom. For example, "various forms of peer learning have been widely recommended as methods for enhancing equal educational opportunities in heterogeneous classrooms" (Gabriele and Montecinos, 2001,p.152). All of the aspects of active learning work together to encourage students to take ownership over their learning and allow them to get involved.

Differentiated Instruction

Tailoring the material to fit each child is crucial in a learning environment where students are on different achieving levels. In a classroom, there will be students from many different ethnic backgrounds as well as learners on different academic stages. Each child has different strengths, and teachers must learn how to adapt their style to connect the content with a child's talents (Tomlinson & Jarvis, 2006). Creating an investigative, exploratory environment in a classroom mandates differentiated instruction. The goal of this type of instruction is "that every student was supported in progressing from his or her present level of understanding to a much higher level" (Ensign, 2012, p.158). To know what level these students need to progress to, teachers must figure out what level their students

are at now. Identifying students' strengths and evaluating interests is crucial to allowing for an open, inviting learning environment. Instructing the students to learn these things about their peers is a great way to facilitate this as well (Tomlinson & Doubet, 2005). Jacque Ensign researches the different ways to differentiate instruction and discovers that an effective approach is grouping students based on their current academic level. This method allows the teacher to meet the students where they are at and enables more one-on-one instruction in these small groups. Other literature concludes that it is effective to "include multiple opportunities for student choice, peer tutoring, game-like learning, multimodal representations, and ongoing assessment as guides to developmentally appropriate instruction" (Hawes, Moss, Finch & Katz, 2012, p.305). Classrooms that encompass a plethora of types of learning activities are shown to be effective in capturing all students' attention. It is seen that "integrating visual, numeric, and kinesthetic representations catered to different learning styles as well as provided multiple entry points for students of varying abilities" is valuable (Hawes et al., 2012, p.309). I believe that differentiating instruction allows all students' interests to be touched on, and students have the freedom to be creative and exercise their freedom of choice with these different activities, rather than a uniform approach.

Teacher Roles

Teachers play a crucial role in the enhancement of a child's view about their education. If a teacher is negative about a subject, the student will most likely maintain that opinion as well. With mathematical anxiety in classrooms rising, a teacher's attitude can play a huge role in lessening the intensity of the subject. By putting too much emphasis on rote memorization through tedious worksheets, teachers can be a catalyst for anxiety

(Newstead, 1998). Teachers are role models and encouragers, and they should maintain this role throughout every part of instruction. With differentiating instruction, teachers' roles have shifted and become a more demanding and time consuming. A study about the changing roles of teachers explains "the sheer number of tasks can increase as teachers are asked to do more things and do so with an increasing level of sophistication" (Valli & Buese, 2007, p.523). This new shift creates a tough environment for teachers, but it is vital that a teacher is reminded of what is at stake. In order to provide a positive learning environment, it is still crucial for a teacher to remain motivating and uplifting. To create an inclusive classroom teachers can "[encourage] students to behave like professionals within a given field…and make connections within and across disciplines more readily" (Gavin, Casa, Firmender, & Carroll, 2013, p.72). In elementary school, the children are at an impressionable age, so a teacher's attitude can easily shape a child's view for the duration of his or her life.

Methodology

The purpose of this study was to determine if the implementation of math games and other hands-on learning techniques had an effect on the attitude, confidence, and achievements in elementary mathematics. The research was conducted in an elementary school, and a group of five 5th grade students participated in the study. This section discusses the demographics, participants, and confidentiality methods involved in this study.

District Setting

This study took place in a school district in Northwest Arkansas. The demographics of this school district printed below are published on the Public Schools webpage and are based on the most updated studies from the 2012-2013 school year. Students in this school district range from kindergarten to 12th grade. The study was conducted in one of the 27 schools in the district; the district serves 20,131 students. Within the district, there are two high schools, four junior high schools, four middle schools, and 17 elementary schools. The Ethnic groups represented in the Springdale School District include 8,803 Hispanic; 8,179 White, 1,939 Pacific Islander; 450 African American; 352 Asian; 306 of two or more ethnicities; and 102 Native American (See Figure 1). There are 13, 538 students receiving free and reduced lunches; 1,923 students in the district's gifted and talented program; 1,923 students enrolled in the special education program; 8,805 students classified as Limited English Proficient; and 49 home languages.

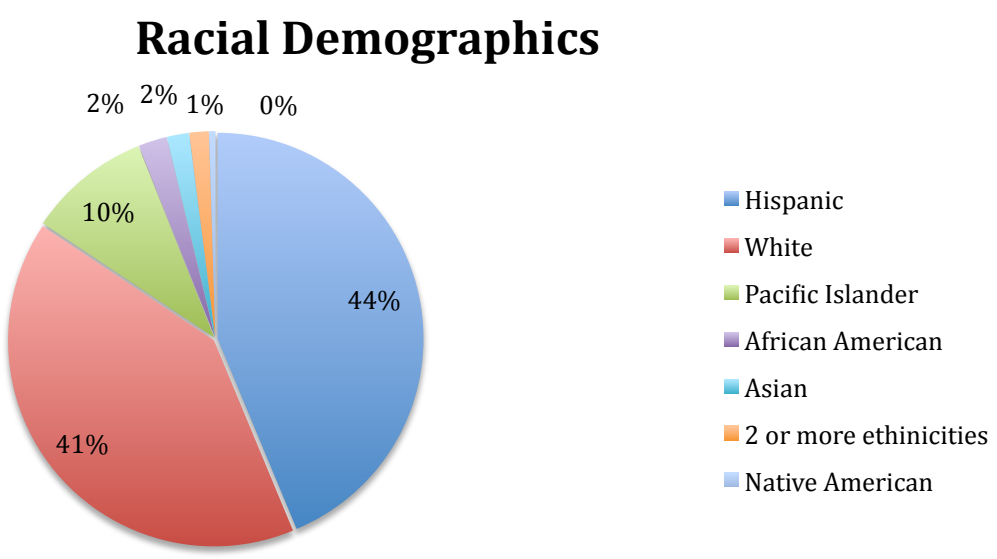

Figure 1: Racial demographics represented in the school district.

School Setting

The elementary school where this study was conducted was located in Northwest Arkansas. There are currently 637 students attending with 328 males and 309 females. The population of the school is comprised of 451 Hispanic, 117 White, 34 Pacific Islander, 16 African American, 10 of two or more ethnicities, 8 Asian, and 1 Native American (See Figure 2). 86% of the students receive free or reduced lunch, totaling 550 students; 53 students are enrolled in the gifted and talented program; 52 in special education; and 430 Limited English Proficiency students.

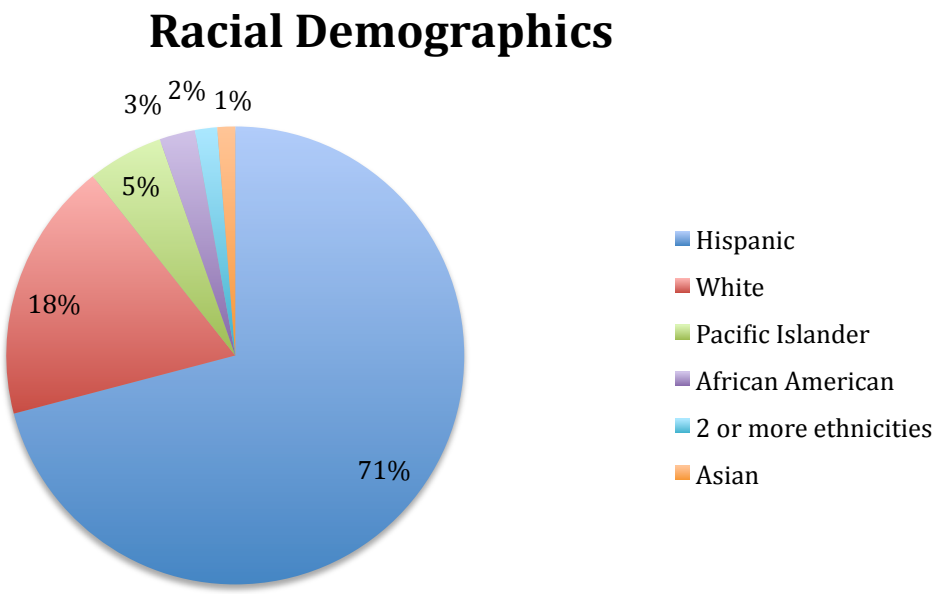

Figure 2: Racial Demographics represented at the elementary school.

Participants

The students involved are fifth graders between the ages of ten and eleven. Two of the students are boys and three are girls all of Hispanic ethnicity. The children range on a spectrum of mathematical ability, and they were chosen for this study through the analysis of pre assessments that gauge attitudes and competencies.

Confidentiality

The study was permitted by the University of Arkansas Institutional Review Board as well as by the elementary school administration at George. Permission to conduct this study was obtained before beginning the research project (See Appendices A&B). A parent letter and informed consent form were sent home with all students in the fifth grade class where the participants were chosen from; these forms were required to be signed by the parents before commencement (See Appendices C&D). These papers sent home with the

students explained the project and purpose of the research. The parents were informed that there was no penalty or reward for participating, and the students' participation was voluntary. The consent form explained that students could withdraw at any point in time, and the researcher kept all data confidential with no use of student names. The students were assigned a code at random, and all data was collected confidentially through using these codes. The researcher was the only individual to have access to the data collected, and once the research was completed, the codes were erased.

Data Collection

The purpose of this study was to determine if the implementation of interactive, game-like methods in math instruction improve students' attitudes and competencies in mathematics. Data was collected during the three-month intervention period to determine if these games implemented into instruction caused change in students' learning. Students' learning was monitored through formative assessments throughout the time spent in the group as well as summative assessments given at the beginning and end of the project.

Evaluation Instrument

A compilation of several assessments was used to gauge student learning throughout the project. This assessment was created using a Singapore Math Assessment 4a and a mathematical attitude survey used at the University of Nebraska-Lincoln (See Appendix E). This summative assessment was given on the first day of the project, and the same assessment was given on the last day in order to compare the results from beginning to end. The students were also monitored throughout the time spent in groups. The students would be asked directed questions individually at the end of each meeting as well

as throughout the games played, and notes were taken by the researcher to record the responses to questions asked.

Baseline Data

The compilation of the attitude assessment and competencies assessment was given to all participants prior to implementation of methods in order to establish a baseline for each student's mathematical levels. This initial test was given on November 6th, 2013. The students were given this assessment again at the end of instruction on February 21st, 2014.

Other Methods of Collecting Data

Throughout the project, data was collected each week during the games that were played with the students. The researcher took notes during the interventions, and anecdotal records aided in data collection as well. The researcher also documented reflections from each week by writing statements that the students gave and answers to questions asked individually. Students' progress throughout the lesson was also monitored and recorded in order to make comparisons week to week.

Post Data Analysis

At the end of the project, the mathematical attitudes and competencies survey was administered to the participants in order to monitor the change of answers over the course of the study. The results of this post-test were then compared to the baseline data that was collected. These two surveys were examined to determine the change between the two tests to resolve the effectiveness of the implemented strategies. The reflections and anecdotal records were also analyzed to determine the change over the course of the study.

