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Teaching mathematics in the classroom with PowerPoint software

Robert Ward Kopp

TEACHING MATHEMATICS IN THE CLASSROOM WITH POWERPOINT SOFTWARE

A Project

Presented to the

Faculty of

California State University,

San Bernardino

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

in

Teaching:

Mathematics

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ABSTRACT

The present quantitative and qualitative study looks at how to better student achievement in an Algebra II course. Specifically this study examines two different modifications made during the second semester of an Algebra II course taught at a high school in Riverside County. The modifications that were made were based on a detailed literature review that suggested looking at how students learn while using PowerPoint software as an instructional tool and at the same time investigate the consequence of rearranging a fairly common and predetermined curriculum pattern.

By looking at three measurement tools, a mid-chapter quiz, an end-of-unit exam, and an anonymous survey implemented in three different class sections of Algebra II, the researcher was able to show with significance that by a combination of using PowerPoint and rearranging the order in which the units of sequences and series is taught in comparison to logarithms can make a difference in student performance.

Based on research findings, there were some recommendations for future studies. The researcher would recommend increasing the population size, introducing another variant group, and studying the effect of using

PowerPoint for more visually challenging types of classes (e.g. geometry and calculus). In addition, there should also be an investigation into the quality of the actual PowerPoint slides and determining how the quality of the slideshow impacts student learning.

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DEDICATION

To Christine

I would like to dedicate this entire project and degree to my wonderful, incredible, and inspirational wife, Dr. Christine Umali Kopp. Without your encouragement and support to go back to school after so many years, I would not even be at the university. You have taught me how to be courageous, determined, strong, and confident through this process and you have been just instrumental with me completing this degree. Without you being in my corner, this degree would not have come to fruition. I am truly grateful for everything you have brought into my life.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

BACKGROUND AND LITERATURE REVIEW

With the advent of technology, the field of education has attempted to incorporate the most cutting edge of innovation and use these computer programs and dynamic software for inspiration inside the classroom. Stemming from its use in the business field, PowerPoint, software developed by Microsoft, has slowly entered into the classroom. This software might have the potential to assist teachers in developing and presenting course material in a more dynamic and interesting manner with the hopes of increasing student knowledge and understanding. The question that can be asked is: How effective has the use of technology in the classroom been for subjects that require not pure memorization, but problem solving and application more than anything else? Furthermore how might using PowerPoint as a way of presenting mathematics visually help or hinder students' learning experience?

The current climate in education focuses on improvement in many different areas including test scores, enhanced student understanding, and student academic achievement. This puts increased pressure on both educators and schools. Within some school districts, including that of the researcher, administrators are encouraging faculty to integrate technology into the classroom to a greater degree. With these challenges in mind, how can educators best prepare students with knowledge that will enable them to be successful in the local and global community? Education has seen its fair share of trends and tendencies to new ideas. Using technology as a means to deliver instruction is increasingly becoming more popular (e.g., distance learning; learning module systems such as BlackBoard and Sakai; online learning resources through textbook publishers; lecture software, etc.) as society progresses towards obtaining more knowledge through quicker and more easily accessible methods (e.g., internet).

While the author would like to focus specifically on the use of PowerPoint software in mathematics courses, in particular those at the high school level, there is limited research looking at such technology in mathematics courses. Since there was difficulty in locating research directly linked to the author's focus of using PowerPoint as an instructional tool, related studies that integrated other types of technology into math courses were reviewed. In looking at the previous research available, it appears that these previous studies have looked at specific technological tools and how they were incorporated into the mathematics classroom at different levels of students' progression through education. The literature ranges from studying the effects of graphic calculators in high schools in Queensland, Australia (Goos & Bennison, 2008); to the influence of computer-assisted instruction within an eighth grade mathematics class in New Jersey (Tienken & Maher, 2008); then up to the levels of college introducing technology as a tool of instructing freshmen students who are deficient in the skills needed to being successful in a developmental mathematics course (Taylor, 2008); and finally to those students who are taking Calculus for the first time in Malaysia (Atan, Suncheleev, Shitan, & Mustafa, 2008).

