

**Improving Student Motivation and Performance in Math:**

*Utilizing the SMART Board Interactive Whiteboard as a Tool to Construct an*

*Understanding of Fractions*

**Jessica K. D. Preisig \* Sixth-grade Math Educator**

**Powdersville Middle School**

**135 Hood Road, Greenville, SC, 29611, USA**

**[preisigj@anderson1.k12.sc.us](mailto:preisigj@anderson1.k12.sc.us)**

## **Abstract**

This research investigated the effects of the SMART Board™ interactive whiteboard on student performance and motivation in a math class. Specifically, this study aimed to discover if the use of the SMART Board interactive whiteboard would improve students' knowledge and understanding in the area of fractions and number relationships, further develop higher order thinking skills, and increase student motivation to learn about fractions. It was hypothesized that the SMART Board interactive whiteboard would increase student performance and motivation among sixth-grade math students. The data collected during this study tended to support the hypothesis concerning student performance and attitudes in the area of fractions and number relationships.

## **Background**

"Fractions"... the word alone is enough to stir up fear and dread among most sixth-grade students, and they seem to shut down at the mention of it. However, developing an understanding of fractions as number relationships and solving problems involving fractions accounts for a significant portion of the sixth-grade math curriculum. Something must be done to improve student motivation and understanding in this area in order for students to successfully complete sixth-grade math.

"(A)ctive engagement of students is not a luxury, but a necessity if students are to truly acquire and retain content, not only for tests, but for life" (Tate, 2003). This is a main theme of the constructivist perspective. "Learning is an active process" (Martinello & Cook, 2000, 137); too frequently, students are seated passively in their desks and are expected to learn by osmosis. It is my belief that all children are born with a natural curiosity and a desire to learn; however, through the over-utilized traditional teacher-centered approach, this desire is discouraged and phased out over time. Educators must seek to encourage this natural propensity to ask deep and meaningful questions, and to involve students in the construction of their own knowledge in order to achieve greater understanding. Interactive technology is a tool for educators to use to make this happen.

Computers and technology have become an important and essential tool for teaching. “Teachers are transforming what can be done in schools by using technology to access primary sources, exposing students to a variety of perspectives, and enhancing students’ overall learning experience through multimedia, simulations, and interactive software,” (Paige, 2004). Though technology cannot take the place of active engagement and other experiences in the classroom, it can help students utilize these experiences to construct knowledge and understanding.

Technology in the classroom can be a powerful instructional tool; however, it is important not to confuse learning **with** technology with learning **from** or **about** technology. When technology is used as a tool for learning, Jonassen (2000) calls it a *mindtool*. He defines *mindtools* as “computer-based tools and learning environments that... function as intellectual partners with the learner in order to engage and facilitate critical thinking and higher order learning.”

Utilizing interactive technology can also become a way to motivate students. “As society has changed, so has the packaging, necessitating the need for alternative ways of unwrapping those packages” (Tate, 2003). Today’s educators are in competition with new technologies and gaming systems outside of the classroom, fighting for students’ attention. *Edutainment* is described as a form of entertainment designed to educate and amuse; technology plays a significant role in this concept. By sparking students’ enthusiasm and engaging students, interactive technology (such as the SMART Board interactive whiteboard) can motivate students to learn more and become more involved in their own learning.

## **Research Design**

In order to assess the effectiveness of the SMART Board interactive whiteboard in a sixth-grade math class, Mrs. Preisig’s experimental group of students was compared to another sixth-grade math class of comparable ability throughout a unit of study entitled *Fractions and Number Relationships*. Students in the school setting were grouped homogeneously. Therefore, Mrs. Preisig’s Level A class was compared to a Level A control group; Mrs. Preisig’s Level B class was compared to a Level B control group. The same standards and objectives were taught to both groups; however, students in the experimental group were presented lessons and

interacted via a SMART Board interactive whiteboard, while students in the control group experienced a more conventional presentation approach via an overhead projector. In order to produce reliable data, variables (such as the content, activities, and games utilized during class) were controlled as carefully as possible in the given circumstances. Additionally, students' achievements and motivations were evaluated utilizing the same measures.

Students' knowledge and understanding were tested utilizing a 22-item multiple-choice test correlated to the South Carolina Standards for fractions and number relationships. Several items on the test also assessed higher-order thinking and learning – the ability to effectively utilize analysis, synthesis, and evaluation skills as outlined in Bloom's taxonomy. A pretest and posttest were used with both groups in order to assess the rate of improvement for each individual over the course of the unit.