Intervention Strategies

For this research study, students worked in a small group of five students during their math block. The students met at the tables stationed outside the 5th grade classrooms once a week for one hour. The students would start each Wednesday morning recapping what was just taught in class, and questions were asked to gauge the students' understanding. Next, the researcher gave instructions for the game that was played during the hour meeting. The students played the games for the remainder of the instruction time and also participated in a review at the end of the game where questions would be asked to the individual students.

Week 1: During this initial meeting time, the students took their pre-assessments and also learned about the expectations of participating in the group. The students were informed the purpose of the meeting time and learned what would happen each week.

Week 2: The second week of the study the students participated in the first math game. This lesson plan was titled, "Place Value Pyramid" Lesson Plan. The students each were given a deck of cards in the shape of a pyramid and rearranged the cards to make the largest possible number. The students were reviewing place value during this lesson and worked on verbally presenting their answers. See Appendix F1 for a more detailed description of the lesson.

Week 3: During this week of the study, the participants took part in "How Tall Is A Mountain" Lesson Plan. The students read Epic Climbs by John Cleare aloud and used cards to display the heights of several mountains. The learning objectives for this lesson included greater understanding of place value and applications to real-life examples See Appendix F2 for a more detailed description of the lesson.

Week 4: The students participated in "Number Spell Out" during week four of the study. During this lesson, the participants created large numbers using a deck of cards under specific parameters. This lesson's focus was place value and number sense using manipulatives for hands-on learning. See Appendix F3 for a more detailed description of the lesson.

Week 5: During week five, the students played "Fraction Bingo" in the small group. The students were introduced to a fractions unit this week, so this game reviewed fractions from fourth grade. The students compared pictures of fractions to the written fraction in a bingo game. See Appendix F4 for a more detailed description of the lesson.

Week 6: Participants were involved in a card game during week six titled: "Grab A Spoon." The students tried to pick up four equivalent fractions written on the cards, and the student to collect all four the fastest was the winner. This game focused on students' ability to reduce and compare basic fractions. See Appendix F5 for a more detailed description of the lesson.

Week 7: Students participated in "Red Light, Green Light" during week seven, and in the small group time, movement and play were incorporated. The students answered questions about equivalent fractions in order to move forward to cross the finish line. This lesson reviewed students' understanding of comparing fractions. See Appendix F6 for a more detailed description of the lesson.

Week 8: To incorporate more movement and hands-on learning, the researcher played "Fraction Line Up" during week eight. The students arranged fraction cards onto a number line, and this game focused on comparing fractions as well as greater than and less than. See Appendix F7 for a more detailed description of the lesson.

Week 9: Participants in the study played "Grab A Spoon Take Two" during week nine. Similarly, to week six, the students collected similar cards but decimals and percents were compared to fractions as well. Students were reviewing comparison of numbers in different forms during this intervention. See Appendix F8 for a more detailed description of the lesson.

Week 10: Students finished the study during week ten by completing the post-assessment and reviewing the learning goals of the study. The researcher recapped the games that were played and key concepts that were learned during the ten weeks together.

Summary

Many modern researchers (Ensign, 2012; Gabreile & Montecinos, 2001; Kyriacou, 1992; Newstead, 1998; Tomlinson& Jarvis, 2006; Valli & Buese, 2007) discovered that producing encouraging learning environments could foster greater learning in students, and this research influenced techniques for implementation. The lessons created reflected the ideas of active learning, differentiated instruction, and change in mathematical attitudes.

Chapter 4

Results

This chapter explains an analysis of the data collected throughout the interventions conducted. The purpose of this study was to conclude if implementing games and other hands-on learning activities into math practice and review will impact students' attitudes, confidence, and competencies. The data collected will help to answer the proposed research question: "Do innovative teaching strategies and math game reviews improve attitudes and achievement in math?"

Over the course of three months, five fifth grade students participated in activities listed in appendix F. The activities implemented ranged from whole group to individual activities and were done once a week for one hour. After the lessons were taught in the classroom, the researcher would create practice games and hands-on activities to review the presented information in order for students to gain a greater understanding. These teaching strategies were implemented in place of skill and drill worksheets associated with reviewing practices. Each week a math game was played, and students were assessed throughout the activity via closing questions and observation of student problem solving. These anecdotal records were transcribed as well as the collection of data from pre- and post-assessments.

Baseline Data

Baseline data was taken using the Singapore math assessment 4a and mathematical attitudes survey from the university of Nebraska-Lincoln. The compiled assessment measured the students' attitude, confidence, and competencies in math. The confidence and attitudes portion of the survey could reveal answers to opinion-based questions ranging

from strongly agree to strongly disagree. The surveys were administered to a large number of students, and the participants were chosen in accordance to their response to these questions. The participants scored a 3 or less: undecided to strongly disagree on average on the attitudes portion of the survey.

The pre-assessment results were analyzed in order to determine which students would participate in the study and were grouped together based on responses to the attitude and confidence survey. This data was gathered in November 11, 2013. The data collected for the opinion portion was calculated into a percentage with 100 percent signifying the highest attitudes and confidence toward mathematics. 14 questions were used to gauge students' views with 5 possible points per question. These percentages are shown in figure 3 for attitude, confidence, and competencies. The results of the pre-assessment concluded an average score of 21.6 points or 72% on attitude, 20.4 points or 51% on confidence, and 9.4 points or 58.8% on competencies.

During Intervention

During the study, participants were assessed through observation by the researcher, and results were recorded through use of anecdotal records. The students were asked multiple review questions during the closure section of the lesson, and the answers were recorded along with their attitudes and actions observed. The researcher also recorded comments about the lessons and overall opinions spoken by the participants. Student participation was a factor transcribed in these records as well. These records can be seen at the end of the lesson plans in Appendix G.

Throughout the project, the results recorded from these anecdotal records factored in to the lessons taught during the next week, so student understanding was gauged in order to determine the procession to new content. The data collection during these formative assessments drove instruction from week to week.

Post Intervention Data

At the end of the study, the participants completed a post-assessment to determine areas of growth through the study. The students were given the same compiled assessment from Singapore Math 4a and the mathematical attitudes survey from the University of Nebraska-Lincoln. The questions in the assessment were identical numbers and questions in order to gauge improvement. The post-data collection results show that growth was achieved in attitudes, confidences, and competencies. The average for all five students for mathematical attitudes revealed 23.4 points or 78%, 22.2 points or 55.5% on confidence, and 11 points on competencies or 68.8%. No student reached 100 percent in any category; however, most made improvement. Appendix H shows details of individual student scoring.

Analysis

The results of the post-assessment taken at the conclusion of the study were analyzed using a t-test assuming equal variances. The mathematical attitude survey was the same assessment used to collect baseline data. The t-test was completed using an alpha level of .05 (See Appendix H2). The results calculated by the test do not show significant growth among the students; however, it is seen that the participants did improve greatly in every area that the study monitors. Before instruction, the average scores for students displayed 72% on attitudes, 51% on confidence, and 58.8% on competencies. After the

intervention, students averaged 78% on attitudes, 55.5% on confidence, and 68.8% on competencies. The t-test did not reveal that this data was significant, but student growth was achieved. The test for mathematical attitudes calculated t(5)= 2.306004; tStat=1.01783; p<.05. The confidence test concluded t(5)= 2.306004; tStat=0.84853; p<.05, and the competencies test showed t(5)= 2.306004; tStat=1.80061; p<.05. The results are shown in Table 1-3.

Table 1
T-test for attitude study assuming equal variances.

Pre-Assessment		**Post-Assessment**				
N	**Mean**	**N**	**Mean**	**t**	**tStat**	**p**
5	**72%**	**5**	**78%**	**2.306004**	**-1.01783**	**0.338551**
Mean calculated out of 30 possible points						***p>.05***

Table 2
T-test for confidence study assuming equal variances.

Pre-Assessment		**Post-Assessment**				
N	**Mean**	**N**	**Mean**	**t**	**tStat**	**p**
5	**51%**	**5**	**55.5%**	**2.306004**	**.84853**	**0.420806**
Mean calculated out of 40 possible points.						**p<.05**

Table 3
T-test for competency study assuming equal variances.

Pre-Assessment		**Post-Assessment**				
N	**Mean**	**N**	**Mean**	**t**	**tStat**	**p**
5	**58.8%**	**5**	**68.8%**	**2.306004**	**1.80061**	**0.10945**
Mean calculated out of 16 possible points.						**p<.05**

The data was then compared using the means calculated between the pre- and post-assessment. All averaged scores showed growth from the start to finish. See Figure 3 for the comparison of data. Students also showed individual growth from the beginning to end of implementation in all content areas assessed, and these individual data assessments can be seen in Figures 4-6.

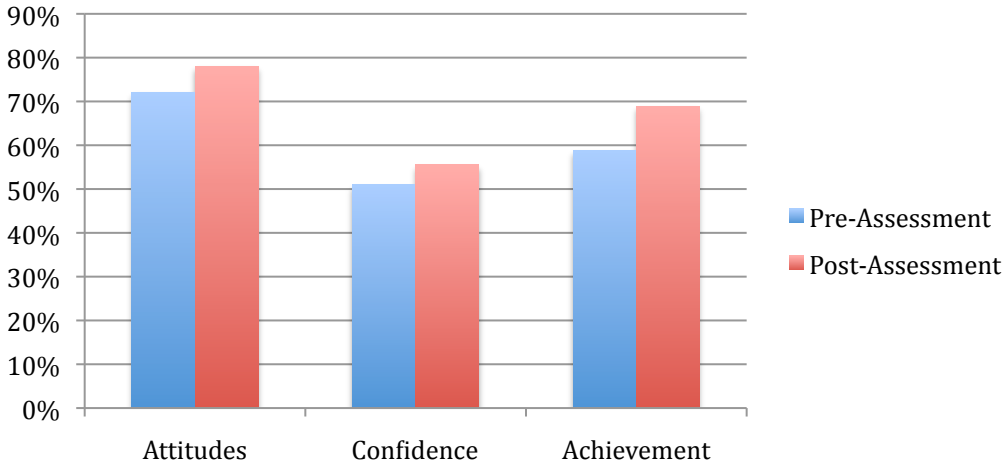

Figure 3: Comparison of percentages of pre- and post- assessment average scores.

