The Effects of Mimio Interactive Technology on Student Achievement in Middle School Science

An Action Research Paper

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By

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Abstract

As desired learning outcomes in the Sciences continue to evolve and change to meet an exploding amount of innovation and new ideas, educators seek to find new ways to engage, interact, and deliver content to their students. Unfortunately, the pedagogical models used in most middle school Science classrooms are outdated and not conducive to assisting students to meet the learning outcomes set forth by state and national standards. In this regard, new tools which allow teachers to foster an inquiry-based, constructivist learning environment in Science are surfacing in schools. Interactive whiteboards allow teachers to teach more efficiently, but there is limited research aimed at the direct effects this sort of technology has on student achievement on a small scale. Using a pre-test/post-test method and systematic classroom observations, the researchers conducted an experimental data comparison on student achievement in a classroom using Mimio Interactive Technology. After final data analysis, it was found that using Mimio interactive technology on a small scale had little effect on student achievement, despite observation of improved environmental behaviors in the classroom.

Introduction

The U.S. Department of Education published the *Trends in International Mathematics and Science Study* (TIMSS), which outlines synthesized data from more than sixty countries worldwide and documents the achievements of students in Math and Science. In its 2011 study, 8th-grade science students in the United States are reported to have not performed as well on benchmark exams as students in nine other countries, including Japan, Korea, Finland, and England. The need for effective tools in science classrooms in this age group is starkly apparent, as educators aim to lessen or overcome this gap. In the 21st century, teachers struggle to keep up with emerging technologies while being mindful of curriculum and standards. An action research project was designed and implemented by a colleague and myself to further investigate this emergent form of instruction.

Review of Literature

Science teachers maintain an advantage over teachers of other subject areas in that they are more inclined to use educational technology in their classrooms (Efe, 2011). Technology can impact student learning in a positive way, and its use is most effective when it is used regularly and its use is closely tied to curriculum objectives (Geer & Sweeney, 2012). Students are comfortable with the presence of technology in the classroom, and are in need of teachers who have moved beyond thinking of computers as merely tools, and now consider them a vehicle to support new educational concepts and higher order thinking (Srinivasan & Crooks, 2005). Interactive technology and the use of simulation is a way to involve students in scientific inquiry.

Observations and experiences take place in a more organic, relevant way, which allows for deeper cognitive understanding (Bruner, 1973). Integrating interactive technology into the science classroom may allow teachers to meet standards while granting students opportunities to perform higher-order thinking tasks, work collaboratively, and learn in a project-based environment. In turn, a gain in student achievement would be a likely outcome of this shift in methods.

Effective teaching of the Sciences requires that students see relevance in the subject matter, make connections to the content from their own lives, and build a meaningful relationship with the curriculum through supportive guidance (Mitchener & Jackson, 2011). Successful science teachers often implement personal relevance, student negotiation and shared control into their classrooms, patterning their lessons from a constructivist point of view (Savasci & Berlin , 2012). To this extent, allowing students to take on a more participatory role in the science classroom through the use of interactive technology fosters a deeper understanding and appreciation of the subject matter. According to Bagley and Hunter (1992), Students who participate and are engaged by solving meaningful problems become part of the scientific processes which they study, and take on an active role as a participant instead of an observer. As a supplemental advantage, computer assisted teaching has been observed to increase student success (Chang, 2002; Guzeller & Dogru, 2011).

Emerging research in this field indicates that computers and interactive whiteboards are considered useful tools by students and teachers alike (Geer & Sweeney, 2012). Although benefits of computer simulations and interactivity in science classrooms may exist, research does not provide strong evidence of these tools enhancing student learning. However, the true value of these tools may be hidden in unexplained variance. In particular, the quality of the planning and implementation of the integrated tools may greatly affect the student outcomes (Eskrootchi & Oskrochi, 2010; Quillen, 2011). For this reason, more research is justified to study whether interactive technology can positively affect student learning in science when presented by an experienced, enthusiastic, and motivated teacher.

