

Does the Use of the TI-Nspire Navigator in a High School Mathematics Classroom Increase Student Achievement?

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Dedication

“Give a man a fish and you feed him for a day. Teach a man to fish and you feed him for a lifetime.”

-Ancient Chinese Proverb

This action research is dedicated to all those who teach, to all those who bestow wisdom, and to all those who mentor. For the sharing of knowledge is one of society's most important responsibilities.

-P.T.W.

Abstract

With the ever changing landscape of American education, it is vital for schools to provide teachers and students with the latest forms of technology that can foster a positive learning environment for all students. The advancements that have occurred in technology and education have greatly helped both students and teachers have success in the classroom. In addition, with the increase in diverse learners and varying achievement levels found in each classroom, it is crucial for teachers to be able to modify their lessons and differentiate instruction so that all learners can achieve. One specific advancement in technology and education has been the Texas-Instruments product, the TI-Nspire Navigator. The TI-Nspire Navigator is a wireless device that connects to the back of the students' calculator. Connection occurs through a router and a laptop. Once connected, the teacher can send the students questions, quizzes, or data to the calculator instantly. At that point, students respond to the question by sending their results back to the teacher. The information is displayed on the laptop in an organized form. It is the goal of this study was to determine how the TI-Nspire Navigator affects student achievement in the classroom.

Specifically, this study analyzed the use of the TI-Nspire Navigator in two mathematics classrooms – one 9th grade Algebra Regents class and one 10th grade Algebra Extended Class containing special education students. Data was collected over a six week period, through student and teacher surveys, quiz/test results, and teacher observations. The researcher analyzed and observed how student achievement changed when the TI-Nspire Navigator was incorporated into the classroom. Furthermore, data was collected to observe its role in increasing student achievement for not just the general education student, but the special needs student as well.

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Using TI-Navigator to Increase Student Achievement

Introduction

Research Rationale

Students in the 21st century are growing up in a technologically driven society. It is important for schools to acknowledge this trend and adjust their instruction accordingly. Immersing students in a classroom rich with technology helps increase motivation and exposure to tools that are so prevalent in this day in age. In addition, technology in the classroom helps differentiate instruction so that all learners can be reached. One of the growing challenges schools face is educating all different types and ability levels of learners. Having technologically equipped classrooms can help the teacher modify instruction and present information through various types of media so that all students can learn. Technology today can help teachers deliver abstract concepts through visual, audio, or computer graphics and allow teachers to create lessons in an engaging way (Leh, Kouba, & Davis, 2005; Bouck, & Flanagan, 2009, p. 247).

One specific educational tool that can be used to help teachers reach all students is the TI-Nspire Navigator. This piece of equipment allows teachers to send questions, quizzes, and data directly to students' TI-Nspire calculators. When the question appears on the student's calculator, he/she responds and sends his/her result back to the teacher. This instantaneous response system allows the teacher to receive feedback from every student in the classroom, as opposed to just a select few. In addition, the responses show up anonymously, so students should have no anxiety about expressing their answer. The teacher can look further into the data and find out what each individual student responded with if need be. On the surface, this form of technology in the classroom has many benefits; increased student participation, immediate

feedback and insight, differentiation of instruction, and dynamic and rich activities, just to name a few.

East Meadow High School, my place of employment, purchased three sets of TI-Nspire Navigators in September 2010. Teachers received staff development and training on how to use and incorporate the TI-Nspire Navigator in the classroom. Over the past year, teachers in the math department have attended conferences and workshops on how to integrate this technology in the classroom. The opportunity to gain knowledge and experience using this technology was exciting and beneficial. I was eager to learn ways to utilize this technology so that my students could have a better classroom experience. This study's goal is to assess how the use of the TI-Nspire Navigator in a high school mathematics classroom can help student achievement. Through various methods of data collection, I will hope to come to a conclusion on to what extent the TI-Nspire Navigator improves overall achievement and success in the classroom.

Demographics

East Meadow is centrally located in Nassau County on Long Island, NY. The East Meadow Union Free School District has two high schools, two middle schools, and five elementary schools. Most of the students come from middle-class families. This study will be conducted in two mathematics classrooms at East Meadow High School. There are 407 students in the freshman class, 432 students in the sophomore class, 387 students in the junior class, and 416 students in the senior class. (EMHS Enrollment, 2011) 65% of the student population is Caucasian, 14% Hispanic/Latino, 17% Asian/Pacific Islander, and 4% African American. (EMHS Enrollment, 2011) For the 2010 school year, 57 students were suspended. East Meadow High School offers extended math classes for its special education population. These special education inclusion classes take Integrated Algebra over the course of two years.

Action Research Question:

Does the Use of the TI-Nspire Navigator in a High School Mathematics Classroom Increase Student Achievement?

This research has led me to propose the following action research questions:

1. How does the TI-Nspire Navigator affect student participation, interest, and behavior in math class?
2. Does the TI-Nspire Navigator have a positive effect on student test scores?
3. How does the TI-Nspire Navigator assist in educating students with special needs?

Review of the Literature

What is the TI-Nspire Navigator and Audience Response Systems?

The TI-Nspire Navigator is a Texas Instruments product that allows teachers to send information, questions, quizzes, and other activities directly to students' handheld TI-Nspire calculators. The necessary equipment are the wireless cradles that hook up to the back of the students' TI-Nspire calculators, a teacher laptop with TI-Nspire Navigator software, and a router with an access point. Once the class is connected, the instructor can send numerous activities and questions directly to the students' calculator. Then, students respond directly and instantaneously. Feedback is immediate and allows for 100% participation.

Specifically, the TI-Nspire Navigator offers numerous features that allow teachers to improve instruction in the classroom. The newest version of TI-Nspire Navigator supports click pad, touchpad, and CX handhelds. It is a fully wireless system, where each handheld has its own wireless cradle. Teachers can send, collect, and delete files. As well, teachers can quickly create questions and send them to each student to ensure student comprehension. Another feature is allowing any student in the class to become the presenter from their seat. Their calculator screen appears on the projected screen and they can "teach" the class from their own calculator. Overall, the TI-Nspire Navigator allows teachers to create engaging and dynamic instruction that fosters total participation from the entire class. (www.ti.education.com)

When creating lessons on the TI-Nspire Navigator, teachers can start with "Instant Assessment." This explains that all the different types of questioning that teachers can send to their students calculators. In addition to multiple choice questions, teachers can create true/false, agree/disagree, and open ended questions. This differentiation of questioning allows teachers to carefully design assessments to meet the needs of all learners. Additionally, the instant

assessment contains a feature called “self-check,” which allows students to work independently and submit answers that are automatically corrected. If they get the question wrong, they can go back and try again. It encourages students to work through problems on their own, and correct their mistakes. Another feature is the “quick poll,” where the teacher can send a question to all the students simultaneously and monitor the results. The teacher can see when and how many students have sent their responses, and also see how well students are understanding material. This is beneficial because students may be more comfortable answering a question anonymously as opposed to in front of the entire class. Also, it forces every student to participate. Often in large classes, it is hard to reach every student. Utilizing the TI-Nspire Navigator effectively can allow the teacher to ensure that all students are accounted for. These are the teaching practices that were thought of when No Child Left Behind was taken into action; a classroom environment that was conducive to all learners and each student was responsible for his/her own learning.

James Pellegrino and Edys Quellmalz, (2010) support that claim by explaining, “With growing class sizes, coupled with increasing numbers of special needs students in our classrooms today, it is difficult for the teacher to be able to reach out to all students, and ensure that each child has met the daily objective....” (p. 17). Certain technologies in the classroom, such as the TI-Navigator and other computer software, can help teachers reach all students in the classroom and receive immediate feedback on short assessments and questioning. No student is able to avoid responding, and each student is responsible for participating.

Pros of Audience Response Systems

Pellegrino and Quellmalz (2010) go on to state that

“Although early uses of technology in large-scale testing have focused on relatively straightforward logistical efficiencies and cost reductions, a new generation of innovative assessments is pushing the frontiers of measuring complex forms of learning. The computer’s ability to capture student inputs permits collecting evidence of processes such as problem-solving sequences and strategy use as reflected by information selected, numbers of attempts, approximation to solutions, and time allocation.” (p. 21)

By immersing students to this new form of learning, they are developing higher order thinking skills and becoming accustomed to new technological advances.

One study looked to analyze how Audience Response Systems (ARS) like the TI-Nspire Navigator can be useful in the classroom. The authors of this research are professors of education at North Carolina State University. The goal of their research was to determine if Audience Response Systems created a more effective learning environment for students in high school classrooms. The research explains that Audience Response Systems are devices that allow teachers to get instant feedback from students in the classroom. A benefit of this technology is that the responses can be collected and displayed anonymously, which is hoped to increase motivation and participation. John Conoley, professor of Education at the University of North Carolina at Chapel Hill, (2007) also noted that Audience Response Systems are beneficial in the classroom because it allows teachers to adapt lessons as the responses come in. If a class is struggling with a particular sub-topic of the lesson, technology like the TI-Nspire Navigator can help the teacher identify those weaknesses and address them.