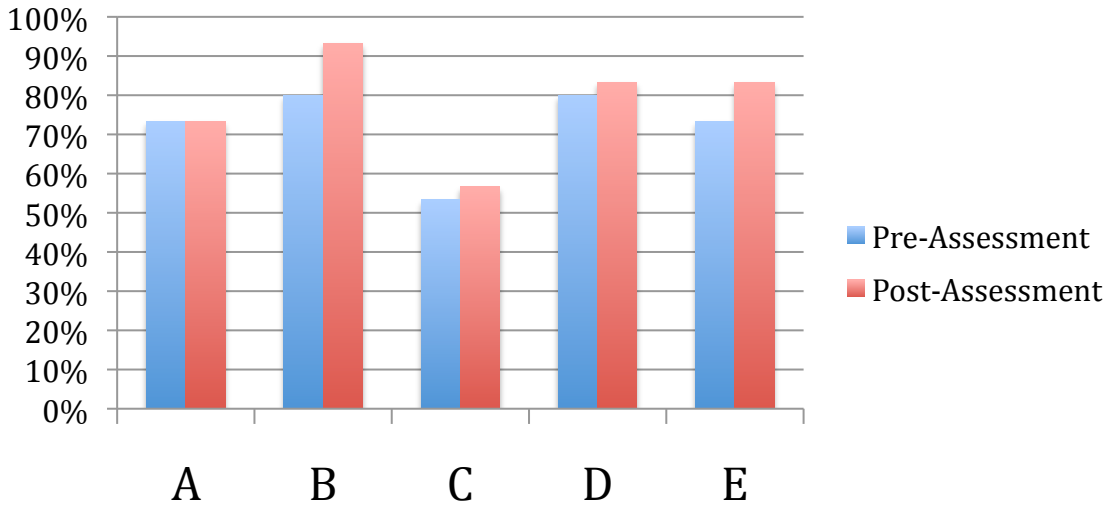

Figure 4: Comparison of individual student scores from pre- to post-assessment in attitudes.

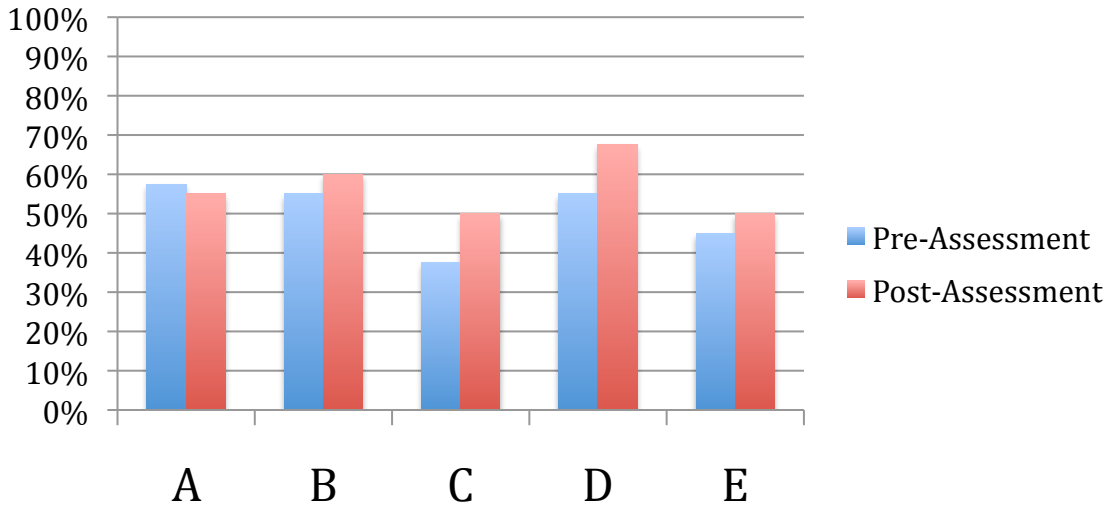

Figure 5: Comparison of individual student scores from pre- to post-assessment in confidence.

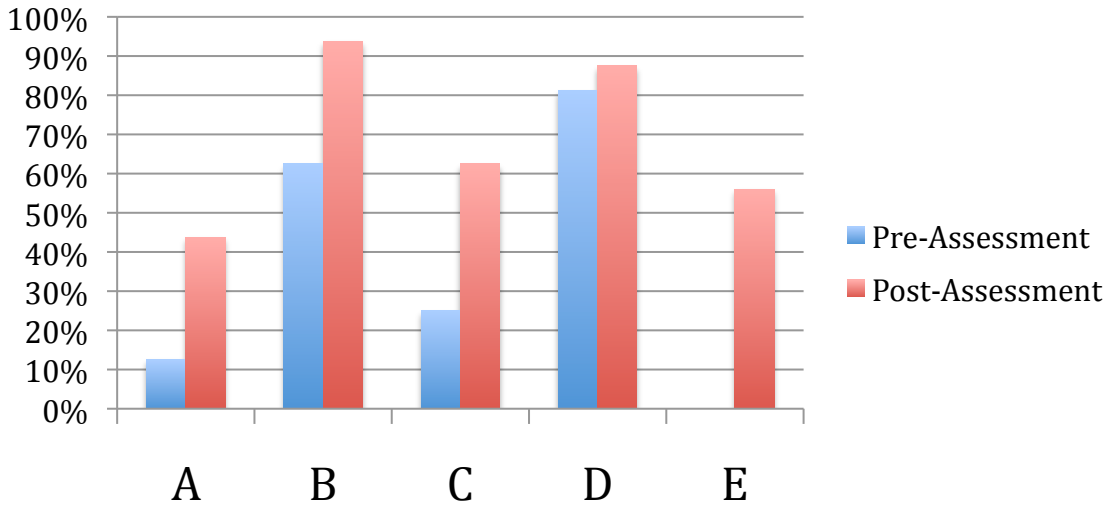

Figure 6: Comparison of individual student scores from pre- to post-assessment in achievement.

Summary

Through the pre- and post-assessments using the survey measuring attitudes, confidence, and competencies, data was collected and analyzed. The results showed that no significant change took place; however, the students all progressed in their abilities and

opinions of math. The next chapter includes a discussion of the results, conclusions of data, limitations, implications and recommendations for further study.

Chapter 5

Discussion

Current research has shown the effectiveness of differentiated instruction, active learning techniques, investigative teaching strategies, and teacher roles on encouraging positive attitudes, confidences, and competencies in mathematical education (Ensign, 2012; Gabreile & Montecinos, 2001; Kyriacou, 1992; Newstead, 1998; Tomlinson& Jarvis, 2006; Valli & Buese, 2007). The purpose of this study was to investigate if using innovative teaching techniques impacted students' attitudes and achievement towards mathematics. The study investigates the research question: "Do innovative teaching strategies and math game reviews improve attitude and achievement in math?"

Results of this study suggested great improvement in all categories among participants. Students were assessed using pre- and post-surveys compiled in order to analyze attitudes, confidences, and competencies in mathematics. Anecdotal records were transcribed with the purpose of recording progress of achievement on a weekly basis throughout the study. The pre- and post-assessments were then analyzed using t-tests assuming equal variances, and though no statistical significance was shown, all students improved their scores for all categories.

Conclusion

Outcomes of this study suggest that the implementation of an active learning environment with specificity on incorporating games increases student's attitude, confidence, and achievement in mathematics. The analysis of data did not signify statistical growth; however, all scores were increased from pre- to post-tests. The anecdotal records

conclude students' positive comments toward the math games, and they show improvement over the weeks of the study. The formative assessments taken allowed the researcher to gauge the opinions and monitor changes in achievement as well.

The results of this study show similar effects to the research done by Newstead, which shows that rote memorization cause for more difficult routes to learning; however, active learning approaches allow students to take ownership over their learning, and are able to learn at a quicker pace (1998). The researcher also saw results similar to research over participation within groups. The students involved in the project showed greater improvement when collaborating with peers, which mirrors the results in the research of Kyriacou (1992).

The design of the project included introducing math games to review and practice new math content taught in the classroom. These interventions were implemented in small group setting, which also greatly affected student's confidence as shown in the anecdotal records taken week to week.

Limitations

There were many limitations that could not be controlled by the researcher that may have had a positive or negative impact on the results taken. Potential negative factors included the number of students involved in the study. The results did not conclude to be statistically significant, and if given more time and number of participants, this may have not been the outcome. Time constraints were also a contributing negative factor. Due to standardized testing, missed school, and the use of the pullout method, students had a limited amount of time to be involved in the study. The environment that the study took place in could have also contributed negatively to the results. The group never met in a

consistent location due to conflicts with scheduling. Inclement weather caused for many issues during the study, as there was a major gap in instructional time. Another negative limitation might be the evaluation instrument used to assess learning. Reliability and validity data for instrument was not available for either assessment used, and this could be a cause for question. The researcher chose the selection of questions used to calculate the score for attitude, confidence, and achievement.

A possibly positive issue could have been the instructional time and growth within the classroom outside of the project timeline. The students still participated in classroom mathematical instruction, so this practice coupled with the implemented instruction that was proposed could have a positive impact on results. The review of learning within the classroom could have had a positive effect on the students' confidences.

Implications

Conclusions of the study illustrate that active learning techniques and exploring activities may positively affect attitudes, confidences, and achievement in mathematics. The instruction implemented in this study had a positive impact on the group of fifth graders involved, and this might be true in other fifth grade classes as well. The research done in this study suggests a positive correlation between creating an encouraging, active learning environment and the improvement of attitudes and achievements in mathematics. The data collected from the pre-and post-assessments show improvement in all categories monitored by the participants; therefore, the researcher suggests that the use of math games and other hands-on activities have a positive impact on mathematical education.

Recommendations

In summary, the results of this study, though not statistically significant, show improvements made by participant in the areas of attitude, confidence, and competencies. In the future, the conclusions of this study can assist in further research and implementation into classroom instruction. This study demonstrates one example of the impact that active learning, hands-on activities, positive learning environments, and differentiated instruction can have on elementary students.

Further research. Further examinations could be done to determine if student growth in mathematical education continues to be impacted through the use of active, exploratory learning techniques. Research could be done to discover if less specified implementation of instruction using active learning would enhance these categories as well. Future researchers could also determine if the length of time given for instruction affects the outcomes of the learning goals. More detailed instruction in the area of exploratory learning, such as STEM implementation, could also be researched and implemented into instructional techniques.

Further use for instruction. For further use within an elementary classroom, it is suggested to implement activities of this study in a larger scope, such as an entire class rather than a small group. The researcher proposes to use these areas of instruction in a greater time frame to increase score results. The ideas of this study could also be implemented in other grade levels to determine if the same effect will take place as educational maturity grows. The instrument used to assess growth could be changed to a survey of proven reliability and validity. The specific areas monitored by the assessments could be separated into different surveys to more accurately calculate growth.

Summary

This research study was conducted in order to determine if the implementation of active, hands-on learning activities could impact students' attitudes, confidence, and competency in mathematics. After data analysis was conducted through evaluation of pre- and post-assessments and weekly anecdotal records, the results did show that the techniques implemented had an effect on student learning although not at a statistically significant level.

References

Adams, C. J. (2013, June 5). Museums open doors to new ways of learning math.*Education Week,* 32, 8-9.

Ensign, J. (2012). Teacher-initiated differentiation: Two classrooms become models for their large, urban district. *Teaching Children Mathematics,* 19, 158-163.

Gabriele, A. J., & Montecinos, C. (2001). Collaborating with a skilled peer: The influence of achievement goals and perceptions of partners' competence on the participation and learning of low-achieving students. *The Journal of Experimental Education*, *69*, 152-178.

Gavin, M. K., Casa, T. M., Firmender, J. M., &Carroll, S. R. (2013) The impact of advanced geometry and measurement curriculum units on the mathematics achievement of first-grade students. *Gifted Child Quarterly*, *57*, 71-84.