Most of the literature that was found dealt with remediation for students who are struggling with mathematical comprehension, or on the other end of the spectrum, enhancement and development of previous knowledge and understanding of mathematical concepts. However, there was little to be found in the review of the literature that used technology as a primary instructional tool. In addition the literature showed that although technology does allow instructors to delve further into a topic, there are many in the field of education that show resistance for taking the time to learn how to use new technology or more importantly how to integrate that technology. This might be a result of various reasons including: 1) access to computers and appropriate software; 2) openness to changing teaching methods; 3) lack of motivation to learn something new; 4) philosophical differences (e.g., some believe the use of technology undermines the purity of mathematics); and 5) limited resources including training and time as faculty maintain already demanding workloads.

There were a number of issues revealed through the studies. Two of which were particularly relevant to the focus of the current study: 1) student accessibility; and 2) the effectiveness of technological learning tools, including the examination of PowerPoint specifically.

Student Accessibility

Not only is it critical to take into consideration the various technological resources both faculty and educational institutions have to choose from, it is important to determine the impact using technology will have on students as well. With the introduction of new technology, there is the issue of student accessibility and training. The question that needs addressing is: What limitations would be placed on the students and is there equity in accessing technological resources?

One problematic issue unveiled by the study in Australia was accessibility (Goos & Bennison, 2008). Initially the intent was to look at the effectiveness of computer software programs to enhance math students' learning. However after surveying various schools throughout the state of Queensland they determined that student access to computers was not equal across schools. As a result the researchers decided to focus on the use of graphing calculators instead. However, accessibility issues arose with this as well since not every class in Queensland had a class set of calculators to use (Goos & Bennison, 2008).

For the study that was conducted in Malaysia with the automated software and in the study done in New Jersey with the eighth grade students, the computers and software were used in the classroom (Atan, Suncheleev, Shitan, & Mustafa, 2008). However it was unclear as to whether or not the researchers took into account how students would access these technological resources were they to have any missed class time.

Another potential function where the technology might not be equitable is seen in the studies for the ALEKS program (Taylor, 2008) and the webOption (Joordens, Le, Grinnell, & Chrysostomou, 2009). It was not made clear if these resource options were only made available to the students while they were on campus or if students had the ability and flexibility to access the curriculum from home.

Effectiveness of Technology

With all of these adversities, the real issue is to determine how effective the studied technologies had been in their usage. Depending on what the desired outcome was of each independent study the results were mixed.

In the study conducted with the webOption in Canada, the students performed worse than the students that just attended the classes (Joordens, Le, Grinnell, & Chrysostomou, 2009). There were many considerations that had been taken into account in this study by the authors, but the main conclusion they came up with dealt with the transference of applicable knowledge. It was the authors' opinion that the study showed that the webOption had been successful for introductory psychology courses as those require more pure memorization skills of definitions and applications; whereas the mathematics courses are more difficult for a student to develop skills such as problem solving and more unique applications and those skills alone are much harder to develop just by watching video clips (Joordens, Le, Grinnell, & Chrysostomou, 2009).

In correlation to that study, the research that was done in New Jersey with the (Computer Assisted Instruction) CAI intervention with middle school students showed no significant increase in performance for the students that had access to the CAI contrasted with those students that did not have access, but instead regular instruction and practice from the instructor (Tienken & Maher, 2008). Overall the study showed that in fact the CAI program that was implemented was not an effective intervention method and had a negative effect on students' performance (Tienken & Maher, 2008). The authors suggest in their review that this program needed to be re-evaulated as the entire district implemented this program to help its underachieving students and there was a district-wide decrease in student scores as the software helped with the concept of drill and practice, however it lacked specifically with teaching its students the skill of problem-solving (Tienken & Maher, 2008).