The purpose of this action research was to gain more understanding of the effects and future uses of interactivity in science classrooms. More specifically, questioning the effect of interactive whiteboard technology and its associated supporting devices on student achievement in 8th grade science is a timely inquiry. Through a review of literature and preliminary planning, we hypothesized that the use of interactive white board technology in an 8th grade science classroom improves student learning as measured by test scores.

Methods

Our mixed-methods approach used a combination of pre- and post-test raw data and repeated systematic passive observation sessions. The testing, an 8-question quiz administered and scored by the teacher, was a CSCOPE (pre-approved science curriculum) pre- and post-test from a two-week standalone unit on Earth Cycles. Our systematic observation form was adapted from Flanders (1970), and required the passive observer to look for ten different interactions/instances in the classroom, both on the part of the teacher and the students. These included questioning, answering questions, hands-on, off-task, and other related classroom actions (see Appendix A). Our subjects are approximately 120 eighth graders at a junior high school in Wichita Falls, Texas. All have the same teacher for their Science period.

As part of our research, we focused on a specific set of interactive tools which were currently in use in one of our local middle schools. The *Mimio* technology suite consists of an interactive whiteboard, a projecting video camera, portable smartpads, and a set of handheld voting units. The classroom was equipped with all of these items, and the teacher was extensively trained in their use.

As part of our procedure, our participating teacher agreed to teach her Earth Cycles unit normally, but omitted the use of the Mimio technology tools in her 4th period class. All classes received the same pre- and post-test, and are taught the same content as set forth by CSCOPE. During passive observations, the researcher observed both the 2nd period and 4th period class on the same days. At the outset of the project, we aimed to have completed observations on twelve different schools days, but because of circumstances out of our locus of control, we were only able to observe on three different school days. Our presence in the classroom was solely dependent on our participating teacher, who assured us she would allow us to observe as much as possible, while keeping in mind her obligation to prepare her students for STAAR testing less than 60 days from our starting date.

Student data was handled in an ethical manner, and an IRB review exemption was obtained from the Human Subjects in Research Committee at Midwestern State University (see Appendix B). The raw pre- and post-test data had the student names and ID numbers removed by the participating teacher, which allowed complete anonymity. During the passive observation sessions, we did not employ the use of audio or video recording, and did not record any identifying student information. All data was used in-context only, and will not be used or specifically referenced in any future projects we may undertake.

Results

To analyze the quantitative data, we created a statistical mean score and standard deviation for each class period, showing not only the scores themselves, but the gain in scores between pre- and post-testing. By using four different experimental classes, we were able to select the class with the greatest gains to compare against the results of the control group (the 4th period class). We chose to make this comparison after we analyzed the quantitative data and noticed it did not support our hypothesis. The experimental group with the greatest achievement gains was the 2nd period class.

The pre-test scores showed that the experimental group went into the Earth Cycles unit with more background knowledge (see Figure 1). Their average correct answer percentage was 57%, or an average score of 4.6 out of a possible 8 points. The control group showed less background knowledge at the time of the pre-test, as shown by the average correct percentage of 48%, or 3.9 out of 8 points. The standard deviations in the two datasets were not significantly different.

Figure 1

Pre-test scores

Class Period	Average	Average %	Standard Deviation
2nd	4.6	57%	1.6
4th	3.9	48%	1.4

Upon examination of the post-test scores, we quickly noted that the test results did not support our original hypothesis. The final correct percentages for each class only differed by two-tenths of a point, but because the control group came into the project with less background knowledge, the gains were greater for that class.

Figure 2

Post-test scores

Class Period	Average	Average %	Standard Deviation
2nd	6.2	78%	1.7
4th	6.4	80%	1.3

The control group in our research not only achieved more gain overall, the average correct percentage for their post-test was slightly higher than that of the experimental group.