Audience Response Systems, such as the TI-Nspire Navigator, offer many tangible benefits to both students and teachers. Conoley’s (2007) research explains that Audience

Response Systems are devices that allow teachers to get instant feedback from students in the classroom. Similarly, Mason and Bruning (2003) also did a study that supported Conoley's research. Their study found, through data collection and classroom experimentation that student achievement increased greatly when ARS were used in conjunction with daily teaching routines.

“There are documented advantages and disadvantages for using technology-based feedback. The ability to provide immediate feedback on all student responses is a primary advantage to using technology-based feedback (Mason & Bruning, 2003). Mason and Bruning also state that the most important outcomes of technology-based feedback are identifying errors, becoming aware of misconceptions and motivating further learning.”

When teachers can immediately see student errors and miscalculations, it allows for adaptation of instruction.

Another benefit of using ARS in the classroom is that retrieving student responses through technology provides an instant unbiased accurate assessment of student comprehension. In addition, teachers can modify instruction based on the immediate results obtained from the automated responses. (Conoley, et al, 2007) In contrast, a common practice for teachers to identify student comprehension is the use of exit cards. The teacher puts up a question or two that relate to the daily objective, and the students have to respond to the question before they leave, and the teacher collects the responses and grades them to assess if students reached the daily objective. Using this process, the teacher must wait until the next day to address the class on concerns or problems. The TI-Nspire Navigator can provide immediate feedback on student comprehension and allow the teacher to address those concerns that same class period.

Furthermore, Conoley (2007) states, Large-scale testing are just beginning to explore the possibilities of using dynamic, interactive tasks for assessing student comprehension and achievement. Under, No Child Left Behind (NCLB), accountability, a number of regulatory, economic, and logistical issues has limited the freedom and creative questioning that fosters true academic achievement. Standard, multiple-choice item formats continue to dominate high-stakes testing, resulting in an overreliance on simple, highly structured problems that assess simple facts and one-dimensional thinking. As supported by Stevenson (2009), true learning results from dynamic and rich problem solving abilities. (p. 120)

It is clear that there has been discussion of changing many state exams to computerized testing. Already, some industries have made that shift. Many medical, financial, and business competency tests are administered electronically. One article explains that paper tests are restricted to static text and graphics. Examinations on the computer can be adaptive and dynamic. For example, a test measuring language efficiency can not only assess how well students read and write, but can also test their ability to hear language through audio or video and respond to questioning. (Practical Considerations in Computerized Testing, 1). A computer based test can be a richer, more realistic experience that allows more direct measurement of the traits in question. The TI-Nspire Navigator can assess students with computerized testing and expose students to this growing area in education. Many students enjoy assessments on the calculator, as opposed to paper and pen exams. The TI-Nspire Navigator can turn abstract concepts into visually appealing graphics, and therefore make the learning process positive for students.

Similarly to Conoley's study, an editorial in *Newsday*, a newspaper on Long Island, N.Y. praised the use of standardized testing being done on computers. The editorial cited how the multiple choice exam was invented in 1914, in response to an influx of minority students and a

shortage of teachers. It was hoped that the multiple choice test would help students pass their courses so that they could graduate. Today, American's are still taking versions similar to these tests. The author, Cathy Davidson, writes, "...these tests were designed to measure 'low order' thinking among the masses...Now is the time to rethink how we assess learning for the challenges of the digital world that lie ahead." This editorial is useful to the research because it explains how multiple choice tests invented in the early 1900's were specifically designed to promote low order thinking so that the masses could graduate. This conflicts greatly with our shift to the new Common Core Curriculum, which stresses problems solving and higher order thinking. The TI-Nspire Navigator allows teachers to send quizzes and tests via the calculator, exposing students to the digital assessment that our country appears to be moving towards.

Walter, Bjorn, et al (2011), researchers for the Journal of College Science Teaching, go on to explain that large classrooms often limit interactions between teacher and student so greatly that it is often hard for both teacher and student to be successful in the classroom. It is easier to make large classrooms feel "smaller" and more connected. Using personal response systems, teachers can quickly access students' questions and answers instantly and provide immediate feedback. The article then explains how social interaction in the classroom is great for learning, and that these audience response systems allow for much more interaction between students and teacher than in the standard classroom. (Bjorn, Walter, et al, 2011, p. 17) The successful use of these response systems correlates nicely with many of the educational theories, such as generative learning.

Cons of Audience Response Systems

When working with any form of technology, it is important to realize that there will be occasional technological malfunctions, and this holds true with the TI-Nspire Navigator system.

There sometimes are connection problems and calculator problems that interfere with the use of the product. Teachers have to acknowledge this and always have backup plans if the technology malfunctions. Steve Jones, a high school mathematics teacher who also does research for Texas A&M University, discusses some of the problems he had when integrating the TI-Navigator into his classroom. “Going from the TI-83 Plus to the TI-Nspire is quite the change. The operating systems are completely different, and the learning curve for some students can be huge. The kids are excited to use them, but most grow frustrated quickly when they have no idea how to do something that was simple on the previous calculator, like bring up a graph.” Furthermore, Jones notes that connection problems often prevented the lesson from quickly taking place.

A study that parallels work done by Jones, Kay and Knack (2009) conducted a study that looks to identify individual differences and attitudes in using Audience Response Systems, such as the TI-Nspire Navigator. When introducing new technologies into the classroom, it is important to be mindful that not all students adjust to technology quickly. Different students will react differently to the TI-Nspire Navigator.

The results from their study indicate that males, students with high computer functioning levels, and students who traditionally do not participate in class had significantly higher positive attitudes towards Audience Response Systems. This study contributes many interesting insights to the field of Audience Response Systems. Their goal was to identify possible characteristics of students who would be predisposed to both liking and disliking Audience Response Systems. As a teacher, it is important to be aware of these types of students so that a proper learning environment can be achieved when working with Audience Response Systems. It also helps to know ahead of time what students are likely to experience difficulties with Audience Response Systems.

In an effort to determine whether personal response systems, combined with effective pedagogy, can help increase student achievement in an introductory biology classroom, a study was done by Walter, Bjorn et al (2011, p. 15). While this study focused on a science class, it can be similarly paralleled with a mathematics class. Faculty taught six to eight topics in biology by lecture or clicker case method, alternating the methods within the same course. Data include student responses to a survey questionnaire. Results indicate that students, especially women and non-science majors, were generally positive toward the use of both clickers and cases. This conflicts with Kay and Knaack's study, which found that males tended to like audience response systems more. It is important to keep in mind that not all studies will yield the same results, and from this contradiction, it is important to realize that all kinds of students may respond to audience response systems differently. It is impossible to predict which students will have pre-disposed problems with using this technology, so it is important to be observant and mindful at all times.

These studies are useful to this section of the research because it is important to realize that not all students are thrilled to use new technology in the classroom. Many students are intimidated and overwhelmed when introduced to new technology. With that being said, it is important to realize the different types of students that might be prone to being intimidated by this technology and adjust instruction accordingly.

Technology and the Special Education Student

Many students with disabilities need special accommodations in order to actively participate and engage themselves in the learning process. Students with special needs are often extrinsically motivated, and therefore rely on teachers, peers, technology, and manipulatives to motivate them. The TI-Nspire Navigator can offer that adaptive learning style that can keep

special education students motivated and focused. Being able to differentiate instruction through the TI-Nspire Navigator can greatly benefit the special education student.

The Individuals with Disabilities Education Act (IDEA) includes a mandate that requires assistive technology be made for every student with an Individualized Education Program (IEP). While the TI-Nspire Navigator has not reached a status where it is officially viewed as assistive technology, one could definitely make the case that the TI-Nspire Navigator is highly useful in helping special education students.

The 2004 reauthorization of the Individuals with Disabilities Education Act (IDEA) mandates that all students must have access to the general education curriculum, including higher level mathematics, and must also be taught using methods that have been proven successful. Since Algebra is a graduation requirement in not only New York, but in most states, all students, including those with disabilities, must take and pass Algebra in order to receive a standard high school diploma. All stakeholders in mathematics education - teachers, students, parents, and state and national officials - recognize a need for more effective mathematics education. Dr. Maxine Harper, professor of education at the University of Mississippi, performed a study that determined the effectiveness of TI-Nspire Navigator technology in helping students with learning disabilities and students who are “at risk” for academic failure. Results for the Intervention group indicate a highly significant change that aligned with the goals of the project—more agree with this statement: *I feel secure about trying new procedures on a calculator*. The primary strategic outcome goal was the discovery of the effectiveness of new technology in teaching Algebra to students who have learning disabilities or who are at risk for academic failure due to low socioeconomic status. The activity sought to broaden the participation of underrepresented groups by enhancing the quality of mathematics education

(specifically Algebra) received by secondary students with learning disabilities and students who are at risk for academic failure by providing innovative technology designed to promote their understanding of algebraic concepts and their enjoyment of Algebra and calculators.