Hawes, Z., Moss, J., Finch, H., & Katz, J. (2012-2013). Choreographing patterns and functions. *Teaching Children Mathematics*, *19*, 302-309.

Kyriacou, C. (1992). Active learning in secondary school mathematics. British *Educational Research Journal*, *18,* 309-316.

Newstead, K. (1998). Aspects of children's mathematics anxiety. *Educational Studies in Mathematics*, *36*, 53-71.

Piper, B. (2008). Attitudes, confidence, and achievement of high-ability fifth grade math students. *Summative Projects for MA Degree.*

"Singapore Math Inc." *Singapore Math Inc.* Singapore Math, 2011. Web. 25 Sept.

2013.

Tomlinson, C. A., & Doubet, K. (2005). Reach them to teach them. *Educational Leadership*, *62*, 8-15.

Tomlinson, C.A., & Jarvis, J. (2006). Teaching beyond the book. *EducationalLeadership, 64*, 16-21.

Valli, L. & Buese, D. (2007). The changing roles of teachers in an era of high-stakes accountability. *American Educational Research Journal, 44*, 519-558.

Appendix A1

UNIVERSITY OF ARKANSAS INSTITUTIONAL REVIEW BOARD
PROTOCOL FORM

The University Institutional Review Board recommends policies and monitors their implementation, on the use of human beings as subjects for physical, mental, and social experimentation, in and out of class. . .. Protocols for the use of human subjects in research and in class experiments, whether funded internally or externally, must be approved by the (IRB) or in accordance with IRB policies and procedures prior to the implementation of the human subject protocol . . . Violation of procedures and approved protocols can result in the loss of funding from the sponsoring agency or the University of Arkansas and may be interpreted as scientific misconduct. *(See Faculty Handbook*)

Supply the information requested in items 1-14 as appropriate. **Type** entries in the spaces provided using additional pages as needed. In accordance with college/departmental policy, submit the original **and** one copy of this completed protocol form and all attached materials to the appropriate Human Subjects Committee. In the absence of an IRB-authorized Human Subjects Committee, submit the original **and** one copy of this completed protocol form and all attached materials to the IRB Program Manager, Heather Brown, ENGR 130, 575-2208, hkbrown@uark.edu .

1. Title of Project- **Investigating Mathematics: Using Active, Exploratory Activities to Further Math Education in an Elementary Classroom**

2. (Students **must** have a faculty member supervise the research. The faculty member must sign this form and all researchers and the faculty advisor should provide a campus phone number.)

	Name	Department	Email Address	Campus Phone
Researcher	**Hillary Walker**	**Curriculum and Instruction**	**hpwalker@uark.edu**	**972-746-1190**
Faculty Advisor	**Marcia Imbeau**	**Curriculum and Instruction**	**mimbeau@uark.edu**	**479-575-3570**

3.Researcher(s) status. Check all that apply.

☐ Faculty ☐ Staff ☐Graduate Student(s) ☒Undergraduate Student(s)

4. Project type

☐Faculty Research ☐ Thesis / Dissertation ☐ Class Project ☐IndStudy /
☐Staff Research ☐ M.A.T. Research ☒Honors Project

5. Is the project receiving extramural funding?

☒ No ☐Yes. Specify the source of funds

Appendix A2

6.Brief description of the purpose of proposed research and all procedures involving people. Be specific. Use additional pages if needed. (**Do not** send thesis or dissertation proposals. Proposals for extramural funding must be submitted in full.)

Purpose of research:
The purpose of this research is to collect data to determine if exploratory, investigative learning techniques in mathematics change student's attitudes toward the subject. I plan to implement hands-on projects, such as games, into a math curriculum and gauge the change in the students' opinions and learning. Through minimizing memorization techniques and skill-and-drill worksheets, I plan to create a play-like atmosphere. The students will take on the role as the math investigator where they will determine why math processes work through their own exploration. The purpose of the study is to determine whether this new approach will enhance achievement in the subject of mathematics.

Procedures involving people:
I plan to work with five to six 4th or 5th grade students once a week on Wednesday mornings for 1 hour during the school day. I will work with this small group of students in their classroom or in a designated place provided by the teacher. I plan to give a pretest during the first meeting and a post-test at the end of the semester in December. I will also be conducting an ongoing assessment of the students' learning through observation of their work.

7. Estimated number of participants (complete all that apply)

5-6 Children under 14 ___0__ Children 14-17 ____0_ UA students (18yrs and older) ___0__ Adult non-student

8. Anticipated dates for contact with participants:

First Contact :October **2013** Last Contact: **January 2014**

9. Informed Consent procedures: The following information must be included in any procedure: identification of researcher, institutional affiliation and contact information; identification of Compliance Officer and contact information; purpose of the research, expected duration of the subject's participation; description of procedures; risks and/or benefits; how confidentiality will be ensured; that participation is voluntary and that refusal to participate will involve no penalty or loss of benefits to which the subject is otherwise entitled. See *Policies and Procedures Governing Research with Human Subjects*, section 5.0 Requirements for Consent.

☒ Signed informed consent will be obtained. **Attach copy of form**.
☐Modified informed consent will be obtained. **Attach copy of form**.
☐ Other method (e.g., implied consent). **Please explain on attached sheet**.
☐ Not applicable to this project. **Please explain on attached sheet**.

10. Confidentiality of Data: All data collected that can be associated with a subject/respondent must remain confidential. Describe the methods to be used to ensure the confidentiality of data obtained.
The researcher will only see all data that is collected regarding individual students, and all reports of data including the tests given at the beginning and end of the project will not discuss identify students' identities.

Appendix A3

11. Risks and/or Benefits:

Risks: Will participants in the research be exposed to more than minimal risk? ☐ Yes ☒No
Minimal risk is defined as risks of harm not greater, considering probability and magnitude, than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests. Describe any such risks or discomforts associated with the study and precautions that will be taken to minimize them.

Benefits: Other than the contribution of new knowledge, describe the benefits of this research.
The benefits of this research include greater learning and understanding in the subject of mathematics, which will benefit the students as well as the teacher by improving test scores. Students also might gain a more positive attitude toward the subject, which will increase their excitement for learning.

12. Check all of the following that apply to the proposed research. Supply the requested information below or on attached sheets:
    - ☐ A. Deception of or withholding information from participants. Justify the use of deception or the withholding of information. Describe the debriefing procedure: how and when will the subject be informed of the deception and/or the information withheld?
    - ☐ B. Medical clearance necessary prior to participation. Describe the procedures and note the safety precautions to be taken.
    - ☐ C. Samples (blood, tissue, etc.) from participants. Describe the procedures and note the safety precautions to be taken.
    - ☐ D. Administration of substances (foods, drugs, etc.) to participants. Describe the procedures and note the safety precautions to be taken.
    - ☐ E. Physical exercise or conditioning for subjects. Describe the procedures and note the safety precautions to be taken.
    - ☒ F. Research involving children. How will informed consent from parents or legally authorized representatives as well as from subjects be obtained? **I will send consent forms home with students for parents to sign and return.**
    - ☐ G. Research involving pregnant women or fetuses. How will informed consent be obtained from both parents of the fetus?
    - ☐ H. Research involving participants in institutions (cognitive impairments, prisoners, etc.). Specify agencies or institutions involved. Attach letters of approval. Letters must be on letterhead with original signature; electronic transmission is acceptable.
    - ☐ I. Research approved by an IRB at another institution. Specify agencies or institutions involved. Attach letters of approval. Letters must be on letterhead with original signature; electronic transmission is acceptable.
    - ☐ J. Research that must be approved by another institution or agency. Specify agencies or institutions involved. Attach letters of approval. Letters must be on letterhead with original signature; electronic transmission is acceptable.
13. Checklist for Attachments

The following are attached:

☒ Consent form (if applicable) or

☒ Letter to participants, written instructions, and/or script of oral protocols indicating clearly the information in item #9.

☒ Letter(s) of approval from cooperating institution(s) and/or other IRB approvals (if applicable)

☒ Data collection instruments

Appendix A4

14. Signatures

I/we agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects/respondents are protected. I/we will report any adverse reactions to the committee. Additions to or changes in research procedures after the project has been approved will be submitted to the committee for review. I/we agree to request renewal of approval for any project when subject/respondent contact continues more than one year.

Principal Researcher _____ Date

Faculty Advisor _____ Date

PROTOCOL APPROVAL FORM

(To be returned to IRB Program Manager with copy of completed protocol form and attachments)

Human Subjects Committee Use Only (In absence of IRB-authorized Human Subjects Committee, send protocol to IRB.)

Recommended Review Status

☙ Human Subjects Committee can approve as exempt because this research fits in the following category of research as described in section 9.02 of the IRB policies and procedures **(Cite reasons for exempt status.)**:

Printed Name and
Signature of the HSC Chair _____ Date

****

☙ Expedited Review by a designated member of the IRB because this research fits in the following category of research as described in section 9.03 of the IRB policies and procedures **(Cite reasons for expedited status.)**:

Printed Name and
Signature of the HSC Chair _____ Date

****

☙ Requires Full Review by the IRB because this research fits in the following category of research as described in section 9.04 of the IRB policies and procedures **(Cite reasons for full status.)**:

Printed Name and
Signature of the HSC Chair _____ Date

IRB/RSSP Use Only

Project Number _____ Received RSSP

Sent to: _____ Date:

Final Status

☙ Approved as **Exempt** under section 9.02 of the IRB Policies and Procedures (**Cite reasons for exemption.**):

☙ Approved as **Expedited** under Section 9.03 of the IRB Policies and Procedures because **(Cite reasons for expedited status.)**

Printed Name and
Signature: _____ _____ Date _____
IRB (for the Committee)

☙ Approved by **Full** review under Section 9.04 of the IRB as meeting requirements of the IRB Policies and Procedures.

Printed Name and
Signature: _____ Date

IRB Chairperson

Appendix B

Annette Freeman,
Principal
afreeman@sdale.org

September 27, 2013

To Whom It May Concern:

I am aware that Hillary Walker is conducting an honors project entitled, "Investigating Mathematics: Using Activities to Further Math Education in an Elementary Classroom" at my school, Gene George Elementary in Springdale, Arkansas. This study has been approved by her thesis adviser, Dr. Marcia B. Imbeau, Professor in the Department of Curriculum and Instruction. Ms. Walker has my permission to conduct this study pending approval of the University of Arkansas Institutional Review Board Committee.

Respectfully,

Annette Freeman, Principal

Appendix C1

Dear Parent,

My name is Hillary Walker, and I am a senior in the Early Childhood Education Program at the University of Arkansas. I am hoping to one day become a math teacher after graduation, and I have a passion for teaching this subject. I am a part of the honors program at the university, and I am conducting research about creatively teaching math to elementary students. With your consent, I hope to involve your child in a new, creative curriculum to further his or her learning as well as overall opinion of math.