Students involved in this study also participated in MAP (Measures of Academic Progress) in the fall and spring semester. Measures of Academic Progress are achievement tests delivered by computer to students. The difficulty of the test adjusts to student performance, so that the more questions are answered correctly, the more difficult the test becomes. Following the test, each student receives a RIT Score, which is then used to track individual student progress. Results can also be broken down by strand in order to identify student strengths and weaknesses. Additional information regarding Measures of Academic Progress can be found at the Northwest Evaluation Association website at [www.nwea.org](http://www.nwea.org). Results from this testing were used to make further comparisons between groups and to track student growth and improvement.

In order to assess student motivation, all students were given a pre-study survey regarding attitudes toward math and learning about fractions. The responses on this survey were later compared to those from a post-study survey regarding attitudes toward math and learning about fractions. Differences between groups were recorded and observed. Observations and anecdotal notes of student involvement and interaction during lessons were also recorded.

## **Results and Evaluation**

It was hypothesized that the SMART Board interactive whiteboard would increase student performance and motivation among sixth-grade math students. An increase in student

performance would be demonstrated through pretest and posttest results and Measures of Academic Progress results. Overall student math performance would also be evaluated utilizing the standardized PACT scores after the duration of the school year. Student motivation would be evaluated through observation as well as student surveys. It was believed that the students' attitudes toward fractions and learning would improve as a result of the interactive technology. "(I)ncreased use of new technologies and motivated expertise of today's students... means that ten years from now we could be looking at the greatest leap forward in achievement in the history of education. By any measure, the improvements will be dramatic" (Paige, 2004).

### **A Look at Pretest and Posttest Results**

Student performance on the 22-item multiple-choice pretest and posttest demonstrated increased average growth among students in Mrs. Preisig's class when compared to the control groups (see Figure 1). Questions on these tests assessed student knowledge, understanding, and ability in the area of fractions and number relationships. Mrs. Preisig's Level A group showed an average increase of 15.56%, compared to an average growth of 10.49% among students in the control group. In Mrs. Preisig's Level B class, student performance increased by 20.11%; while students in the Level B control group showed an average increase of just 11.65%.

<b>Level A Groups</b>	<b>Preisig</b>	<b>Control</b>
Pretest Results (Average Class Score)	62.4444	67.6800
Posttest Results (Average Class Score)	78.0000	78.1667
Average Growth	<b>+ 15.56</b>	<b>+ 10.49</b>

<b>Level B Groups</b>	<b>Preisig</b>	<b>Control</b>
Pretest Results (Average Class Score)	39.6111	44.2000
Posttest Results (Average Class Score)	59.7222	55.8500
Average Growth	<b>+ 20.11</b>	<b>+ 11.65</b>

*Figure 1 – Pretest and Posttest Scores*

### **Examining Measures of Academic Progress**

Upon evaluation of the overall Measures of Academic Progress RIT scores, a significant difference between Level A groups was not observed (see Figure 2). Mrs. Preisig's Level A group

showed an average increase of 6.19 points from the fall testing to the spring, while students in the control group showed an average increase of 6.12 points. Overall MAP RIT scores among students in Level B groups actually demonstrated more significant growth in the control group (see Figure 3). Students in Mrs. Preisig's Level B group showed an average increase of just 5.33 points, compared to an average increase of 8.52 points among students in the control group. These scores, however, reflect student achievement and progress in all mathematical areas.

<b>Level A Groups</b>	<b>Preisig</b>	<b>Control</b>
Fall MAP RIT Scores (Average Class Score)	234.963	233.12
Spring MAP RIT Scores (Average Class Score)	241.1481	239.24
Average Growth	<b>+ 6.1851</b>	<b>+ 6.12</b>

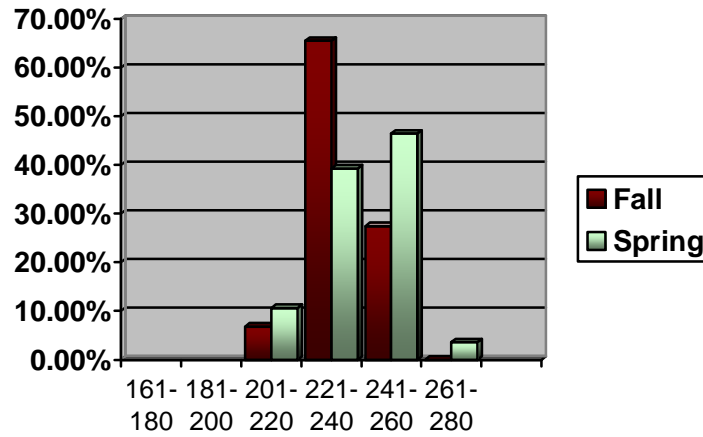
*Figure 2 – Level A MAP RIT Scores*

<b>Level B Groups</b>	<b>Preisig</b>	<b>Control</b>
Fall MAP RIT Scores (Average Class Score)	218	215.8182
Spring MAP RIT Scores (Average Class Score)	223.3333	224.3333
Average Growth	<b>+ 5.3333</b>	<b>+ 8.5151</b>