As mentioned before, delivering instruction and lessons in a dynamic way can greatly help special education students who are extrinsically motivated, and need those hands on learning activities. Introducing innovative teaching methods and technology may ultimately promote students' success in Algebra, which is a necessary step toward graduation and possible entry into a STEM (Science, Technology, Engineering, and Mathematics) field of study after graduation. Currently students with learning disabilities are underrepresented in the STEM fields, and this project helps to create awareness of the underrepresentation of students with learning disabilities in Algebra classes. This project has important implications that will benefit society. Promoting success in the learning of Algebra will potentially raise the graduation rate of students with learning disabilities and who are at risk for academic failure. It would have been nice if this article gave more concrete evidence on specific areas of improvement instead of just general statement. Also, data such as test scores, student responses, teacher observations, etc. would have added to the credibility of the article.

Another benefit to TI-Nspire Navigator is adaptive testing and questioning. With the growing number of special needs students in the classroom today, the TI-Nspire Navigator helps diversify instruction and present material in many different ways, which can help all learners. Conoley (2007) explains, "When coupled with technology, such knowledge has propelled various advances in adaptive testing, including knowledge and skills diagnosis, the provision of immediate feedback to teachers and students accompanied by scaffolding for improvement, and

the potential for accommodations for special populations.” (p. 71) This supports the claims that technology in the classroom can be helpful in reaching all students. When used appropriately, technology can advance learning and stimulate interest into a topic. Technology is growing in every industry, therefore it is vital to get students comfortable with working with the latest technologies. It is hoped that in doing so, students will increase interest in the topic and see better results on assessments.

Aside from helping to promote motivation, the TI-Nspire Navigator can help modify instruction for the special education student. The self-check tool allows teachers to send each student a group of questions. Students have the opportunity to answer the questions and go back and correct their mistakes. (education.ti.com) This self-checking encourages the special education student go back and acknowledge their mistakes and make corrections. As is often the case, the special education student rarely goes back and checks his/her work. Using the self check encourages students to use the TI-Nspire Navigator as a self-correction tool.

TI-Nspire Navigator and Differentiation of Instruction

A main problem for educators today is being able to successfully differentiate their instruction so every student can meet the daily objective. With the growing number of special education students and students with learning disabilities, it is challenging for teachers to be able to find ways to ensure that all students learn. Howard Gardener’s Theory of Multiple Intelligences claims that students learn in many different ways, and anything worth learning should be presented in different ways. (Dodge, 2005, p. 4) Consistent with those claims, many multiple intelligence theories challenge the notion that students can learn in teacher centered classrooms and pen and paper exercises. Dodge goes on to explain that students should be

immersed in a dynamic classroom setting that presents information in a variety of ways and allows students to showcase their knowledge through multiple formats.

The TI-Nspire Navigator can be used in the classroom to create a learning environment described above. A study done by Roberta Pardo, a researcher at Chandler-Gilbert Community College in Arizona, looked to analyze the effect of the TI-Nspire Navigator and differentiation of instruction. Pardo found that the dynamic representation of mathematical concepts to be a major advantage of using TI-Nspire technology.

“TI-Nspire technology allowed students to visualize, in a dynamic way, tough to-learn concepts such as average rate of change and slope: the ability for students to also see slope as a fraction not only in the way it is entered into the calculator, but also in the subsequent answer. Another advantage is the technology’s ability to evaluate and solve a function graphically by grabbing and moving a point. This allowed students to make the connection that the point is related to the algebraic evaluation or solution. Students were able to quickly make connections that would otherwise take more time.” (Pardo, 2010, p. 2)

Pardo noticed that continual use of the Navigator in the classroom had a great increase on the level of participation and motivation. She noticed that students were working together and gaining a deeper level of understanding. To support that claim, Conoley’s (2007) study found that the TI-Nspire Navigator generates a deeper understanding by engaging all learners. Conoley’s work added to the claim that the TI-Nspire Navigator helps differentiate instruction and achievement for all learners.

Additionally, Kay & Knaack (2009) explain when using ARS,

“The principal advantage of using an ARS is that it gives instant feedback to both students and instructors on how well the entire class understands concepts being presented using multiple choice questions. Once this feedback is attained, a teacher can alter the course of instruction or students can work out misconceptions via peer or classroom discussion and further discovery.” (p. 17)

TI-Nspire Navigator and the Common Core Curriculum

In an effort to provide clear and consistent curriculum throughout the United States educational system, the Common Core Curriculum is being implemented. Already in place in New York elementary schools for the 2011-2012 school year, the Common Core Curriculum will be implemented in secondary schools beginning September 2013. The mission of this new curriculum is to provide a consistent, clear understanding of what students are expected to learn, so teachers, administrators, and parents know what they need to do to help them. Instead of having individual states set their own standards and curriculum, this action is an attempt to unify standards and ensure that all states are properly educating students and preparing them for life after high school. The standards are designed to be rigorous and relevant to the real world, reflecting the knowledge and skills that our young people need for success in college and careers. It is hoped that this consistent, challenging curriculum will help students be prepared and able to compete successfully in the global economy. (www.corestandards.org)

Some of the shifts in mathematics under the Common Core are improvements in coherence, fluency, deeper understanding, and application. According to the website, www.engageny.com, coherence between grade levels will be emphasized. For example, a topic such as fractions, which is covered in 4th grade, will be continued to be covered in succeeding years, continuously increasing rigor. The “dual intensity” shift explains, “Students are practicing

and understanding. There is more than a balance between these two things in the classroom—both are occurring with intensity. Teachers create opportunities for students to participate in ‘drills’ and make use of those skills through extended application of math concepts.” (corestandards.org)

This is relevant to educators because this new shift to the Common Core forces teachers to create lessons that are engaging and rich in nature. The shifts that are discussed in these two websites indicate American Education is stressing the importance of discovery and challenging problem solving. Teachers across the nation will have to collaborate on ways to plan lessons and activities to meet the standards set forth in the new Core Curriculum.

Technology such as the TI-Nspire Navigator is one tool, that when integrated into the curriculum properly, can help teachers design lessons that align with the Common Core Standards. The Navigator allows for students to be responsible for their own learning, by fostering participation and active involvement. George Whitehurst, a researcher for Texas Instruments, analyzed various studies on the use of the TI-Nspire Navigator in classrooms across the country. Whitehurst noted that the greatest gains when using the Navigator were found in greater student engagement, increased understanding of complex subject matter, increased interest and enjoyment, and promotion of class discussion and interactivity. (Whitehurst, 2003, p. 7)

Whitehurst’s findings are vital because they support the claim that the TI-Nspire Navigator is a tool that can help teachers design classroom activities that correlate to the Core Curriculum. All of the gains that Whitehurst found are areas that are discussed in the Common Core “shifts.” By analyzing studies that have used the Navigator in the classroom, it is clear from his research that those benefits include ones that are talked about in the Common Core. Along

with effective usage, the TI-Nspire Navigator can help teachers create lessons that are interactive and engaging, thus adhering to the Core Curriculum and its standards.

Overview of the TI-Navigator

Jeff Aureli, a high school math teacher in Canton, N.Y., used the TI-Nspire Navigator in his mathematics classroom to demonstrate shifts in quadratic equations. Students were challenged to send quadratic equations to the board that match given real life arcs, such as water fountains and a students' chin. Aureli (2010) commented that the lesson required a strong knowledge of shift changes. (pg. 2) He also noted that during the lesson the class was engaged and productive. This example of the TI-Nspire Navigator in the classroom provides further proof of how when used correctly, the Navigator can create dynamic learning activities and student centered lessons.

In conjunction to Aureli's research, a study done by Anjur Somwaya (2011), a researcher for the the American Physiology Society, noted that students generally have more success in classrooms when activities are student centered and rich in nature. By student centered, Somwaya refers to activities and learning that forces the students to create, interact, and be responsible for their own learning. This counters a classroom that is teacher centered, such as one that is lecture based or a teacher driven lesson. Using Somwaya's analysis, teachers should become aware that when designing lessons at all levels, it is important to create lessons that are rich and dynamic and forces students to drive their own learning. For example, in Somwaya's physiology class, which deals with advanced math and science students, one group was given an experiment, with complete rules and guidelines. The other group was not given a specific set of instructions – they were allowed to design their own experiment and come up with their own conclusions. Somwaya noted that the group that designed their own experiment and

was given less direction ended up achieving better results. (pg. 6) It is the assumption that forcing students to create and design their own learning process will help them with skill retention and overall comprehension.