Although it might seem that the results are negative, there are two studies worth noting as being highly successful. The study conducted with incoming freshmen in a Texas university with its ALEKS program, showed increased scores in many facets. First, the research shows that there was an increase in the mean scores for the students in the experimental group of four points from pretest to post-test which was statistically significant (Taylor, 2008). The conflicting data in this study showed that the control group did in fact increase its score as well and even outperformed the experimental group in general. However, one important aspect of teaching and learning mathematics is how to cope and resolve the situations involving mathematical anxiety and in this study, the students that were in the experimental group had in fact lowered their mathematical anxiety (Taylor, 2008). Not only was this an important aspect to consider, the study also showed that the students saw an improvement in their attitudes towards mathematics improved; whereas the students in the control group after taking the class in a standard lecture manner saw their attitude towards mathematics become worse (Taylor, 2008).

Lastly, the study conducted in Malaysia (Atan, Suncheleev, Shitan, & Mustafa, 2008) with the animated software for the Calculus classes had the most significant results in not only student and teacher feedback, but also in grade results. In this study, it was shown to be a belief amongst the staff and the students that the software increased interest in the subject, students were able to understand the material, students learned faster, and their retention increased, the software saved time; and there was an increase in the level of grades (Atan, Suncheleev, Shitan, & Mustafa, 2008). Overwhelmingly the data in this study showed that students' attendance increased and it made students more actively involved in the class and the learning process (Atan, Suncheleev, Shitan, & Mustafa, 2008).

PowerPoint as an Instructional Tool

Previous research has examined the effectiveness of PowerPoint as a learning tool in various courses outside of mathematics. Studies have had mixed reviews, however, one common theme is the quality of PowerPoint made a difference on its effectiveness as an instructional tool.

Amare (2006) found that within English technical writing courses while students preferred delivery of information via PowerPoint during lecture, higher scores were earned by students in sections where traditional instruction was implemented (i.e., no PowerPoint was used). While students claimed to have more enthusiasm for PowerPoint, this did not translate to higher test scores, greater performance and/or more consistent attendance. Amare (2006) speculated that this could have been caused by a number of possibilities including: 1) her presentation style was not conducive to PowerPoint; 2) her PowerPoint presentations were not as well developed as she had thought; and 3) students may have reached saturation with too many PowerPoint slides. However it cannot be ignored that PowerPoint has become more of a norm with technological advancements and to some extent is now an expectation during information delivery (Amare, 2006). Instead it is important to keep in mind that PowerPoint alone is the not the complete solution, rather instructors must also keep in mind that how they deliver narratives along with the level of enthusiasm they express for the subject matter can certainly make a significant impact on students' interest as well.

Other studies found PowerPoint to be an effective instructional tool, depending on its level of use. PowerPoint appears to have some benefits when used appropriately such as providing structure and pacing as well as being more time efficient. Susskind (2005) found within Introduction to Psychology courses that while PowerPoint accompanied lectures did not result in increased academic performance that students expressed higher positive attitudes and self-efficacy in the subject matter and when online notes were provided ahead of time, greater confidence in note taking as well. Susskind (2005) also recommended that future research should examine aspects of PowerPoint (e.g., animation, graphics, video) that might enhance student learning, not just focusing on its mere presence. So perhaps the depth to which a PowerPoint presentation is developed (i.e., bulleted items versus complex slides using graphs, color variation and animation) may make a difference.

Szabo and Hastings (2000) also found that students found PowerPoint lectures to be more interesting than traditional ones. While this might be attributed to one's ability to manipulate visual stimuli on slides; create more structure; and be more organized, it is also possible that for some students PowerPoint as a delivery tool might be novel in certain classes, therefore peaking students' interest at least temporarily. While Szabo and Hastings (2000) researched has mixed results, within one of their studies they revealed PowerPoint's positive impact on student performance. Within this study the researchers compared assessment scores over three conditions: 1) lecture with overhead projector; 2) lecture with PowerPoint; and 3) lecture with PowerPoint and notes.