*Figure 3 – Level B MAP RIT Scores*

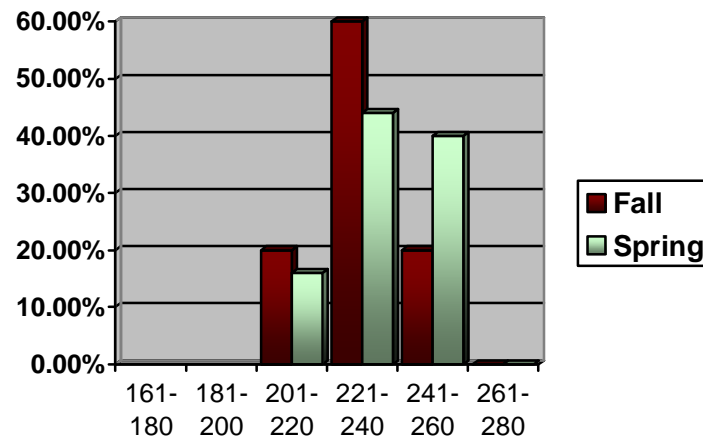
It is more informative to note differences between group scores in the area of number and operations, which is most pertinent to this study. After running a class breakdown by goal report, the percent of students within each group falling into each range of scores in the area of number and operations was calculated. During the fall MAP session, 65.5% of Mrs. Preisig's Level A group performed within the 221-240 RIT Range in the area of numbers and operations and 27.5% fell in the 241-260 cluster. Similarly, 60% of students in the control group performed within the 221-240 range and 20% scored in the 241-260 range. The results of the spring session showed that the percent of Mrs. Preisig's Level A class performing above 240 increased from the initial 27.5% to 50.6%. The percent of students in the control group scoring within this range increased from 20% to 40%. Slightly more increase was evident among students in Mrs. Preisig's Level A group (see Figures 4 and 5).

**Percent of Students per Number & Operations RIT Range  
Preisig – Level A**



*Figure 4 – Preisig ~ Level A ~ N&O RIT Ranges*

**Percent of Students per Number & Operations RIT Range  
Control – Level A**

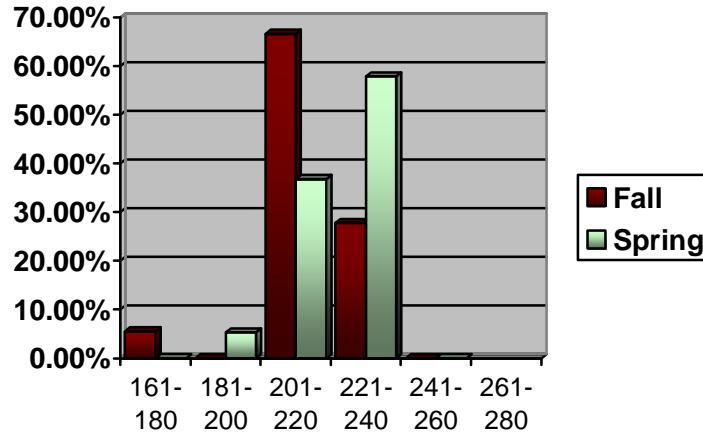


*Figure 5 – Control ~ Level A ~ N&O RIT Ranges*

Upon examining this same data among students in the Level B groups, different results can be noted (see Figures 6 and 7). In the fall session of MAP testing, 72.1% of Mrs. Preisig's Level B group achieved scores below the 220 range in the area of number and operations, and 27.9% scored in the 221-240 range. By the spring session of the test, the percent of students scoring within the 221-240 range increased dramatically to 57.9% of students. More significant increases were seen among students in the Level B control group, with the percent of students