This is useful to this research because as high school teachers, it is important not to “spoon feed” information to students. Creating lessons that are dynamic in nature and require students to hone a specific set of skills allow students to grow in the content area and experience a rich classroom experience. The TI-Nspire Navigator is a technological tool that helps teachers infuse technology and rich learning activities to ensure students receive the best education in their classroom.

In summary, students in today’s schools need to be exposed to information that is interesting, thought-provoking, and challenging. “Dynamic visualizations of scientific phenomena have the potential to transform how students learn and understand....” (Chiu, pg. 116, 2010) By integrating the TI-Nspire Navigator into mathematics classrooms, teachers are able create math activities that are engaging and can relate to young minds. By steering away from traditional lecture based lessons and delving towards classrooms that are connected and engaging is a great way for teachers to adjust to the new Common Core requirements coming down from the Department of Education. The Common Core Curriculum is a movement to unite education among states and help create a strong foundation in math skills for students. “The high school standards call on students to *practice applying mathematical ways of thinking to real world issues and challenges*; they prepare students to think and reason mathematically.” (www.corestandards.org) Proper use of the TI-Navigator is one tool that can help teachers foster a learning environment for students that is not only challenging, but engaging and interesting as well.

Methods and Procedures

This action research consisted of student and teacher surveys, and quizzes and test scores, and the researcher's observations during class regarding participation, engagement, behavior, and motivation. During this study, the researcher alternated days of using the TI-Nspire Navigator. It was hoped that the researcher would be able to discover a significant amount of data regarding the effect of the TI-Nspire Navigator on student achievement in the mathematics classroom. Overall, it was the goal of the study to determine if the TI-Nspire Navigator, when used in the mathematics classroom, improved student comprehension and overall achievement. Sub-questions were addressed as well, regarding the Navigator's affect on special education, behavior, and test scores.

The basis of this research was to determine if using the TI-Nspire Navigator in the classroom increased engagement and interest in mathematics, and in turn, then increased overall student comprehension. This action research was conducted in two Integrated Algebra classes. The first class was an Integrated Algebra Regents class (will be referred to as Algebra 1R), which was held during 5th period (10:27 AM – 11:11 AM). There were 26 students in the class, with one student being classified as special education and one student classified as 504. The class met one period daily. The second class was an Integrated Algebra Extended class (will be referred to as Algebra 2RS), which was held during 9th period (1:27 PM – 2:06 PM). There were 13 students in the class, with one student being classified as special education. All of these students in this class have been placed in an extended class due to their prior struggles in mathematics. This class met one period daily. They were in year two of the Integrated Algebra two year program for extended students. By performing this study in two different classrooms with two different ability groups, the researcher hoped to acknowledge not only how the TI-Nspire Navigator enhanced instruction for the general education student, but also for the special needs student as well.

Both classes will were exposed to the TI-Nspire Navigator and as such, were engaged in various exercises and activities. The use of the quick poll, self-check, and computerized quizzes will be used to gather data. The researcher continually made notes and observations regarding behavior, participation,

engagement, and overall achievement while the study is conducted. The goal of the study was to find a tangible link to whether or not there is an increase in overall achievement when the Navigator is used in class as opposed to when it is not used.

Both classrooms used in the study had SMART board capable technology. This study was conducted over a six week period beginning January 2012 and ending in February 2012. By gathering data from student surveys, teacher surveys, quiz/test scores, and researcher observations, the researcher hoped to discover a wide range of data that can help prove the aforementioned action research question.

Researcher Observations

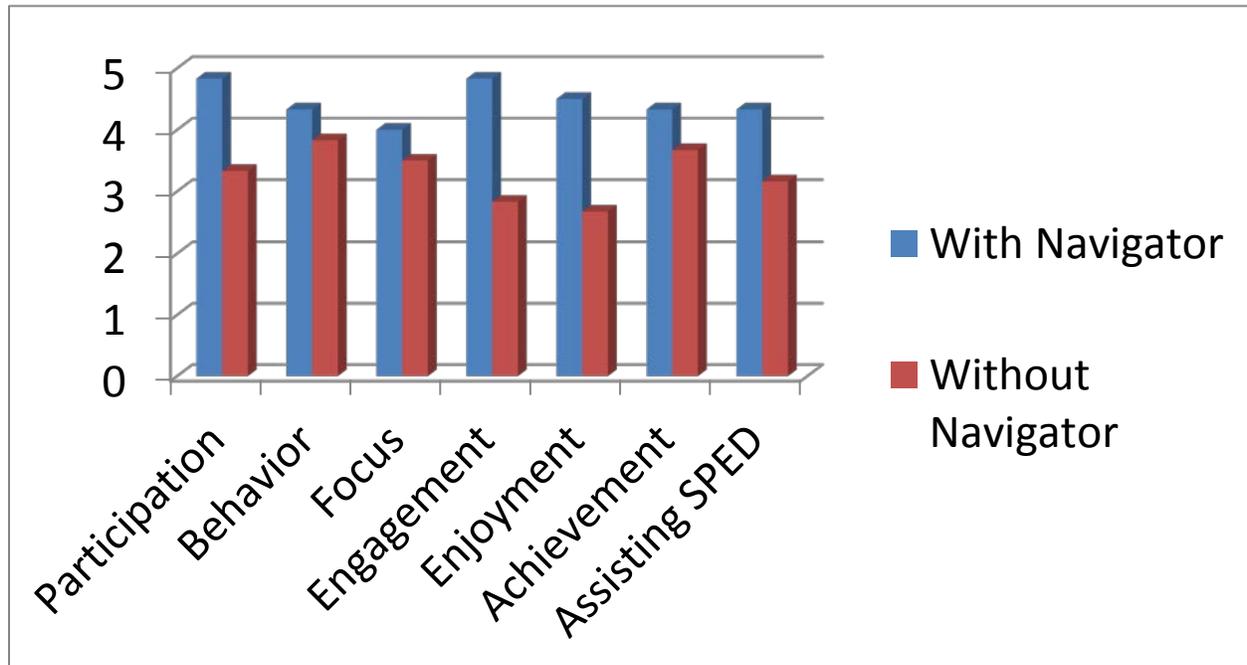
A critical component of this research was the researcher conducting weekly observations of the classes involved in the study. An on/off approach was used, where the researched alternated using the Navigator in the classroom on certain days, and using different methods of instruction on others. The goal was to determine, through observations, how the class was affected when the Navigator was used as opposed to when alternative methods were used. The observation log that was used (Appendix C), was based on a scale which scored categories on a 1-5 basis. The rankings are as follows:

1- Poor 2- Below Average 3-Average 4-Above Average 5-Exceptional

The researcher specifically honed in on 7 categories during the research. The categories are as follows: Participation, Behavior, Focus, Engagement, Enjoyment, Achievement, and Assisting Special Education Students.

The researcher conducted the observations in two separate classes. One Algebra Regents Class and one Special Education 10th grade Algebra class. It was hoped that by comparing two different classes of two different ability groups, one would obtain a deeper understanding of how the Nspire Navigator affects students of all abilities. Figure 1, shown below, illustrates the observations that the researcher made throughout the study on the Algebra 1R class.