The program will consist of a meeting once a week on Wednesday mornings during class where we will work in a small group of about six students. We will work on different hands-on, investigative projects involving mathematical concepts as well as playing fun games that will encourage students to take an active role in their own learning. I plan to create a safe learning environment where students will be unafraid of trial and error. As a group, we will work through challenging concepts and investigate why things work, rather than focusing on memorization and worksheets. For example, I plan to focus a lesson on multiplication. During our time, we will explore why multiplication works and use manipulatives to see multiplication in action. Through this time, we also will be playing games that aim to get the students excited about learning and change their view about math. The purpose of this study is to increase the students' knowledge in this area and allow them to become the expert in order to teach others what they are learning.

In order to involve your child, I will need your consent by providing your signature on the attached sheet. My research findings will be confidential and will not identify any child in particular, and your child's name will not be used in any reports of data. All information will be released anonymously.

On the attached consent form, I have provided more information concerning my research project. Please contact me with any questions or concerns that you might have! I look forward to getting to know you and your child.

I am very excited to meet your child and get started on the fun activities that are planned for these next two months! Thank you for your cooperation.

Hillary Walker
University of Arkansas Student
hpwalker@uark.edu
972-746-1190

Appendix C2

Estimado(s) Padre(s),

Me llamo Hillary Walker y estoy en mi último año en la universidad. Estudio educación primaria en La Universidad de Arkansas. Espero ser maestra de matemáticas después de graduarme, tengo una gran pasión para enseñar esta materia. Soy estudiante de honores en la universidad, e investigo unas maneras de enseñar matemáticas de manera creativa a los estudiantes de la primaria. Con su permiso, espero involucrar su(s) hijo(s) en este currículo nuevo y creativo para avanzar el aprendizaje del niño y su opinión de las matemáticas.

El programa consistirá en una reunión cada semana las miércoles durante sus clases. Vamos a trabajar en grupos pequeños, de seis estudiantes. Trabajaremos en proyectos interactivos e investigativos conceptos matemáticos que a la vez trabajan. También vamos a jugar juegos divertidos que animarán a los estudiantes a ser más activa en su aprendizaje. Crearé un ambiente seguro de aprendizaje en el que estudiantes no tendrán miedo de cometer errores.

El propósito de este estudio es aumentar el conocimiento del estudiante esta área y permitir que ellos se hagan para poder enseñar a otros de que han aprendido.

Para involucrar a su(s) hijo(s), necesito su permiso por firma en el documento adjuntado. Los resultados del estudio serán confidenciales y yo no identificaré a nunca chico/a, ni el nombre de su hijo/a no será utilizado en la reseña. Toda la información será anónima.

En el documento adjuntado de permiso, preveo más información sobre mi estudio. Por favor, pongase en contacto conmigo, si tiene preguntas o dudas. Espero que conozca a usted y, también, su(s) hijo(s).

Estoy emocionante para conocer a su hijo y empezar a las actividades divertidas los próximos dos meses. Muchas gracias por su cooperación.

Hillary Walker
Alumno de La Universidad de Arkansas
hpwalker@uark.edu
972-746-1190

Appendix D1

INFORMED CONSENT

Title: Investigating Mathematics: Using Active, Exploratory Activities to Further Math Education in an Elementary Classroom.

Researcher:
Hillary Walker, B.S.E. student
Marcia Imbeau, Faculty Advisor
University of Arkansas
College of Education and Health Professions
972-746-1190
hpwalker@uark.edu

Administrator:
Ro Windwalker, Compliance Coordinator
Research and Sponsored Programs
Research Compliance
University of Arkansas
210 Administration
Fayetteville, AR 72701-1201
479-575-2208
irb@uark.edu

Description: The present study is an honors project designed to see the benefits of using exploratory, investigative activities increase mathematics learning. The purpose of this research is to collect data to determine if exploratory, investigative learning techniques in mathematics change your student's attitudes toward the subject. I plan to implement hands-on projects, such as games, into a math curriculum and gauge the change in your student's opinion and learning. Through minimizing memorization techniques and skill-and-drill worksheets, I plan to create a play-like atmosphere. Your students will take on the role as the math investigator where he or she will determine why math processes work through his or her own exploration. The purpose of the study is to determine whether this new approach will enhance achievement in the subject of mathematics.

Risks and Benefits: There are no risks associated with this study, other than those associated with regular classroom instruction, anticipated in this research. The potential benefits include improving your child's overall understanding of mathematics and provide him or her with a new view of the subject.

Voluntary Participation: Your child will participate in the Investigating Mathematics study and curriculum should you grant permission.

Confidentiality: Your child's scores on the pretest and posttest along with any evidence of progress throughout the semester will remain confidential throughout the project. To ensure confidentiality, a code will be established by randomly assigning a number to each participant. All scores and grades for data analysis will be recorded using this code. The code, as well as all data collected during the study, will be stored in a secure place and will only be accessible to the researcher. Neither your child nor his/her scores or responses will be personally identified. The code will be destroyed at the conclusion of the study.

Right to Withdraw: If you choose to allow your child to participate in this program, but at any time and for any reason change your mind, you may withdraw your consent. In that case the mathematics program will discontinue and your child's scores would not be reported in the project data. There would be no negative consequences for this decision.

Informed Consent: I, _____, have read the description of this study.
(please print name)

I understand the purpose of the project, the procedures to be used, the potential risks and benefits, how confidentiality will be established and maintained, and the option to withdraw. I have read and discussed this project with my child, _____.
(please print your child's name)

My signature below indicates that my child and I freely agree to his/her participation in this program and his/her scores and projects to be recorded and analyzed as a participant of this program.

_____ _____ _____
Parent/Guardian Child/Participant Date

Appendix D2

CONSENTIMIENTO INFORMADO

Título : Investigando Matemáticas: Utilizando Actividades Activas y exploradas para Avanzar Educación de Matemáticas en la Clase Primaria

Investigador:
Hillary Walker, B.S.E. estudiante
Marcia Imbeau, consejera
Universidad de Arkansas
Colegio de Educación y Profesiones de la Salud
972-746-1190
hpwalker@uark.edu

Administrador:
Ro Windwalker, Coordinador de Cumplimiento
Programas de Investigación y patrocinado cumplimiento de Investigación
Universidad de Arkansas
210 Administración
Fayetteville, AR 72701-1201
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Descripción: El presente estudio es un proyecto diseñado honores a ver los beneficios de la utilización de actividades exploradas. Al inicio del estudio, quiero investigar si hay cambio en la actitud de su hijo a las matemáticas. El investigador registrar el proceso y las respuestas de su hijo. Su hijo va a participar en las lecciones y actividades como juegos de currículo de matemáticas. Por maneras sin memorización ni la tarea, creará un ambiente de jugar. Sus hijos van a ser investigadores en que investigar conceptos matemáticos que a la vez trabajan. El propósito del estudio es para determinar si que este currículo particular y nuevo puede avanzar los éxitos de los estudiantes primarias.

Riesgos y Beneficios: No existen riesgos asociados con este estudio, que no sean los relacionados con instrucción en el aula regular, previsto en la presente investigación. Los posibles beneficios incluyen mejorar la educación general de su hijo de una manera emocionante que le motivará a seguir viendo a la lectura en todas las oportunidades.

Participación voluntaria: Su hijo participará en El Estudio Investigando Matemáticas y Currículo debe conceder el permiso.

Confidencialidad: Resultados de su hijo en la prueba previa y posterior a la prueba, junto con cualquier evidencia de progreso a lo largo del semestre serán confidenciales durante todo el proyecto. Para garantizar la confidencialidad, un código será establecido mediante la asignación de un número al azar para cada participante. Todas las puntuaciones y calificaciones para el análisis de los datos se graban utilizando este código. El código, así como todos los datos recogidos durante el estudio, se almacenarán en un lugar seguro y sólo serán accesibles a los investigadores. Ni su hijo ni sus / sus resultados o respuestas se identificarán personalmente. El código será destruido en la conclusión del estudio.

Derecho de Retiro: Si usted decide permitir que su hijo participe en este programa, pero , en cualquier momento y por cualquier razón cambia de opinión, puede retirar su consentimiento. En ese caso, el programa de alfabetización interrumpirá y calificaciones de su hijo no se le informó de los datos del proyecto. No habría consecuencias negativas de esta decisión.

Consentimiento informado: Yo, _____, he leído la descripción de este estudio.
(por favor escriba su nombre)

Entiendo que el propósito del proyecto, los procedimientos que se utilizarán, los posibles riesgos y beneficios, cómo se establece y se mantiene la confidencialidad, y la opción de retirarse. He leído y discutido este proyecto con mi hijo,

_____.
(por favor, escriba el nombre de su hijo)

Appendix D3

Mi firma abajo indica que mi hijo y yo estamos de acuerdo libremente a su / su participación en este programa y su/ sus resultados y proyectos para ser registrados y analizados como participante de este programa.

_____ _____ _____

Padre / Tutor del Niño/ Participante Fecha

Alergias alimentarias: _____

Appendix E1

Mathematics Confidence and Attitude Survey

Please answer each of the following statements and questions about your attitudes and feelings toward math and math problems. Don't just think about this year, but think about all of your experiences with math both in and out of school. Please answer each of the questions honestly. It is very important that your answers reflect your TRUE feelings and not what you think your teacher wants you to say. Your teacher will be looking at overall results and not your individual answers. Circle the number that best matches your attitudes or feelings about math.

1 = (SD) Strongly Disagree
2 = (D) Just Disagre
3 = (U) Unsure or no feelings one way or the other
4 = (A) Just Agree
5 = (SA) Strongly Agree

I am a boy/girl (circle one)

1. I like Math. 1 2 3 4 5

2. Math is usually easy for me. 1 2 3 4 5

3. 5th grade math is harder than I expected. 1 2 3 4 5

4. Math is mostly about memorizing rules and procedures. 1 2 3 4 5

5. I like learning new things in math. 1 2 3 4 5

6. I like showing other students my answers. 1 2 3 4 5

7. I like showing other students how I solved a problem. 1 2 3 4 5

8. I only like doing math problems I already know how to do. 1 2 3 4 5

9. I don't like explaining or showing how I get my answers. 1 2 3 4 5

10. I like learning new things in math, even if it is challenging. 1 2 3 4 5

11. I usually get good grades in math. 1 2 3 4 5

12. I feel like most of the students in my math class are better at math than me. 1 2 3 4 5

13. I would probably get better scores in math if I tried harder. 1 2 3 4 5

14. The mistakes I make in math class are usually because I don't understand how to do a problem. 1 2 3 4 5

15. Put these numbers in order from greatest to least.

167,897 176,980 99,897 1,678,760 163,876

_____ _____ _____ _____ _____

16. In 26,532 the 6 stands for 6 x _____

Appendix E2

17. Round to the nearest 10(a) 286 (b) 5696

a)_____ b)_____

18. Find the positive common factors of 15 and 18. _____

19. Find the product of 35 and 4 _____

20. When 73 is divided by 9 the quotient is _____ and the remainder is _____

21. During the last half year, Mr. Wilson's salary was $1985 each month. He saved $4025 during that time and spent the rest. How much did he spend?

22. A rectangular swimming pool measures 24 m by 16 m. A concrete path 2 m wide is paved around it. What is the area of the path?

Appendix F1

Place Value Pyramid

Grade Level: 5th Grade

Unit: Math-Place Value

State Standards:

- 5.NBT.A.2 (Number & Operations in Base Ten)- Understand the place value system.