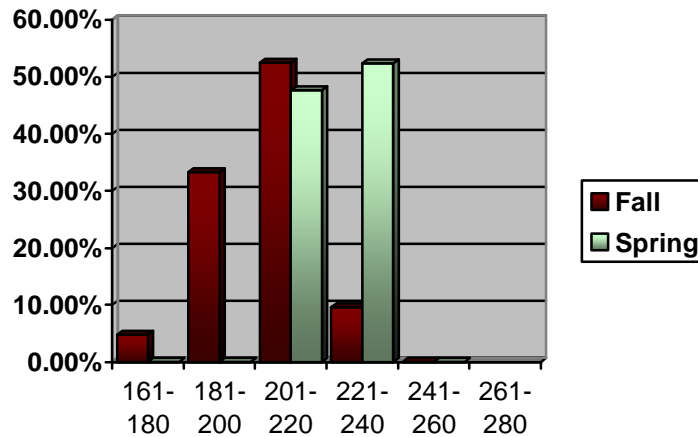
performing in the 221-240 range increasing from just 9.6% to 52.3%. However, it is important to notice that students in the control group performed at lower levels in the fall session when compared to those in the experimental group.

**Percent of Students per Number & Operations RIT Range  
Preisig – Level B**



*Figure 6 – Preisig ~ Level B ~ N&O RIT Ranges*

**Percent of Students per Number & Operations RIT Range  
Control – Level B**



*Figure 7 – Control ~ Level B ~ N&O RIT Ranges*

### Investigating Student Attitudes and Motivation

In order to investigate student attitudes and motivation, students in all groups were given a final survey that had twelve questions (see Figure 8). Questions most relevant to this study



included questions 6-10 dealing with fractions and overall attitudes regarding math instruction. Student responses toward these questions tended to support the hypothesis in regards to students' motivation in the area of fractions (see Figures 9 and 10). When compared to students in the control groups, more students in Mrs. Preisig's classes reported feeling comfortable when working with fractions and fewer students reported an inability to solve problems that involve fractions. Though slightly more students in the Level A control group agreed with the statement, "Math is fun," significantly more students in Mrs. Preisig's Level B group agreed with this statement when compared with the Level B control group. Students in Mrs. Preisig's Level B group also remarked on their love of the using the SMART Board interactive whiteboard in the free response section of the survey. Among those in the Level A groups, more students in Mrs. Preisig's group reported that problems involving fractions were easy.

<b>Math Student Survey</b>	
Use the following scale to respond to the statements below.	
<b>1 Strongly Disagree * 2 Disagree * 3 Neutral * 4 Agree * 5 Strongly Agree</b>	
1. I am good at Math.	_____
2. I enjoy learning new things.	_____
3. I love solving problems.	_____
4. Math makes me nervous.	_____
5. I have a hard time solving word problems.	_____
6. I feel comfortable working with fractions.	_____
7. I cannot solve problems that involve fractions.	_____
8. I feel confident about my ability to do math.	_____
9. Math is fun.	_____
10. Problems involving fractions are easy.	_____
Please answer the questions below in complete sentences.	
11. What was your favorite thing about Math class?	
12. What was your least favorite thing about Math class?	