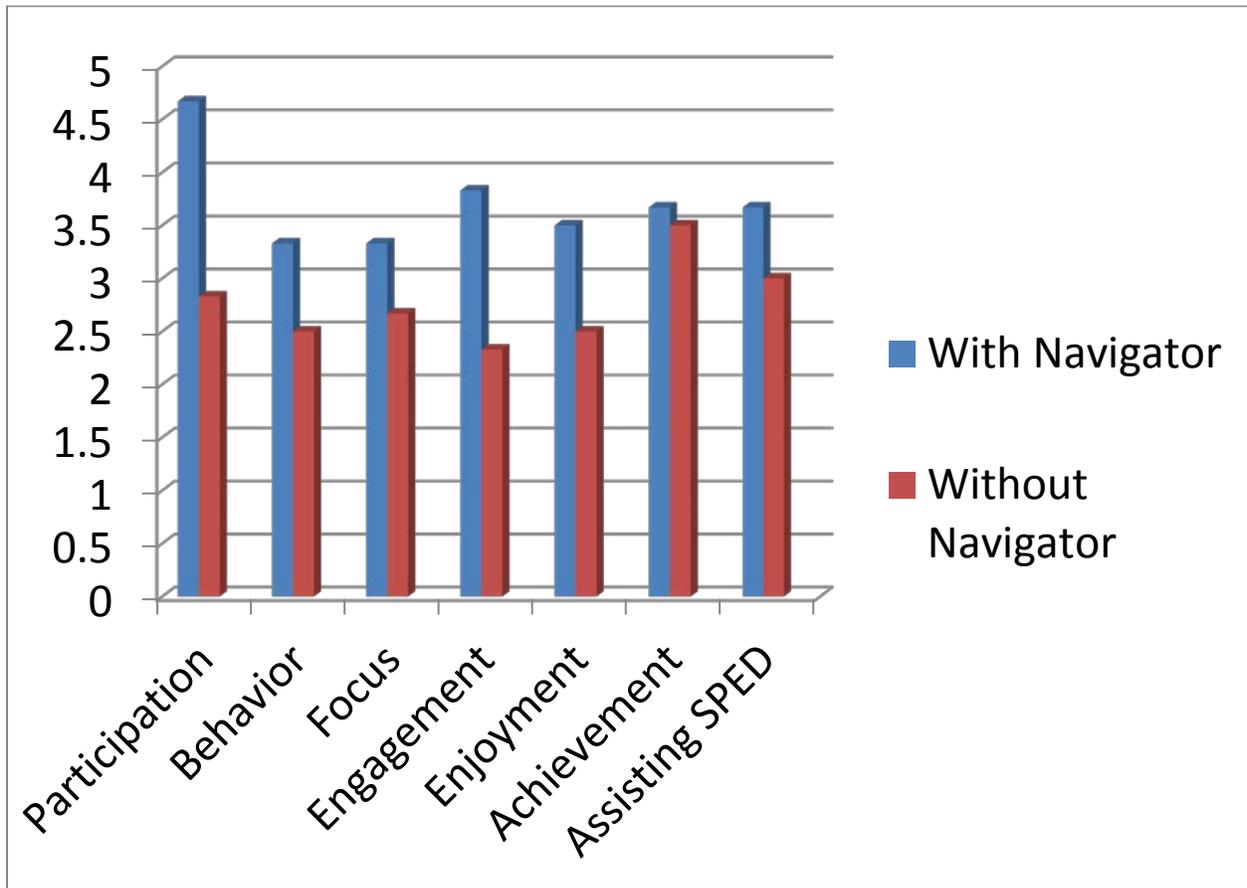
Figure 1: Researcher Observations (Algebra 1R)



While all categories saw increases when using the Navigator, it was interesting to see the largest improvements were found in the areas of participation, engagement, and enjoyment. Those categories saw improvements of roughly 1.5 points, on average. Behavior was not affected much since the class is consistently well behaved on a normal basis. It is worth noting that the Navigator's role in assisting special education students improved one whole point, on average, when using the Navigator during lessons. One potential explanation for this is the Navigator's ability to provide instant feedback of student data and assessment, which is extremely helpful when educating the special needs population.

The second class involved in this study underwent the same procedure. Using the on/off approach, the researcher tried to compare class activity when the Navigator was used as opposed to when it was not used. It is important to note that this class contains fewer students (13 compared to 26), students that struggle in math, and the class is held at the end of the day. Figure 2 details the results from the observation logs.

Figure 2: Researcher Observations (Algebra 2RS)



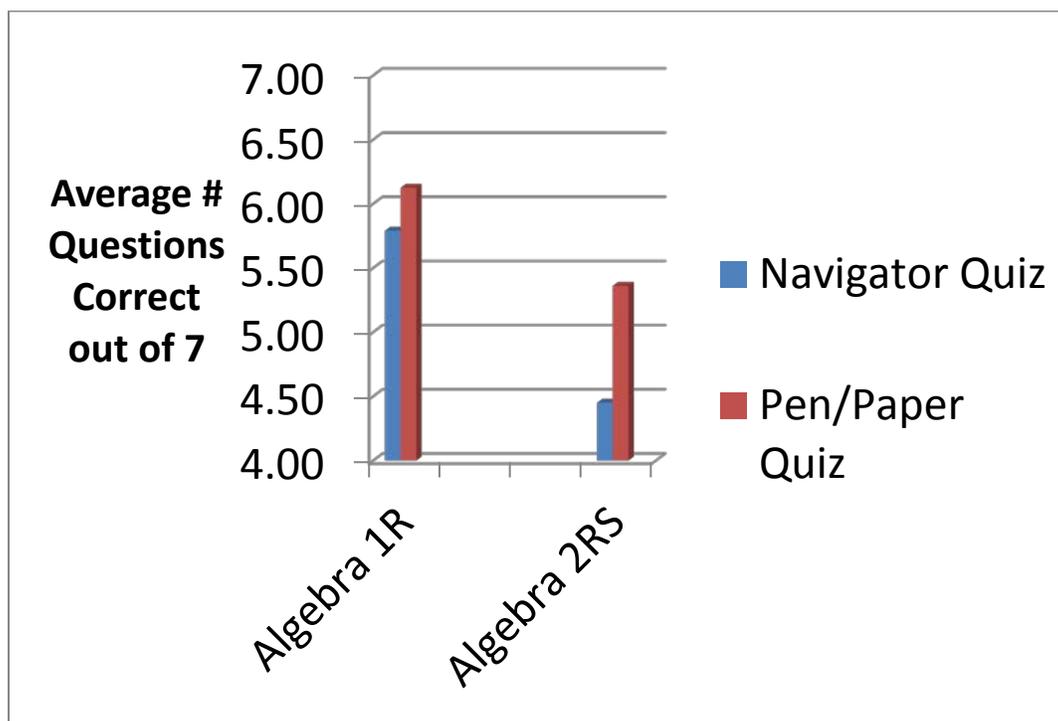
The data collected from the Algebra 2RS class was interesting and informative. There was a significant increase in student participation when using the Nspire Navigator in this particular classroom. On average, the researcher noted a 1.84 point increase in said category. This is a tremendous increase and the largest change in any category among both classes. It is logical to conclude that the Navigator helps promote participation among students who lack confidence in math class because of the ability to anonymously submit responses and being able to reach every student with a click of the mouse. Enjoyment and Engagement were also two categories that saw notable increases when using the Nspire Navigator. It is worth noting that there was not a significant increase in student achievement in this class. One possible explanation is that special needs students sometimes feel overwhelmed by this new technology, and therefore they are not fully prepared to grasp the concepts being delivered. In some cases,

students got frustrated using the technology because their usage skills were not on par with other students in the class. Overall, every category registered at least some increase, leading to believe that using the Navigator as a learning tool in the classroom can improve the students' learning experience.

Navigator Quiz vs Paper Quiz

One of the features that the Nspire Navigator offers is allowing teachers to send students quizzes or tests through the calculators. The students can respond to the questions on the calculator and the teacher instantaneously can collect student work with a mouse click. The computer automatically grades the quiz, which is extremely useful in assessing student achievement and comprehension quickly. As well, the results are saved in a portfolio, which keeps a running log of student grades. Computer based testing is an important aspect to analyze, because the State Education Department has been looking into changing standardized state exams to a computer based format. While there are many benefits to testing on a computer, such as easy grading, less paper, and cost efficiency, to name a few, it is also important to look for possible drawbacks to computerized testing that may lead to skewed results. The Nspire Navigator offered a chance to see how students fared on a computer based test compared to a standard pen and paper test. For this study, both classes were sent a quiz on the Nspire Navigator that had seven randomly selected questions from the curriculum. After students completed the computer based exam, they were given a paper quiz of seven questions that mirrored the computer based quiz. To ensure for consistency, the researcher created questions using the same exact New York State standards for both exams, to make sure both exams were of equal difficulty. (See Appendix D and E) It was reasonable to conclude that questions on both quizzes were extremely similar in content and therefore the data strictly measured how the format of the test (computer based vs. pen/paper) affected students' grades. It is important to note that the raw score on the exam was not the important part of this research, but the difference in the results between the two formats of the exam. Figure 3, shown below, shows the results from both classes on both types of exams.

Figure 3: Results from Quiz Analysis



These findings show that on average, students did not do as well on the Navigator quiz as compared to a traditional pen/paper quiz. Since the questions on both exams mirrored each other, the only variable that was in play was the format of the exam. One could conclude, using the data from these classes, that students as a whole performed worse on the computer based test. The Regents class answered approximately .335 fewer questions correct on the Navigator quiz, on average. That class works well with the Navigator and does not usually experience much difficulty when using the technology.

The alarming trend, however, was found in the extended math class. On average, they answered .91 fewer questions correctly when taking the Navigator quiz. Nearly one whole question lower is a large deviation. This group sometimes struggles with advanced technology and change in routine. The different format of the quiz clearly affected their results. When taking the pen/paper quiz, they answered a respectable 5.36 questions out of 7 correctly, on average. However, when taking the Navigator quiz that addressed the exact same learning standards, the average number of correct answers dropped to approximately 4.45, on average.