Conditions 2 and 3 resulted in higher scores on multiple-choice tests when compared to Condition 1 with no significant difference between these two groups (i.e., Conditions 2 and 3). In Conditions 2 and 3 PowerPoint was used along with a comfortable pace thus allowing students' note taking without distraction (Szabo & Hastings, 2000). Szabo and Hastings (2000) state that "PowerPoint could be useful in specific instruction where dynamic models, animation, and variation of color may definitely help in the better illustration of the key concepts" (p. 187).

Additionally lecturing with PowerPoint must be balanced with one's level of spontaneity, personal interaction with students, and effectively engaging students without appearing to be too rigid or scripted (Susskind, 2005; Craig & Amernic, 2006). Educators must not use PowerPoint as a mere crutch, but rather ensure that students' learning is enhanced by drawing the connection between concepts so that information does not appear fragmented which can result in surface level processing of information (Craig & Amernic, 2006). "PowerPoint should not be viewed as a replacement for the blackboard, but rather as an efficient auxiliary medium, that can improve learning" (Szabo & Hastings, 2000, p. 187). Ultimately it appears that PowerPoint might only be helpful when used in combination with effective teaching strategies.

The Difficulties of Learning Exponential and Logarithmic Functions

The reality that many professors and instructors face while teaching mathematics is that there are certain topics that students generally do not understand the very first time they are introduced. Whether the instructor is teaching elementary, high school, or even college-level students, the initial introduction to such topics can determine whether or not students develop a complete understanding of those topics. This in turn could have serious implications of student's mathematical self-efficacy. Unfortunately, the concept of exponential functions and their inverse operation of logarithms typically causes many students to experience confusion and ultimately frustration.

Confrey (1994) has studied why students inherently struggle with learning about exponential and logarithmic functions. In her work, she suggests that the issue is students beginning at a young age are instructed to think of multiplication as repeated addition. Although this is not an incorrect thought to have, the issue Confrey (1994) argues that the students in fact are only taught a singular structure of Algebra, that is repeated addition and nothing else. "Once students have learned to manipulate and evaluate exponential expressions, exponential functions can be defined…with this developmental model of exponential functions, it is not surprising to find students having difficulties in their conceptual development of exponential inverses, logarithmic functions" (Smith & Confrey, 1994, p. 337). Confrey (1994) believes limiting students to such a restrictive and limited way of thinking is hurting their ability to consider multiplication (and consequently, division) as more than just repeated addition. Instead she recommends that multiplication should be taught as an unique or different action that happens on a specific number. As a researcher that conducted many experiments to understand how students learn repeated multiplication, Confrey (1994) suggests that in order to help students be successful with understanding repeated multiplication more efficiently, instructors need to introduce a new way of counting which she terms as "splitting". The concept of splitting is similar to exposing young students to the patterns that are made through geometric sequences where instead of having a common difference in a repeated addition pattern (e.g., 1, 5, 9, 13, 17), a ratio is used as the rate of change between terms or values (e.g., 1, 4, 16, 64) (Confrey, 1994).

Other researchers have investigated the specific issues students have in learning exponents and logarithms for the first time. As a result they have identified very specific issues students have with understanding core concepts about exponential expressions and logarithms. Weber (2002) mentions that "students' understanding of exponential functions only makes sense when their domain is restricted to the natural numbers" (p. 5). This implies that students have the inability to calculate an exponential value when an exponent is negative, rational, or irrational. DePierro, Garafalo, and Toomey (2008) conducted a study with chemistry and physics students and found that they "often encounter difficulties when attempting to create or interpret mathematical representations of physical phenomena" (p. 1226). The authors specifically mention that "students are often unable to translate equations with the general form $\log_b N = L$ into statements that do not contain the words "log" (DePierro, Garafalo & Toomey, 2008, p. 1226), which is one of the most fundamental skills needed to evaluate logs.