Figure 3

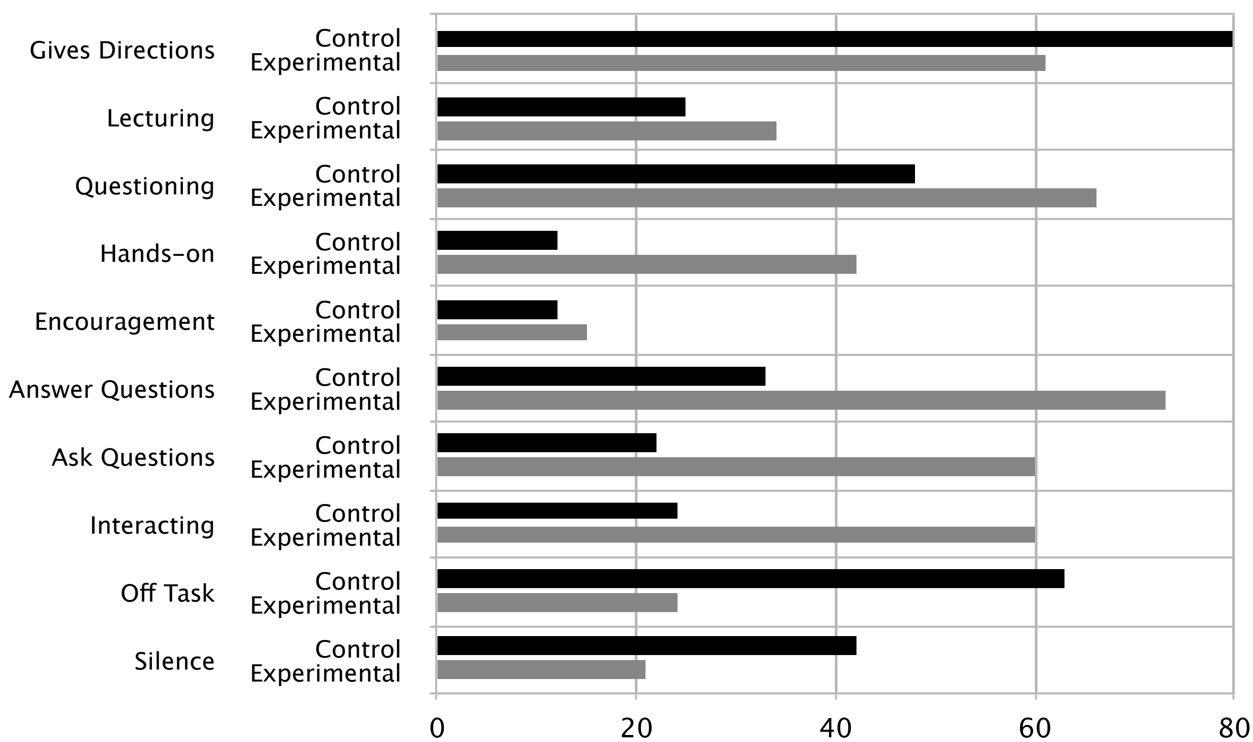
Gains in Scores

Class Period	Average	Average%	Standard Deviation
2nd	+1.6	+21%	+.1
4th	+2.5	+32%	-.1

When reviewing the qualitative data, we examined the total number of observations of different types. On the systematic observation form (see Appendix A), the observer must look for and record ten different things that happen often in the typical classroom. On our form, the first five actions are teacher-based, and the latter five are student-based. When totaling the observations, we noticed that the control classroom had more occurrences of teacher generated directions and off-task behavior among students. This group also had low occurrences of hands-on teacher contact, and students asked far less questions and interacted less. This raw data lends itself to a more traditional lecture environment where the instructor delivers the lesson and initiates and dominates most of the discussion.

On the contrary, the experimental group exhibited a pattern of frequent teacher generated questions. Correspondingly, the amount of questions that students answered aloud in this classroom was also quite high. Students were also off-task much less, and had more instances

Figure 3: Systematic Observation Totals



with interaction amongst peers. We also observed that students in the experimental classroom asked far more questions than the students in the control class. The data presented here is indicative of an inquiry-based, interactive, engaged class. We agreed that these summative totals shown in Figure 3 accurately portrayed what we saw in the classroom during our three observation sessions.

Discussion

The results of this research study show that in this specific case, the use of interactive technology had little or no effect on the student outcomes as measured by testing. The validity of the results may have been affected by several external factors. First, we were only able to attend one two-week unit, as opposed to collecting data over several units of study of varying difficulty and scope. Collecting more data would have allowed us to identify possible trends that are hidden in the limited data of this study.