Teacher Surveys

Two groups of teachers were surveyed with the purpose of gaining insight to the advantages and disadvantages of using the TI-Nspire in the mathematics classroom. It would be foolish not to include direct insight from actual teachers who are using the product in their own classrooms. Since it is a relatively new tool, only five teachers from the participating school were able to be used for this survey. Fortunately, they were willing to participate in the anonymous survey (Appendix B). The second group of teachers is from a program in El Paso, Texas, which involves 14 schools, where Texas Instruments has, under the auspices of a large grant, supplied 54 classrooms with a class set of 30 Nspire CX handhelds and an Nspire Navigator system. I was able to gather surveys from a handful of these teachers that are using the Nspire Navigator daily in their classrooms, mostly filled with diverse learners of many ethnicities and abilities. My school district employs a Texas Instruments trainer, who is also doing work with this cohort, and he forwarded the researcher their completed surveys.

First, the teacher surveys from the East Meadow School District will be analyzed. Following that, the results from the teacher surveys from the program in El Paso, Texas will be analyzed.

When asked about how frequently the Navigator is used in their classroom, four out of five teachers from the East Meadow School District responded with one period a week, with all of them noting they wish they used it more. One teacher uses it 6 periods a week. When asked to elaborate as to why they don't use it as much as they would like, teachers cited difficulty in setting up the hardware and connectivity issues. Two teachers, moreover, admitted they are not fully comfortable teaching a majority of their lessons with the Navigator. A common thread among all participants from the East Meadow School District was that quick polls and Do Nows were their favorite use of the Navigator. Many cited the Navigator's ability to obtain quick assessment was its greatest feature. Interestingly, three out of five teachers mentioned the word "engaged" when answering the question addressing the Navigator's greatest

feature. For three teachers to mention the exact same word for an answer indicates that there is a strong link between using the Navigator in class and student engagement.

For the question addressing how student participation is affected, five out of five participants acknowledged that student participation increased when using the N-spire Navigator. Similarly, five out of five also noted that positive behavior and focus increased when the Navigator was used in the classroom. The survey also asked teachers to respond to how the Navigator affected test scores in the classroom. Three out of five teachers responded by saying there was little to no correlation and that it was not possible to make a connection at this point. This is interesting because there is much discussion in education of shifting towards computer based testing. Analyzing how a computer based tool like the Nspire Navigator affects student test scores can lead the way to determining how successful a computerized test might be for assessing student growth and achievement.

When teachers were asked to list any problems or difficulties with the Nspire Navigator, five out of five teachers responded that technical difficulties were the biggest hurdle; Connectivity issues, students having trouble logging in, being intimidated by the technology, and creating computer based lessons were the common responses. One teacher is quoted, "...setting up the system is preventing me from using it." This emphasizes the point that proper staff training is essential to ensuring that teachers are equipped to use the product in a way that will enhance student learning.

The teacher surveys from the teachers from the program in El Paso, Texas were also used in this study. When asked about how frequently the Navigator was used in their classroom, 3 out of 5 teachers responded with 3-5 hours a week. One teacher uses it 5-7 hours per week and another uses it 15-20 hours a week. All teachers responded by saying they wish they had a chance to use it more in their classrooms. All teachers indicated that they use the Quick Poll feature and the lesson templates provided by Texas Instruments. The result from the question on how the Nspire Navigator has affected their class was extremely useful to this study. Three out of five teachers used the words "self-guided" and "student centered." It was clear that these teachers noted that using the Navigator in class created a classroom that made learning more dynamic and interactive. One teacher specifically noted an increase in participation.

“They [students] all like to have input in class discussion.” The Nspire Navigator makes large classrooms feel smaller since every student can have their voice heard.

When asked to identify benefits of the Navigator in their classroom, all teachers indicated there was some form of a positive effect. Specifically, student centered learning and allowing all students to quickly participate were common themes throughout the responses. When asked to explain any problems or negative aspects of the technology in class, four out of five teachers indicated technical problems as the main culprit. Specifically, successfully connecting the entire class to the network and battery life of the product was mentioned.

Since the TI-Nspire Navigator has many features for educators to use in the classroom, the researcher asked the teachers to identify what they felt was the most useful feature offered by the Navigator. One teacher explained how she is able to do a quick do now at the beginning of class that involves the whole class. Another teacher mentioned that the Navigator allows her to “accommodate all levels of learning in one single classroom.” Such ability to differentiate instruction is crucial to good teaching and is one of the huge benefits of the Navigator. Finally, one teacher noted that the ability to create a student portfolio on the computer that includes current grades and instant assessments was the most useful feature.

This group of teachers was asked to respond to how the Nspire Navigator has affected their classroom in a variety of categories. For participation, five out of five teachers noted an increase in overall classroom participation. Four out of four teachers noted an increase in positive behavioral tendencies, with one teacher electing not to respond. On whether or not the Navigator affected student test scores, three out of five teachers felt that it was too early in the program to make a conclusion. Finally, a majority of the teachers explained that using the Navigator to help align to the Common Core Curriculum was a difficult transition but could be achieved with time and training.

Student Surveys

A vital part of this research was to analyze student opinions of the Nspire Navigator through a student survey. The researcher created a ten question survey (Appendix A) that questioned the students on

their thoughts regarding the Navigator. Students were reminded that this survey was anonymous and in no way would anything written affect their grade in the class. The researcher conducted student surveys from the two classes involved in the study with hopes of finding student feedback from the general education student as well as the student in the extended math program. The results were very useful for the study. One specific question asked students to respond if they would prefer to use the Nspire Navigator more often, less often, or the same amount. Figure 4 and Figure 5 show the results from that question.

Figure 4: Student Responses- Desired Usage of Navigator (Algebra 1R)

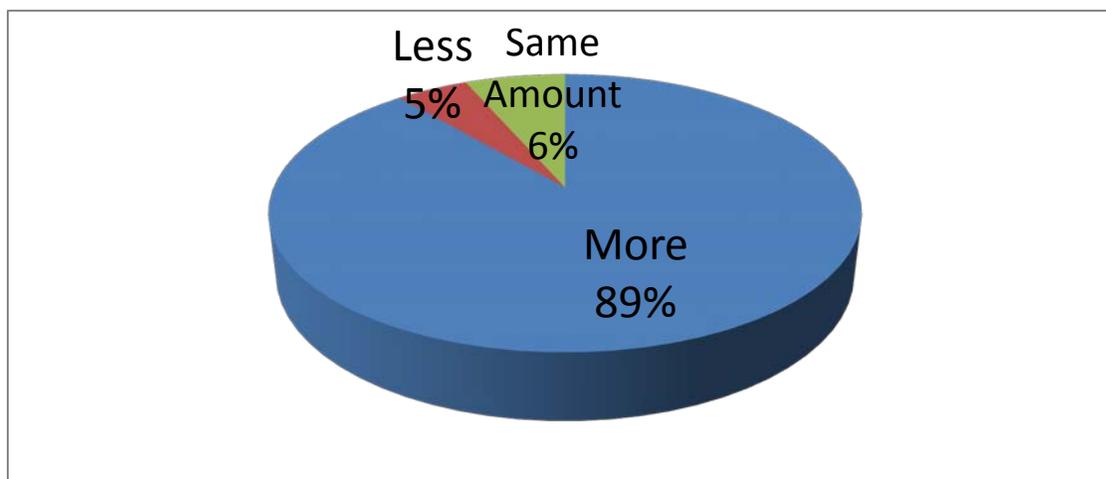
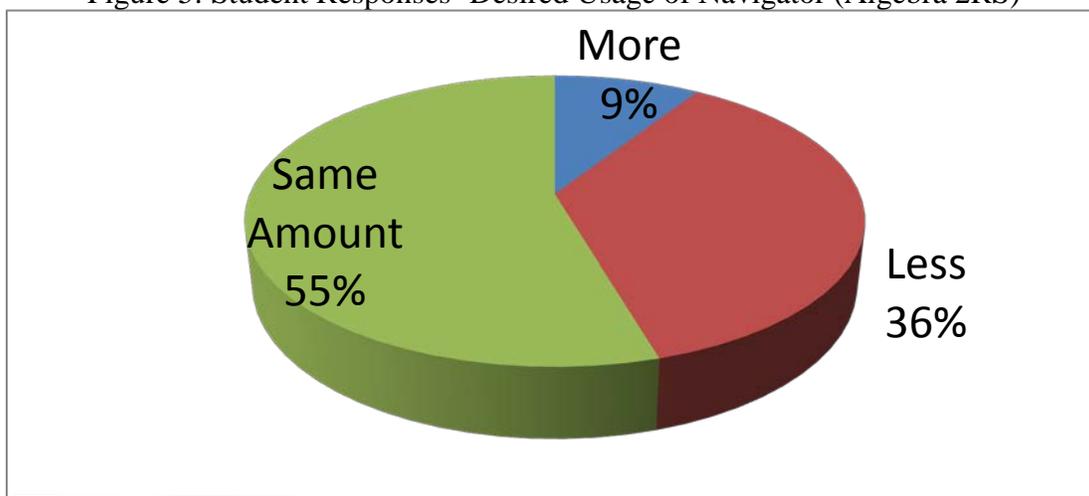


Figure 5: Student Responses- Desired Usage of Navigator (Algebra 2RS)



It is interesting to notice how the Algebra 1R class responded strongly for more Navigator activities in the class. In contrast, the Algebra 2RS class, all but 9% preferred the same amount or less Navigator activities. Only 5% of the Algebra 1R class indicated they would prefer less Navigator activities, compared to 36% of the Algebra 2RS class. One 2RS student was quoted as saying, “It is hard to use, more complicated, and more difficult than regular activities.” It is clear that there is a usage concern with the Navigator- some students clearly have trouble adjusting to the different method of instruction, especially those students who struggle in math or are special education.