Know: Students know the place value of the number determines how large the number is. Students know how to compare numbers to gauge greater than, less than, and equal to.

Understand: Students will understand to determine how large the number is by the place value of the number to the farthest left. Students will understand how to read numbers that they will create aloud.

Do: Students will determine the place value of a set of cards that will be put together to form a number. The students will be able to switch cards around to make the largest possible number. Students will then read aloud the number they create, and together the group will decipher who has the largest number represented by the cards.

Materials:

- Deck of cards (using only the numbers 2-9 and each student will need 10)
- Single piece of paper and writing utensil to keep score

Procedure:

Schema activation- I will start by asking the students basic questions about place value. I will use the cards to create numbers, and as a group, we will determine the greatest

number that can be made. I will use their prior knowledge of the basics of place value and expand understanding.

During the lesson- Students will be given ten cards and be told to arrange them in a pyramid with four cards on the bottom. We will start by flipping over the card at the top of the pyramid. The students will read their number aloud and determine who has the greatest number, and this student will receive a point. We will then move on to the next round, and the students will flip over the next row of cards. Students will be allowed to make one switch of cards to try to create the largest two-digit number possible. Students will read their number aloud and determine who has the greatest number value. This will continue until the last round where four cards will be turned over, and students will be able to make one switch, read the numbers, and determine the winner. The student with the most points wins the game.

After lesson- We will recap over place value and determine who the winner is (who has the greatest number at the end of the fourth round). I will ask the students why he or she is the winner, and why that number is the greatest. I will ask the students to point to the ones, tens, hundreds, and thousands place.

Assessment: I will use a formative assessment to determine if the students are learning what is being taught. I will monitor the students' ability to successfully read their number aloud. At the end, I will monitor overall learning by asking questions about place value and evaluating students' answers.

Evaluation: Overall, I think this lesson went very smoothly. The students enjoyed the game-like atmosphere and were able to participate in a non-threatening situation. I think

this lesson might need to be improved to challenge the students more. This can be done by adding more rows to the bottom of the pyramid to move the numbers into the millions rather than the thousands. I think I was able to communicate the purpose of the lesson though, and it was a great introductory game to reinforce place value.

Citation:

"Place Value Game." *Education.com*. N.p., 24 July 2013. Web. 27 Dec. 2013. <http://www.education.com/activity/article/hold-the-line/>.

Field Notes

11/13/13

Student A: Student A is very shy and reserved, and he was not thrilled to participate in the games. He liked the game when it was being played, and he was able to answer several questions, but he had an ambivalent attitude overall. He struggles with the math concepts more than the other students, but he is willing to learn.

Student B: Student B was extremely excited to play games and be pulled out of class. He seemed shyer at the beginning, but he opened up very quickly. He answered most questions correctly, and was willing to help the other students when they needed assistance.

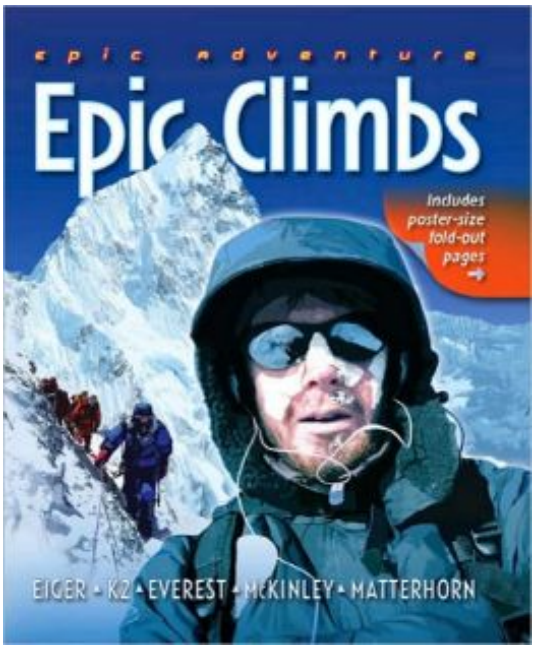
Student C: Student C is extremely reserved. She did not want to speak, share her answers, or even talk to the other students. She participated in the game, but she seemed detached. She is very bright and answers most questions correctly though.

Student D: Student D was quiet at the beginning of the game, but she became attached to me pretty quickly. She seemed to like the attention given in a small group setting, so she

was more willing to speak up in front of the group. Student D lacks confidence in her abilities though and is afraid of getting answers wrong.

Student E: Student E was excited to be pulled out of class, but she did not like the idea of being challenged in her math skills. She spent much of the time joking around with the other students and did not take the game very seriously. She participated later on, but it was a challenge to get her to listen to what was being said to her.

Appendix F2



How Tall Is A Mountain?

Grade Level: 5th Grade

Unit: Math-Place Value

State Standards:

- RI.5.2 Reading Informational text- Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.
- RI.5.3. Reading Informational Text-Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.
- RI.5.4 Reading Informational Text- Determine the meaning of academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.
- 5.NBT.A.1-Number and Operations in Base 10-Understand the place value system

Know: Students know the place value of the number determines how large the number is. Students know how to compare numbers to gauge greater than, less than, and equal to.

Understand: The students will understand how to compare and contrast two pieces of information. The students will be able to read informational text and find the main ideas. The students will be able to summarize informational text after reading. The students will know how to compare large numbers and examine place value.

Do: Students will determine how large a mountain is by comparing the heights of different landforms. Students will use cards to demonstrate the place value of numbers depicting the height of mountains.

Materials:

- *Epic Adventure: Epic Climbs* by John Cleare
- Scanned copies of pgs. 46-47 and 51-52 for each student

- Whiteboard with markers
- Printouts of Compare/Contrasting diagram
- Printout pictures of different mountains
- Decks of cards

Procedure:

Schema activation- The teacher tells the students that today we will go on an adventure to the top of some big mountains. Ask, "Does anyone know the names of some tall mountains?" We will then discuss key vocabulary and introduce unfamiliar words (glacier, summit, peak, crevasse, mountain chain, etc.). Show students pictures of different mountains. Explain what an informational text is and the purpose they serve.

BEFORE READING

- Open the book to the three pages showing the mountains that will be discussing (30, 46, 50).
- Ask the students to predict which mountain is the tallest.
- Discuss comparing and contrasting. What does it mean for two things to be similar?
- Model how to use a comparison chart and graphic organizer.

DURING READING

- Teacher model reads page 30 about Mount Everest.
- Teacher asks students what the important facts and information were, and write down ideas on the whiteboard.
- Pass out the scanned copies of the books to each student, and have students read independently while taking down key points of the pages.
- Teacher observes students reading and notes taken.

AFTER READING

- When students have finished reading, they will fill in the comparison chart comparing and contrasting the three mountains.
- Teacher checks for comprehension by asking the students how tall each mountain is, the differences between the mountains, etc.
- Teacher fills in a class comparison chart with the different ideas attributed from students.
- Determine if students' predictions were true about the height of the mountains.

Additional Instruction:

Discuss the heights of the three mountains and the place value of the numbers. Use a deck of cards to visually see the numbers and place into a place value chart. Switch around numbers to make the largest number possible. Have students read the numbers aloud. Use greater than, less than, and equal to signs to compare the three numbers.

Place Value Chart:
Matterhorn Example-

Hundred Thousands	Ten Thousands	One Thousands	Hundreds	Tens	Ones
	1	4	6	9	0

Assessment: The teacher will evaluate the students' comprehension through the notes taken while they were reading as well as the comparison charts done individually. The closure activity with the whole class will help to gauge the comprehension of the class.

Evaluation: The students really enjoyed this lesson because it incorporated a topic that was interesting to them. The students loved learning about the different mountains, and the book was a great visual aid. The students seemed to understand the importance of place value because they were able to see the differences in the height of mountains and how important each number in the overall value was. The students were able to grasp the concept of place value in extremely large numbers, so I believe this lesson was successful in reaching anticipated learning goals.

11/20/13

Field Notes

Student A: Student A seemed detached from the game and quiet at first, but when a question was directed to him, he would answer and participate. He was able to correctly identify the place value of the numbers that I questioned, but he did not give this information voluntarily.

Student B: Student B really enjoyed the book being read because he is fascinated with mountains and loved all the pictures. He answered nearly every question correctly about place value. He was excited to help his classmates and pointed out the correct answers on his own cards as well as those sitting next to him.

Student C: Student C was very shy this morning again, but when I asked her a question, she responded correctly. She lacks confidence in her abilities, but when she is encouraged, she is more willing to answer. Like Student B, she was very engaged in the book about mountains.

Student D: Student D enjoys the math games that we have been playing. When I walk into the class, she gets very excited and is ready to start. She is very bright and answers most questions correctly, but throughout the game, she repeatedly tells me that she isn't good at math. She seems discouraged by the grades she has been receiving in class, but during the game, she performs well.

Student E: Student E had a difficult time sitting still while I was reading the book, but she was more engaged in this game during last week. She had a more difficult time answering place value questions, but enjoyed receiving help from the other students.

Appendix F3

Number Spell Out

Grade Level: 5th Grade

Unit: Math-Place Value

State Standards:

- 5.NBT.A.2 (Number & Operations in Base Ten)- Understand the place value system.

Know: Students know the place value of the number determines how large the number is. Students know that the location of the number represents a larger portion of the number. Example: 3,756-The seven means 700.

Understand: Students will understand to determine how large the number is by the place value of the number to the farthest left. Students will understand how to read numbers that they will create aloud.

Do: Students will create four digit numbers after being read the number and must correctly place the numbers in order being aware of place value.

Materials:

- Deck of cards (using only the numbers 2-9 and each student will need 10)
- Single piece of paper and writing utensil to keep score

Procedure:

Schema activation- I will start by asking the students basic questions about place value. As a group, we will create numbers after given certain parameters. We will identify the ones, tens, hundreds, and thousands place of the numbers created.

During the lesson- Each student will have their own deck of cards with the face cards and tens removed. The teacher will give the parameters for the number they must create (ex: “create a four digit number with a 6 in the hundreds place”). The students will create their numbers, and after everyone is finished, they will say the number out loud and identify the ones, tens, hundreds, and thousands places. After a few rounds of this, it will begin to be a competition with the student creating their number the fastest being the winner of the round. After each round, the students will explain their answers and identify place value.

After lesson- We will recap over place value and determine who the winner is. We will discuss place value once more and reinforce the meaning of the location of the numbers in the entire four-digit number.

Assessment: I will use a formative assessment to determine if the students are learning what is being taught. I will monitor the students’ ability to successfully read their number aloud and identify the place value of the numbers. I will also assess if the students were able to meet the specific parameters given at the beginning of the round.

Evaluation: I think this lesson went really well with the students. They were able to communicate their answers with the rest of the group and could meet the given parameters. The students are starting to be more comfortable around me and the rest of the students, and I think this is helping them be more confident to communicate their answers.

Field Notes

12/4/13

Student A: Student A was able to understand this game immediately when it was explained, and he got most of the answers correct. He moves slower than the rest of the students, so he didn't win any of the rounds, but I think he was encouraged that he got a lot of number created correctly.