Second, our original plan to observe during twelve different class days was disrupted because the teacher experienced a serious family issue which arose just before the unit began, causing the teacher to have several absences. Also, she was understandably affected by the situation (lack of sleep, lack of concentration) and her teaching style may have been compromised. To add to our scheduling difficulties, the school principal insisted that we finish all classroom observation and data collection before the first week of March so that the teacher had ample preparation time for the upcoming state standardized test, which put us on a very tight schedule.

Last, the assessment tool used may not have been the best measure of learning outcomes in this case. Unfortunately, we had little control over any of the assessment tools selected because we did not want to disrupt the teacher's normal teaching flow and materials. The quiz, consisting of only eight questions, was identical in both the pre-test and post-test. The test, which is most similar to the instruction that the control group received, may be too simplistic and may not accurately measure the content gained in a more interactive environment. Again, more data would have fostered a greater confidence in the accuracy of the results.

There certainly are hidden benefits to using interactive technology such as Mimio in a classroom. As we observed, the teacher had far more time to interact and assist students when the interactive tools were used. She could provide individualized help and circulate throughout the class providing assistance. The Mimio tools shift the focus from the teacher to the student, and they seemed to enjoy themselves more in the interactive classes.

Another benefit that we observed is the efficiency in which the teacher could check for understanding and provide feedback to students. Use of the voting devices allowed her to immediately check for whole class understanding, which is a significant time saver. Also, the data the students were working with was located on the whiteboard, which could be manipulated real-time by any of the smart pads in order to gain a deeper understanding of the concepts. This was particularly helpful when discussing the moon phases in relation to tidal patterns.

Upon her review of the results, the teacher mentioned that these small-scale results didn't suggest the students gained more knowledge, but it certainly made her job easier. In the control group, she spent fifteen minutes of her prep period creating a large chart on the board using a yard stick and dry-erase marker. With the whiteboard, she could call up a table for student use for collaborative data recording with two clicks of a mouse.

The results of our action research lead us to several conclusions about requirements for this type of study and suggestions for future research. We felt that the incorporation of a longer data collection period and observation schedule would provide results with more validity. We also would suggest the use of student and/or teacher surveys which inquire about the benefits of interactive whiteboard technology and its accompanying tools. This may reveal hidden benefits which the data alone may not suggest.

We also recognize the importance of attempting to eliminate all barriers to the effective use of tools like Mimio. Teachers must be dedicated, well-trained, and confident in the possibilities these tools provide in order for them to be used effectively, and for results to be more representative of what knowledge students have gained from its use. Lastly, ensuring that researchers have an environment which is within the locus of their own control would contribute to a more complete, comprehensive result because the assessment tool used will be more suited to measuring the learning outcomes set forth by the teacher themselves.

We conclude that Mimio interactive technology certainly belongs in the classroom, and its benefits are apparent to teachers and students who use it. Further research is needed to explore whether its use in a classroom genuinely contributes to a greater amount of content knowledge and mastery of learning outcomes.

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Appendix A

Systematic Observation Form

Date of Observation: ____________ **Group: Experimental Control** Observing Researcher: ____________________

TEACHER OBSERVATION																																							
Gives Directions																																							
Lecturing																																							
Questioning																																							
Hands On																																							
Encouragement																																							
STUDENT OBSERVATION																																							
Answer Ques.																																							
Ask Questions																																							
Interacting																																							
Off Task																																							
Silence																																							

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Appendix B

Human Subjects
In Research
Committee

Institutional Review Board in
Compliance with 45 CFR 46

MSU Policy 2.37

MEMORANDUM

TO: Jessie Canaday
Allison Curry

CC: Darrell Mohr

RE: IRB Claim for Exemption - To what extent does the use of Mimio interactive technology increase student achievement in science?

DATE: February 8, 2013

Your proposal for research utilizing human subjects has been reviewed and determined to be exempt from further IRB monitoring of your research.

The number assigned this project is 13020501.

Please include this file number in any presentation or publication arising from this research. You may be required to place a copy of this letter within the thesis or other class, department, or college documentation.

Respectfully,

Laura C Spiller

Laura C. Spiller, Ph. D.
Chair, Human Subjects in Research Committee (IRB)