The next question that was analyzed was, “What was the most popular feature of the Nspire Navigator?” Choices included Quick Polls (a quick, instant question sent to calculators and then sent back by students), Self-Check (where students can work on a document and check their answers as they go), and Calculator Quiz (as opposed to taking a quiz by pen/paper). Figure 6 and Figure 7 display the results.

Figure 6: Favorite Feature (Algebra 1R)

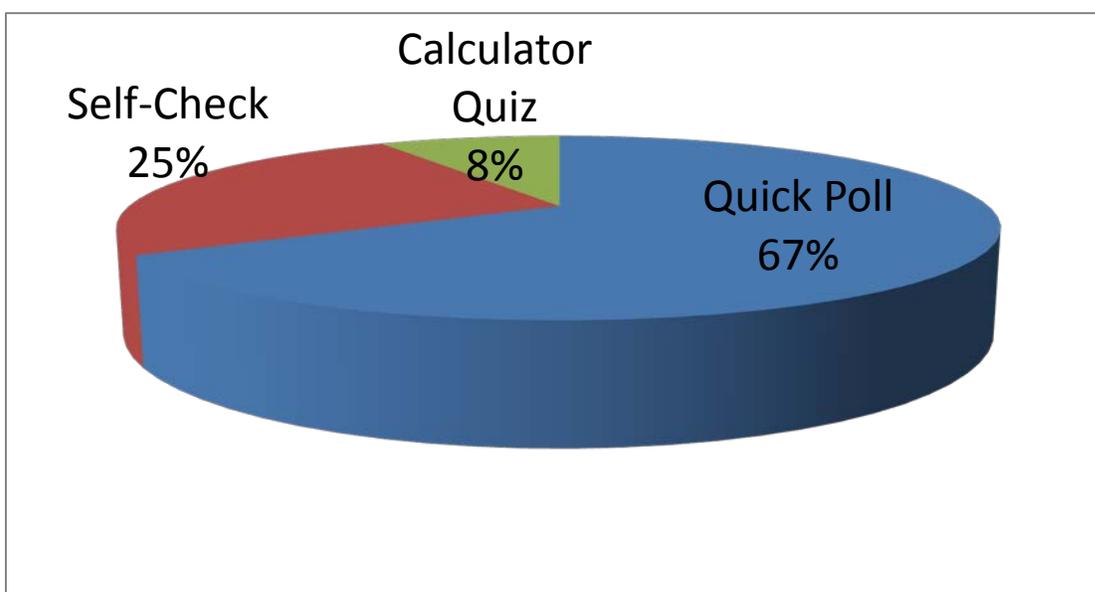
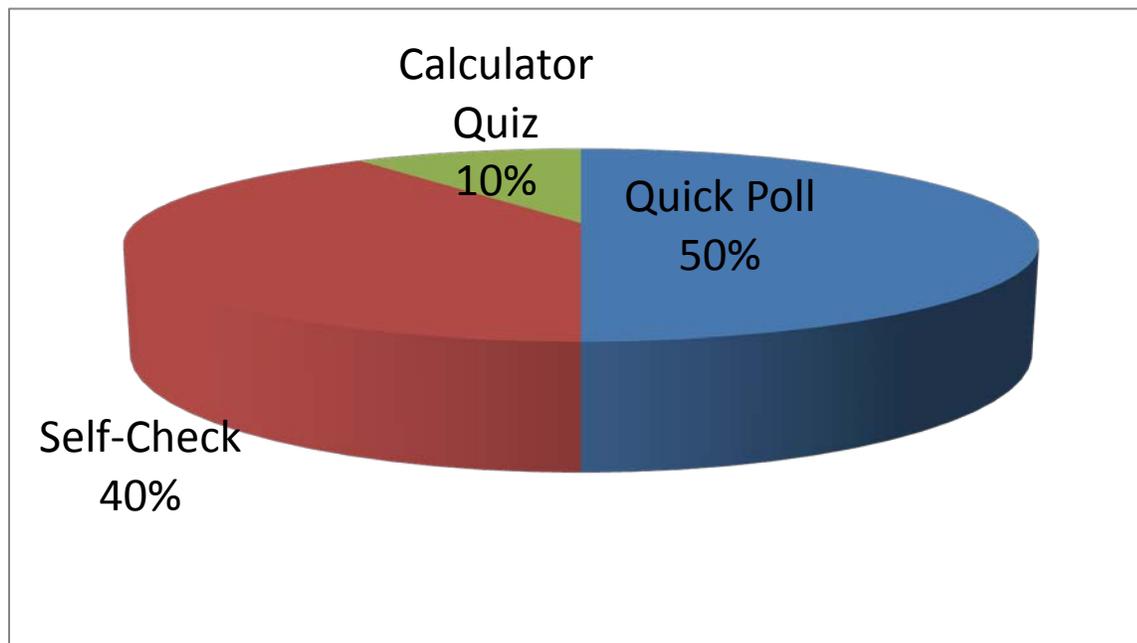


Figure 7: Favorite Feature (Algebra 2RS)



Both classes preferred the use of the quick poll, and it is likely because of its quick, easy usage. The teacher can quickly send students questions and students send their responses back instantaneously. Among the three categories, the calculator quiz (compared to the pen/paper quiz) was the least desired feature of the Nspire Navigator.

When questioned on whether the Nspire improved their participation in class, 57% of the 1R class and 36% of the 2RS class responded that the Nspire Navigator did in fact increase their participation in class. In the study mentioned previously, where the researcher noted student behavior in class, it appeared there was a significant increase in participation among both groups, but especially the 2RS class. It is interesting to note that the students did not seem to think they were participating more, however the teacher noted a drastic improvement. One of the benefits of the Navigator is that students do not even realize they are active and participating, even when they clearly are.

Other student quotes that were useful to this research were as follows: One student responded they prefer using the Navigator, specifically the quick poll, because, "...other people can't see if you're right or wrong." Another student commented, "If I'm wrong, I can know myself. With the whiteboard, everyone sees my mistake." This supports the notion that the Nspire Navigator helps promote student comfort and participation in class because it removes fear and anxiety of getting a question wrong in front of the class. A critic of the Nspire Navigator claimed, "It's so big and bulky. I'd rather solve as a class."

Discussion of the Study

Limitations

There were several limitations to this action research study. Firstly, the sample size of the population was small. The Algebra 1R class contained 26 students and the Algebra 2RS class contained 13 students. It is important to note, that with any study, anytime the sample size is small there is room for coincidental or somewhat skewed results. This study, however, was able to identify trends, despite the small sample population. An ideal study for this research would have included at least one hundred students.

Another limitation is that this study was conducted over a six week period, with alternating use of the Navigator in the classroom. To provide a more conclusive study, it would be recommended to conduct a study of one full scholastic year with even more forms of data collection. The more data that a study has, the more valid the conclusions can be.

Conclusion

This research strived to discover a discernible link with the use of the TI-Nspire Navigator and student achievement in the high school mathematics classroom. Through researcher observations, student and teacher surveys, and analysis of student test scores, there seemed to be a positive correlation between the use of the Navigator and student achievement. Specifically, the researcher hoped to answer related questions such as its influence on student participation, behavior, interest in math, etc., as well as its ability to improve student test scores, and its role in assisting the special needs student. In summary, researcher observations lead to a discovery that the Nspire Navigator improved student achievement in all areas, to some extent. The largest increases were in the Algebra 1R class in areas of participation, engagement, and enjoyment. The Algebra 2RS class saw the largest increase in the entire study for the participation section, improving by nearly 1.84 points (See Figure 2).

The teacher surveys all found a common link in the area of participation. All teachers specifically noted an increase in student participation, which may be attributed to the Navigator's ability to collect student responses from all students instantaneously. As well, most teachers wished they could use the Navigator more in their classroom. The student surveys from the Algebra 1R class stressed the fact that they enjoy new forms of learning, as 89% indicated they wish the Navigator was used more (Figure 4). A new and exciting tool such as the Navigator made them interested and gave a nice change of pace to the classroom. The Algebra 2RS class was not as open to the Navigator; however, this was somewhat expected because their general attitude and approach towards learning and school is different from that of the Algebra 1R class. The researcher observations helped verify that the Navigator did have some positive effect on the

class. One explanation for their hesitation towards the Navigator is that special education students often like to stick to a routine, and this change of instruction might have disrupted their normalcy in the classroom.