Student B: Student B won the game when we started the competition part of the activity. He was able to correctly create his numbers the quickest. He explained that he liked using the cards for these activities because you don't have to write them on paper.

Student C: Student C did really well during this game also. She was able to make her numbers using the parameters given, and she was even able to be the fastest a couple of times.

Student D: Student D worked similar to Student B during this game. She got many answers correct, and she won nearly as many times as he did. As the weeks are going by, she is becoming more confident in speaking in front of her peers and explaining her answers to the group.

Student E: Student E was excited to be playing another math game today, and like the other students, she worked hard and did well. She participated more in this game than she has in the last couple of weeks.

Appendix F4

Fraction Bingo

Grade Level: 5th Grade

Unit: Math-Introductory fractions

State Standards:

- 5.NF.A.1 (Number & Operations: Fractions)- Use equivalent fractions as a strategy to add and subtract fractions.

Know: Students know the basic concepts of fractions-how to represent in a picture and can match a written out fraction with its' corresponding picture.

Understand: Students will understand how to visualize a fraction given the fraction in written form and since this is a review, automaticity will quicken.

Do: Students will match the cards of written out fractions with cards containing the corresponding picture representation in a bingo game.

Materials:

- Empty bingo game board
- Written fraction sheet
- Picture fraction sheet
- Scissors
- Glue
- Pencils

Procedure:

Schema activation- I will start by asking the students if they have ever played a game of bingo before. I will then ask students a couple example questions about matching the two sets of fraction cards, and we will discuss the correct answers as a group.

During the lesson- Students will cut out the written fraction cards and glue them in a random order on their game board. Next, they will cut out the picture fraction sheets and scatter around their desk in order to pick out the right fraction quickly. I will them call out fractions, and the students will put the corresponding picture fraction card with the written card to cover their boards. We will play several times until the students have four in a row. We will repeat the game for a couple of rounds for students to gain understanding of representing fractions in different ways.

After lesson- We will recap what we learned during the activity, and students will be asked a few review questions where they will draw their own fraction circles to represent a fraction that I call out.

Assessment: I will use a formative assessment to monitor students' progress throughout the game, and the questions after the lesson will be a good indicator of the students' overall learning as well.

Evaluation: Overall, I think this lesson went very smoothly. The students enjoyed playing the game so much that we had to play multiple games of bingo before they were ready to join the rest of the class. I saw progress throughout the game of students' overall learning as well. I think the students are becoming more comfortable with me as well as each other during the lessons, and they are more willing to answers questions in front of the group.

Field Notes

12/11/13

Student A: Student A seemed to enjoy the bingo game today, and he put forth more effort today than I've seen in last few weeks. He played the game and answered the questions that

were asked. He was still shy and reserved, but he seemed to like this game more than the last few.

Student B: Student B was ready for another game today. He was able to correctly identify the pictures with the fractions that were called out, and he was excited to reveal his answers and explain why the pairings were correct.

Student C: Student C moved slower during this game than the rest of the students, but she was able to get many of the correct answers. She explained her answers to me as well. She worked hard during the game today, which I saw because she more engaged and participated more than the last few weeks.

Student D: Student D won this game and got a bingo first. She was excited to play this game, but when I asked her questions to explain why she paired certain fractions and pictures, she was shyer.

Student E: Student E worked hard today and was able to identify her fraction pictures with the fractions being read. She seemed more willing to learn today, but she was still having trouble communicating her answers and staying on task.

Appendix F5

Grab A Spoon!

Grade Level: 5th Grade

Unit: Math-Fractions

State Standards:

- 5.NF.B.3 (Number & Operations: Fractions)- Apply and extend previous understandings of multiplication and division to multiply and divide fractions.

Know: Students know the basic concepts of fractions-fractions are a division problem, equivalent fractions, etc.

Understand: Students will understand how to reduce fractions and create equivalent fractions by manipulating the numerator and denominator. They will be able to compare fractions by putting them in reduced form.

Do: Students will collect four cards with equivalent fractions written on them as a deck of fraction cards pass around the circle.

Materials:

- Fraction cards (Provide 13 sets of 4 equivalent fractions).
- Spoons (One less than the number of students)

Procedure:

Schema activation- I will ask the students what it means to reduce a fraction and give examples of fractions that can be reduced and ask them to put the fraction in simplest

form. I will go through a few examples of groups of four equivalent fractions from the deck of cards.

During the lesson- The teacher will deal out four cards for each student placing the rest of the deck in front of one student. Spoons will be placed in the center of the group having one less than the number of players. The student with the deck in front of him or her will begin flipping up the top card and passing it to the next player, only holding four cards at a time, and the goal is to collect four equivalent fractions. When the student flips to a card desired, he or she will replace the card with one that is already in the hand. The first player to get four equivalent fractions will grab a spoon and this will as a cue for the remaining students to grab a spoon as well. The student left without a spoon will be out, and this process will continue until there is one winner.

After lesson- We will recap what we learned during the activity, and students will be asked what it means to reduce a fraction and the process that is used in reducing them.

Assessment: I will use a formative assessment to monitor students' progress throughout the game, and the questions after the lesson will be a good indicator of the students' overall learning as well. I will determine the students' learning by their ability to successfully identify four equivalent fractions among the cards.

1/29/14

Field Notes:

Student A- Student A seemed a little discouraged when he got to the table today, so I sat next to him and we played as a team during this game. He enjoyed the help, and he was more involved during the game than usual. Student A responds well to words of encouragement.

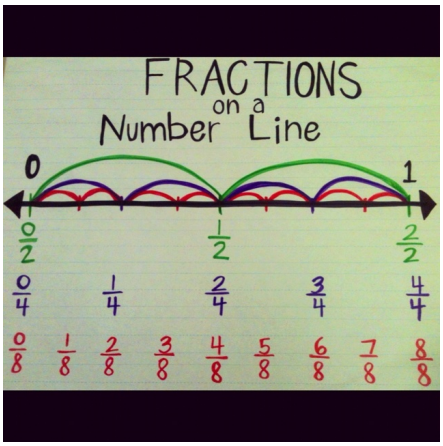
Student B- Student B loved this game. He explained that it reminded him of the games he played at home with his family, so he connected well with what we were doing today. He had a little trouble identifying the equivalent fractions, but he grew in understanding by the time we finished the game, and he came in second place.

Student C- Student C was absent from school today, so she did not participate in the game.

Student D- Student D won this game and ended up loving it. She asked repeatedly to not go back to class and continue playing. She worked very hard to reduce the fractions on her cards, and she took more time to analyze them. Because of her persistence, she was able to collect equivalent fractions the fastest.

Student E- Student E struggled with this game at the beginning, but she understood better by the end of our time today. She never collected all four fractions, but she was able to explain why she picked up certain cards to the group when asked.

Appendix F6



Fraction Line Up!

Grade Level: 5th Grade

Unit: Math-Fractions

State Standards:

- 5.NF.B.3 (Number & Operations: Fractions)- Apply and extend previous understandings of multiplication and division to multiply and divide fractions.

Know: Students know the basic concepts of fractions-fractions are a division problem, equivalent fractions, fraction ordering, and greater than, less than.

Understand: Students will understand that fractions can be ordered on a number line from least to greatest, and fractions are between two whole numbers (in this case, between 0 and 1).

Do: Students will order fractions on a number line from 0 to 1 to show least to greatest.

Materials:

- Yarn or string
- Clothespins
- Fraction cards

Procedure:

Schema activation- I will ask the students to place the numbers 0 and 1 on the number line and ask what the number line represents. We will discuss and predict which fractions will be larger during a comparison between two fractions.

During the lesson- As a group, we will discuss the most common fractions and compare them from greatest to least (1/2,1/3, 2/3, ¼, ¾, 1/5, 2/5, 3/5, 4/5, 1/6, 1/7, 1/8,

2/8, 3/8, 4/8, 5/8, 6/8, 7/8, 1/9, 1/10). After places all fractions on a number line from 0 to 1 as a whole group, students will take turns placing the same fractions on the number line by themselves. The students will have 30 seconds to place as many fractions on the number line as possible, and this will continue until all students have a chance to play the game. At the end, the winner will be the student who correctly identifies the most number of fractions places on the number line.

After lesson- We will review the fractions and look for patterns on the number line. As a group, we will discuss the pattern of the larger the denominator, the closer the fraction is to 0 when the numerator is 1. We will also place all the fraction cards on the number line to review the placement of each card.

Assessment: I will use a formative assessment to determine students' progress, and I will be able to see each student's understanding of fraction place value when he or she competes in the game. As a group, we will review at the end, and I will assess understand after the game as well.

Evaluation: I believe that this lesson was great to reinforce place value for the students. It proved to be very challenging for most of the group, so we reviewed the fractions multiple times. By the end of the game, the group was able to identify where each fraction card was supposed to be placed on the number line though. The students enjoyed this game because it was times, so they were able to move around quickly, and since it was not only judging on ability but on time too, the students felt more confident competing one-on-one.

2/5/14

Field Notes:

Student A- Student A was the most discouraged of the group by this game. He began not confident in his ability to correctly place the fractions on the number line, but by the end of the game, he grew in his confidence. I asked him a question about the patterns of the numbers at the end, and he was able to determine the pattern without any assistance. His face lit up when I told him that he was correct. He lacks confidence in his math ability, but he responds well to positive affirmation when he is correct.

Student B- Student B is always thrilled to learn that we will be playing another game. He is the most enthusiastic out of the rest of the students. He was able to identify the correct locations of most of the fractions with the exception of a few. He jumps at the chance to explain his reasoning to his classmates, which was not the case at the beginning of the project. Student B, now, always has his hand raised, ready to answer another question. His confidence has grown tremendously. He was the winner of this game.

Student C- Student C struggled with this game at the beginning, but she was able to answer most questions correctly at the end of the game. She is more reserved, so she did not love competing by herself, but after I allowed Student D to pass her the cards, she was able to move past her anxiety. She correctly identified most of her fractions on the number line.

Student D- Student D did well during this game and greatly enjoyed it. She missed a few of the fraction placements, but she seemed to have the most fun during the game. She also was very vocal during the lesson wrap up when I asked the recapping questions. She came in second during this game.

Student E- Student E struggled with the game, but she seemed to still enjoy it. I had to walk through the process with her several times, but at the end, she was able to place the fractions in their correct location on the number line. She needs affirmation during the game to continue and be motivated to not give up. She finished the rounds of the game, which would've been unexpected at the beginning of the project.

Appendix F7

Red Light, Green Light!

Grade Level: 5th Grade

Unit: Math-Fractions

State Standards:

- 5.NF.B.3 (Number & Operations: Fractions)- Apply and extend previous understandings of multiplication and division to multiply and divide fractions.

Know: Students know the basic concepts of fractions-fractions are a division problem, equivalent fractions, fraction ordering, etc.

Understand: Students will understand that fractions are a division problem, and can be reduced by dividing the numerator and denominator by the same number. There are several ways to create equivalent fractions.

Do: Students will write down an equivalent fraction to the one drawn on the teacher's white board.