Figure 8 – Math Student Survey Questions

**Math Student Survey Results  
Level A Groups  
Spring 2007**

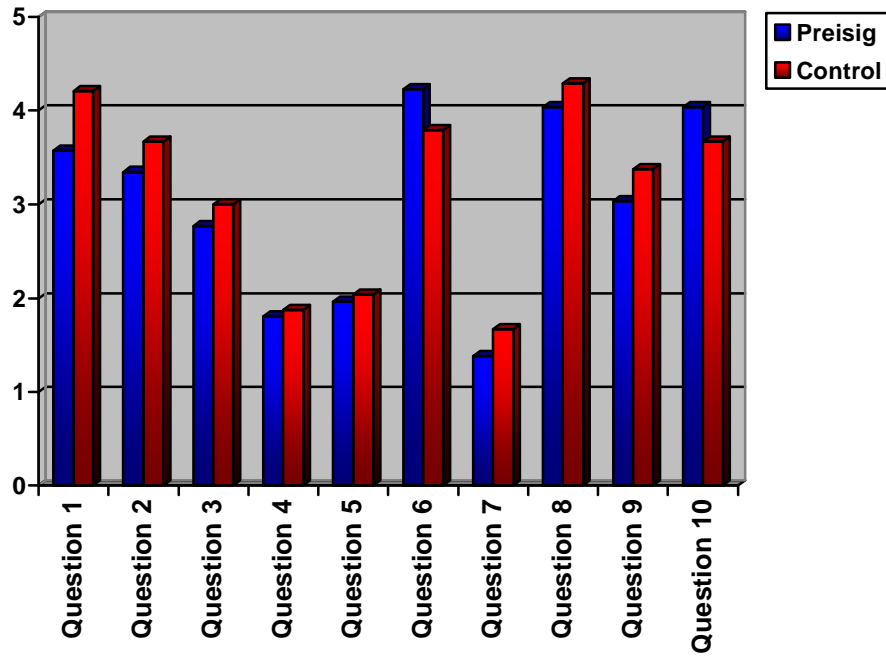


Figure 9 – Level A Group Survey Results

**Math Student Survey Results  
Level B Groups  
Spring 2007**

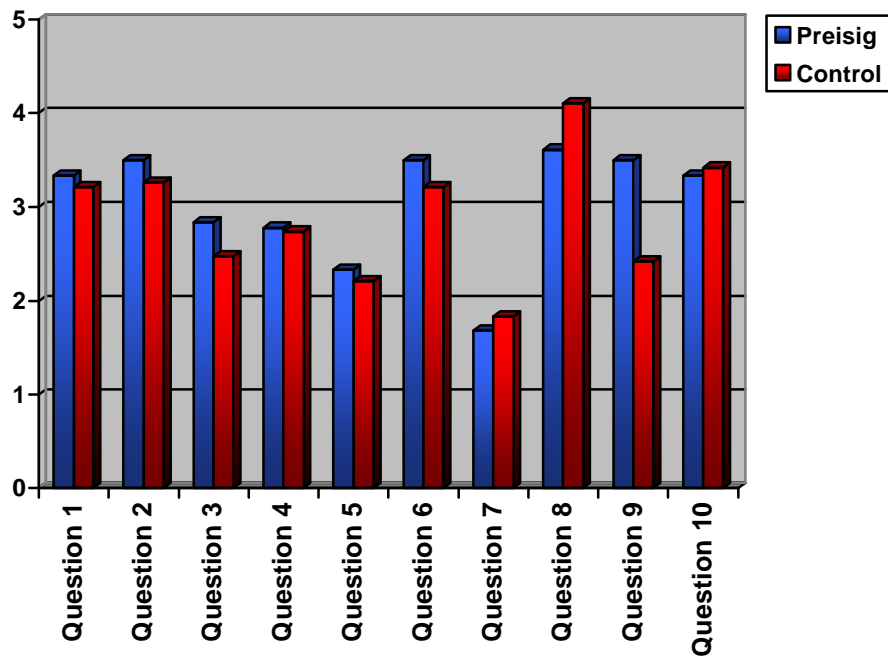


Figure 10 – Level B Group Survey Results

## Conclusions

Has the SMART Board interactive whiteboard demonstrated an ability to improve student performance and motivation in the area of fraction and number relationships? In examining the data collected during this study in regards to student performance and attitude toward fractions, the answer appears to be “yes.” Evidence to support the hypothesis was discovered upon evaluation of the pretest and posttest scores on the fraction and number relationships unit test, results from the number and operations section of the Measures of Academic Progress, and student responses on the final survey. Mrs. Preisig observed an increase in students’ enthusiasm and excitement during lessons involving use of the SMART Board interactive whiteboard, especially at the start of this study. This was especially evident among students in the Level B group.

Controlling variables between Mrs. Preisig’s groups and the control groups proved to be quite challenging due to differences in scheduling, planning, teaching style, teacher personality, and classroom social dynamics. Therefore, it is difficult to state with certainty that using the SMART Board interactive whiteboard as a tool in the mathematics classroom was the direct cause of the increases in student performance and more positive attitude toward problems involving fractions. Future studies could examine the same hypothesis in a heterogeneous setting. More reliable data could be gathered if the same teacher was utilized for both the experimental and control group, eliminating the impact of teaching style and differences in classroom settings.

## **Bibliography**

Jonassen, D. (2000). *Computers as Mindtools for School*. Columbus, OH: Merrill/Prentice Hall.

Martinello, M. L., & Cook, G. E. (2000). *Interdisciplinary Inquiry in Teaching and Learning*. Upper Saddle River, NJ: Prentice Hall.

Paige, Rod. (2004). Office of Educational Technology. *Toward a New Golden Age in American Education: How the Internet, the Law, and Today's Students are Revolutionizing Expectations*. Washington, D. C.: U. S. Department of Education.

Tate, Marcia. (2003). *Worksheets Don't Grow Dendrites*. Thousand Oaks, CA: Corwin Press, Inc.