A final important conclusion was that on average, students in both classes performed lower on the calculator quiz as opposed to a pen/paper quiz assessing the exact same learning standards. The Algebra 1R class got .335 fewer questions correct on the calculator quiz, and the 2RS class got .91 fewer questions correct on the calculator quiz. This was alarming and was cause to assess the validity of calculator/computerized tests.

Implications and Recommendations

This study has many lasting implications for not only the researcher involved, but the field of education as well. Technology is quickly infusing into classrooms across the country, and it is important to consider both sides of the issue. Few will argue the benefits that technology can bring to the world of education. As classrooms become more technologically advanced, students become exposed to the latest and up to date forms of software and tools that can accelerate and enhance their student experience. It is important to remember, however, that technology has to be used correctly, and in conjunction with good teaching. A high tech classroom will not necessarily yield stellar results for students just solely from the technology; a classroom with solid teaching practices aided by the latest forms of technology will produce an environment most conducive to student learning. The Nspire Navigator is clearly a form of technology that when added to an effectively run classroom can help teachers create an engaged, student centered environment.

With that being said, it is clear that the Nspire Navigator is a form of technology that can bring lasting benefits to a classroom. It has the ability to make a large classroom feel small, by connecting the class and allowing each student to be “heard.” The benefits of increased participation and engagement are almost impossible to dispute. For the most part, students in this survey seemed to generally enjoy using the technology. However, teachers often noted difficulty with technical issues and designing lessons to align with the software. So while there are many benefits, both teacher and students noticed some negatives, as well. One recommendation would be to ensure teachers had proper training of the product well before implementing it in their own classroom. In summary, it is clear however that the pros outweighed the cons.

An important concept that must also be acknowledged is education and computerized testing. There is a strong push to move all standardized state exams to a computer based format. On the surface, it generally seems to be a relatively good idea. Cost efficiency, the ability to get quick results, and the movement to a more technologically savvy form of assessment are the benefits, to name a few. It is important, however, not to overlook the clientele being affected. Students are the ones that are forced to adapt their normal practices to this potential new movement. As seen in this survey, students of multiple ability levels scored lower on the calculator (computer) based test as opposed to the pen and paper test, which addressed the exact same learning standards. Even more alarming was how poor special education students performed on the calculator based assessment. These students are used to a routine, and changing the format of the assessment seemed to affect their results. These findings are extremely important in the field of education, because there is a strong push for computer based testing for standardized exams. It is crucial for education policy makers to be aware that different formats of testing, such as computer or calculator based, can often yield skewed results that do not accurately depict student knowledge. Specifically, the special education population might suffer more so than the general education

student since they would likely have a more difficult time adjusting to the change in format. In fact, I would predict that as general education students got more practice taking computerized tests, their results would normalize. Across the board, however, special education and general education students alike performed at a lower level on the computer based quiz compared to the pen/paper quiz in this study. This needs to be considered when discussing the notion of computerized testing. The goal of assessment is to assess knowledge of content, not the ability to handle the format of the assessment. If the format of the exam skews the results, as it did in this study, alternative approaches needs to be considered.

Overall, this study addressed the aforementioned action research question that the Nspire Navigator can improve student achievement in the mathematics classroom. Through observations, surveys, and test scores, it is clear that this cohort saw improvement in many areas by using the Navigator in the classroom. It is recommended to make the Navigator a consistent method of instruction within the classroom; however it should not dominate instruction. As mentioned before, technology is a supplement to quality teaching practices. Technology will never replace good teaching; however, when used in conjunction with solid teaching methods, students will encounter a stimulating learning environment. The Nspire Navigator is a learning tool that can greatly help teachers create an environment that challenges students and delivers instruction through multiple mediums and can reach diverse learning styles.

Molloy College Dispositions

The Molloy College Dispositions of teaching address many important qualities that teachers must possess. I believe this study and my actions as a teacher thus far adhere to the dispositions listed above. Specifically, I whole heartedly agree **that all children can learn**. It is our role as educators to come up with many ways of delivering instruction so that the needs of

our diverse students are met. It is often the main challenge of a teacher to come up with exciting and alternative methods that can reach all children. By performing this research in my classroom and using multiple modes of delivering instruction, I clearly saw the concept that all children can learn.

Throughout this research, a common thread was acknowledging **values and nurturing students' intellectual, aesthetic, and social growth**. The Navigator is a tool that promoted student growth both educationally and socially. It is a tool that enables students of all ability and confidence levels to feel comfortable in class. With that said, all students experienced a classroom environment that promoted growth and a nurturing atmosphere.

Part of becoming an effective teacher is **possessing enthusiasm and passion about teaching and learning with a commitment to students and their learning**. Incorporating new and exciting technologies such as the TI-Nspire Navigator is important to enhance each students' learning experience. Students can feed off of a teacher's enthusiasm and passion for the subject, and delivering content through exciting forms can greatly improve student learning.

An important part of improving as an educator is **evaluating professional research and proven best practice to make informed decisions**. Teachers have a responsibility to grow as professionals, and one way to do that is to research proven practices and reflect on them. Through this action research, I have analyzed many leaders in the field who have done similar work. By critiquing and reflecting on their research, I feel that I have improved in my practices as well.

The Nspire Navigator allows educators to use multiple forms of assessment and strategies that can assess student knowledge. This relates to the Molloy College disposition; **reflects on,**

uses, and implements a variety of assessment to improve effective practice. Through this action research, my classroom was assessed through many different mediums. Quick polls, self-check, and calculator quizzes are just to name a few.

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Appendix BTI-NAVIGATOR TEACHER SURVEY

1. How many hours a week do you use the Navigator in your classroom?
2. What type of activities do you conduct when using the Navigator?
3. Respond to the following statement: The Navigator has affected my class.....
4. What benefits have you noticed while using Navigator in the classroom?
5. What problems/concerns have you experienced with Navigator?
6. What do you think is the most desirable aspect of using the Navigator in math class?
7. How has using the Navigator increased any of the following:
 - a) Student Participation
 - b) Student Behavior
 - c) Student Test Scores
 - d) Aligning to the Common Core Curriculum

Appendix C

Researcher Observations

Using a 1-5 scale, the researcher will observe student performance in the classroom.

1- Poor 2- Below Average 3- Average 4- Above Average 5- Exceptional

Date: _____

Was the TI-Nspire Navigator used? _____

Participation	1	2	3	4	5
Behavior	1	2	3	4	5
Focus	1	2	3	4	5
Engagement	1	2	3	4	5
Enjoyment	1	2	3	4	5
Achievement	1	2	3	4	5
Assisting Special Education Students	1	2	3	4	5

Appendix D

Name: _____

Navigator Quiz

___ 1) Simplify the given expression:

$$(7x^2 - 5x + 2) - (-3x^2 + 8x - 4)$$

- A) $4x^2 + 3x - 6$
- B) $10x^2 - 3x + 6$
- C) $10x^2 - 13x + 6$
- D) $4x^2 - 3x + 6$

___ 2) Find the quotient of the given expression:

$$\frac{12x^4 - 20x^2 + 8x}{4x}$$

- A) $3x^3 - 5x + 2$
- B) $3x - 5x^2 + 2x^4$
- C) $3x^4 - 5x^2 + 2x$

___ 3) Which expression is a factor of $x^2 + 2x - 15$?

- A) $(x + 15)$
- B) $(x - 5)$
- C) $(x + 3)$
- D) $(x - 3)$

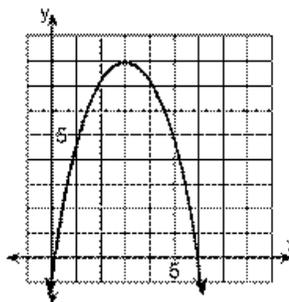
___ 4) What are the factors of $9x^2 - 16$?

- A) $(9x + 16)(x - 1)$
- B) $(3x - 4)(3x - 4)$
- C) $(3x + 4)(3x - 4)$
- D) $(9x - 16)(x + 1)$

___ 5) What is the slope of the line whose equation is $y + 2x = 4$?

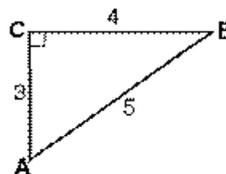
- A) $\frac{1}{2}$
- B) -2
- C) 4
- D) 2

___ 6) What conclusion can be drawn from the graph below?



- A) The maximum height occurs when $y = 3$.
- B) The axis of symmetry is $x = 3$.
- C) The coefficient of a must be positive.

___ 7)



What fraction represents the value of $\cos B$ in $\triangle ABC$?

- A) $\frac{4}{5}$
- B) $\frac{3}{4}$
- C) $\frac{5}{4}$
- D) $\frac{3}{5}$