Materials:

- White boards (one for each student and teacher)
- List of non reduced fractions
- Tile floor to play on
- Dry-erase marker (one per student and teacher)
- Socks (one per student and teacher)

Procedure:

Schema activation- I will ask the students to line up on the "starting line" (line marked on the tile with tape) and play one normal game of red light, green light. We will then discuss equivalent fractions and how to create an equivalent fraction.

During the lesson- Students will line up on the starting line with a whiteboard, maker, and sock. The teacher will write a non reduced fraction on his or her board, and the students will write the reduced fraction on their own board. The first student to reveal a correct answer will move forward 2 tiles closer to the teacher or the "finish line". The teacher will ask the student how he or she found this answer. Each student who answered the question correctly, but were not first will move forward one tile, and the students who answer incorrectly will stay in the same place. The first student to reach the finish line, a certain number of tiles away will be the winner of the game.

After lesson-We will review equivalent fractions and how to find them. The teacher will use specific examples from the game to identify what the correct answers were.

Assessment: I will use formative assessments throughout the game to determine which students understood and which were struggling. I also will assess students' responses after the activity to discern if the students grasped the process of finding equivalent fractions.

Evaluation: I believe that this lesson went smoothly, and the students seemed to really enjoy moving around rather than sitting in a desk. A few of the students were challenged by this game, but overall, I think the students began to understand and gained more practice in finding equivalent fractions. The students asked to play this game multiple times and wanted to teach their classmates how the game works when they returned to class.

2/12/14

Field Notes:

Student A- Student A was not feeling well today, so he did not participate in the game.

Student B- Student B was excited to play another game today, and he ended up in second place at the end. He was very vocal in wanting to share his answers and how he came to

them. When he began explaining and realized he made a mistake, he would stop and correct himself, which was a great indication that he understood what he was learning.

Student C- Student C did well during this game, and answered many of the questions correctly. She moves slower than the rest of the group, which caused her to become a little discouraged, so we modified the game to only move a certain number of tiles for a correct answer. She is generally very quiet, but she raised her hand many times to explain why she got the answer she had written down.

Student D- Student D was the winner of this game, but she started in last place. She didn't understand how to create equivalent fractions at the beginning of the lesson, but it clicked halfway through, and she answered every question correctly and quickly to end up winning. She responds well to words of encouragement. She becomes discouraged very easily and tells me that she is not smart, but she stops saying these things once she gains more confidence, which I have found is helped by encouraging her.

Student E- Student E caused a few behavior problems this morning, and she struggled a little with the game today. She liked moving around rather than being stuck in a desk, which was easily seen by her return back to the classroom. Student B helped her during this game, and explained to her how to get the correct answers. Student E performs well when she is allowed to collaborate with her peers and talk about her answers because when this was happening, she was a lot more confident to explain her answers.

Appendix F8

Grab A Spoon! Take Two!

Grade Level: 5th Grade

Unit: Math-Fractions/Decimals/Percents

State Standards:

- 5.NF.B.3 (Number & Operations: Fractions)- Apply and extend previous understandings of multiplication and division to multiply and divide fractions.
- 5.NBT.A.3 (Number & Operations in Base Ten)- Read, write, and compare decimals to the thousandths.

Know: Students know the basic concepts of fractions-fractions are a division problem, equivalent fractions, etc. Students also know equal decimals to the fractions given.

Understand: Students will understand how to compare fractions by putting them in simplest terms. Students will understand that fractions can also be represented as decimals and percents.

Do: Students will be able to correctly identify equivalent fractions, decimals, and percents with the most simple fractions.

Materials:

- Fraction cards (Provide 13 sets of 4 equivalent fractions, decimals, and percents).
  - For the cards, I used 1/2, 1/3, ¼, ¾, 1, and I wrote the most reduced fraction, an unsimplified fraction, a decimal, and a percent. I repeated this process with the fractions above until 13 sets were made.
- Spoons (One less than the number of students)

Procedure:

Schema activation- I will ask the students to think back to the last spoons game we played and ask one student to explain how the game was played. I will then explain that this game will now be played with decimals and percents as well. We will discuss some of the fractions, decimals, and percents that we will be working with.

During the lesson- The teacher will give each student four cards and pass the deck to the student to the left. Spoons will be placed in the middle with one less spoon than the number of players. Students will begin to pick up one card when they are passed, and will look at their hand to determine if they would like to keep this card. Students will discard their unwanted card to the player on the left. When one student has a set of four equal fractions/decimals/percents, he or she will grab a spoon. When the first spoon is taken, the rest of the players will grab a spoon, and the student without a spoon will be out for the next round. This will continue until there are two students left, and whoever is the first to collect four equivalent cards wins!

After lesson- We will recap what we learned during the activity, the teacher will lay out the equivalent cards, and ask the students to explain why they are all equivalent.

Assessment: I will use a formative assessment to monitor students' progress throughout the game, and the questions after the lesson will be a good indicator of the students' overall learning as well. I will determine the students' learning by their ability to successfully identify four equivalent fractions, decimals, and percents among the cards.

Evaluation:

The students love this game! They asked me to play this game every time we met since the first one played, so I recreated this game to fit what they were learning in class

currently. I think they really enjoyed this game the second time too. All of the students were excited to participate, and they begged to play multiple rounds before returning to class.

2/19/14

Field Notes:

Student A- Student A seemed enthusiastic about playing another card game, but he is not as motivated as the others in the group. He tried harder during this game than during any of the other activities, but he did struggle to get the correct answers. He was the first to be out, but he liked helping the other students as the rounds continued. Student A is gaining more confidence as the activities continue because he no longer tells me that he is "too bad at math" to play.

Student B- Student B loves the spoon game. He begs to play this game, and he is the most participatory, even when he loses a round. He is always the first to explain why the answers are correct and volunteers to explain every answer he gives. He even wants to help his classmates with their own hands. Student B ended up winning this game.

Student C- Student C played very well during this game. She was third overall, and she was willing to explain her answers to the rest of the students when asked. She has gained confidence throughout the last few weeks because she is less reserved during our time together.

Student D- Student D is showing the greatest improvement over the weeks. She has become confident in her math abilities, which is seem in her demeanor. She answers questions correctly, and she is less hesitant to share her answers. She came in second place at the end of the game, and asked if we could continue playing games the rest of the day.

Student E- Student E put forth a lot of effort during the game today. She is not afraid to ask for help, and I sit next to her to help her with her cards. She lacks confidence in her own ability, but with a little encouragement, she is more vocal.

Appendix G

Anecdotal Records By Week

Attitude: Positive attitude during the small group time.

Enthusiasm: Showed excitement in the game being played or the content that was learned during the intervention time.

Cooperation: Participated well with peers and with the researcher throughout instruction.

Confidence: Trust in their own abilities and shared their answers with the rest of the group.

Improvement: Demonstrated great improvement in attitude, confidence, or ability.

Performance: Answered a majority of the questions correctly.

Winner: Won the overall game being played.

Week 1

Student	Attitude	Enthusiasm	Cooperation	Confidence	Improvement	Performance	Winner
A							
B		✓	✓			✓	
C						✓	
D	✓		✓				
E							

Week 2

Student	Attitude	Enthusiasm	Cooperation	Confidence	Improvement	Performance	Winner
A					✓		
B	✓	✓	✓			✓	
C			✓		✓		
D	✓		✓			✓	
E							

Week 3

Student	Attitude	Enthusiasm	Cooperation	Confidence	Improvement	Performance	Winner
A			✓		✓		
B	✓	✓	✓			✓	✓
C			✓			✓	
D	✓		✓		✓	✓	
E					✓		

Week 4

Student	Attitude	Enthusiasm	Cooperation	Confidence	Improvement	Performance	Winner
A					✓		
B	✓	✓	✓			✓	
C	✓		✓		✓	✓	
D	✓		✓			✓	✓
E	✓						

Week 5

Student	Attitude	Enthusiasm	Cooperation	Confidence	Improvement	Performance	Winner
A			✓		✓		
B	✓		✓			✓	
C	n/a	n/a	n/a	n/a	n/a	n/a	n/a
D	✓	✓	✓			✓	✓
E	✓		✓				

Week 6

Student	Attitude	Enthusiasm	Cooperation	Confidence	Improvement	Performance	Winner
A	✓		✓		✓		
B	✓	✓	✓	✓		✓	✓
C			✓		✓	✓	
D	✓	✓	✓			✓	
E			✓		✓	✓	

Week 7

Student	Attitude	Enthusiasm	Cooperation	Confidence	Improvement	Performance	Winner
A	n/a	n/a	n/a	n/a	n/a	n/a	n/a
B	✓	✓	✓			✓	
C	✓		✓		✓	✓	
D	✓		✓	✓	✓	✓	✓
E					✓	✓	

Week 8

Student	Attitude	Enthusiasm	Cooperation	Confidence	Improvement	Performance	Winner
A		✓	✓	✓	✓		
B	✓	✓	✓	✓		✓	✓
C	✓		✓	✓	✓	✓	
D	✓	✓	✓	✓	✓	✓	
E	†		✓		✓	✓	

Appendix H1

Attitudes

Student	Pre-Assessment	Post-Assessment
A	22	22
B	24	28
C	16	17
D	24	25
E	22	25

Pre- and post-assessment scores from the mathematical survey measuring attitudes. Points are out of 30 total.

Confidence

Student	Pre-Assessment	Post-Assessment
A	23	22
B	24	22
C	15	20
D	22	27
E	18	20

Pre- and post-assessment scores from the mathematical survey measuring confidence. Points are out of 40 total.

Achievement

Student	Pre-Assessment	Post-Assessment
A	2	7
B	10	15
C	4	10
D	13	14
E	0	9

Pre- and post-assessment scores from the mathematical survey measuring achievement. Points are out of 16 total.

Appendix H2

T-test: Paired Two Sample Assuming Unequal Variances For Attitudes.

	Variable 1	*Variable 2*
Mean	21.6	24
Variance	10.8	17
Observations	5	5
Pooled Variance	13.9	
Hypothesized Mean Difference	0	
df	8	
t Stat	-1.01783	
P(T<=t) one-tail	0.169275	
t Critical one-tail	1.859548	
P(T<=t) two-tail	0.338551	
t Critical two-tail	2.306004	

Appendix H3

T-test: Paired Two Sample Assuming Unequal Variances For Confidence.

	Variable 1	*Variable 2*
Mean	20.4	22.2
Variance	14.3	8.2
Observations	5	5
Pooled Variance	11.25	
Hypothesized Mean Difference	0	
df	8	
t Stat	-0.84853	
P(T<=t) one-tail	0.210403	
t Critical one-tail	1.859548	
P(T<=t) two-tail	0.420806	
t Critical two-tail	2.306004	

Appendix H4

T-test: Paired Two Sample Assuming Unequal Variances For Competencies.

	Variable 1	*Variable 2*
Mean	5.8	11
Variance	30.2	11.5
Observations	5	5
Pooled Variance	20.85	
Hypothesized Mean Difference	0	
df	8	
t Stat	-1.80061	
P(T<=t) one-tail	0.054725	
t Critical one-tail	1.859548	
P(T<=t) two-tail	0.10945	
t Critical two-tail	2.306004	