PowerPoint as an Enhancement Tool for Learning Mathematics

The question therein lies, how does PowerPoint instruction address the issues of learning mathematics and more specifically help students understand exponential and logarithmic functions? The answer may be as simple as a change in the dynamics of instruction.

When an instructor lectures using a white board, some important aspects of teaching may not be happening. One concern is that the instructor would likely have their back to students while using the board, thus eliminating personal connectedness with the class while at the same time restricting the conversation or dialogue that could be challenging for the auditory learners. Not only does the usage of PowerPoint enhance visualization, it also provides the opportunity to have discussion. When an instructor uses a whiteboard, typically the instructor sets the tone of the lecture and will basically write new information down without eliciting responses from the class. If performed properly, a PowerPoint presentation can initiate a collaborative learning environment. According to Kramarski (2003) a collaborative learning environment in which students work together with peers and the instructor is one of the most effective learning tools within the classroom. Additionally when students are in such environments where peer interaction and collaboration are encouraged, this pushes them to explain concepts and ideas on the related subject matter, thereby enhancing their knowledge acquisition even further. Therefore using PowerPoint as an instructional tool when implemented effectively can allow for greater student-teacher interaction (e.g., faculty can have more face-to-face time with students) and as a result enhance the dialogue that takes place in the learning environment.

Another consideration regarding whiteboard instruction is the lack of visual stimuli such as aspects like animation and color variation that using PowerPoint can provide. This limitation might hinder the learning experience of visual learners.

> ...Visualizations are often produced on static media (e.g. chalkboard) and thus only offer limited exploratory possibilities and reduced epistemic utility as most of the exploration and manipulation need to occur within students' minds. As a result, although useful, static visualizations may still fall short of being able to engage students in exploratory activities that are conducive to the positive learning experience. (Liang, 2010, p. 974)

In the same study where technology was used the researchers found that

> ...the inability of visualizations to dynamically adjust to students' cognitive and perceptual demands can cause visuo-mental incongruities not always favorable to active exploration or increased levels of engagement. This in turn can negatively impact students' understanding of the explored concepts. More importantly, this can also affect students' feelings and predisposition towards these concepts in undesirable ways. (Liang, 2010)

Lastly, PowerPoint can be an useful aid because of the ease with which it can be published on the Internet. In their study on mathematics achievement Kitsantas, Cheema and Ware (2011) suggest that the more homework support resources that were available to the students, the higher their mathematics score were. If a teacher was to use the white-board as the instructional tool, at best the lecture notes could be posted online if at all. As helpful as that may be, progression through a PowerPoint where the information is disseminated in parts allows the students to digest information at a pace conducive to student learning.

The connection that PowerPoint can provide to any mathematical topic, specifically exponential and logarithmic functions, is that it provides color; it provides the opportunity to engage students; it can integrate attention capturing animation; and therefore, it can visually deliver the subject matter in a more dynamic manner. As suggested "about how this topic might be made more interesting and relevant in a secondary classroom: In most cases, the treatment is multi-modal using numerical, graphical, and algebraic approaches" (Wood, 2005, p. 167).

Literature Summary and Conclusion

Being that mathematics has historically been one of the most challenging subjects for the general population to comprehend, there have been numerous techniques that have been developed to bridge the gap of being lost and confused, to the land of understanding and application. Technology has been the latest trend to be introduced to make mathematics more mainstreamed for the general population. Based on this review, it is the author's opinion that perhaps there needs to be more studies conducted to determine the appropriateness of what type of technology is used and at what mathematical skill level that technology is to be used.

Where this project fits within this topic of using technology inside the mathematics classroom is to measure how the specific usage of PowerPoint as the delivery tool and how providing students with personalized instruction from the teacher can aid students in their understanding, or almost just as important their personal opinion about the subject of math in general. While research studies specifically examining PowerPoint's impact on student learning have been conducted, none focused on this effect within the mathematics classroom. While overhead projectors, white boards and other traditional teaching methods continue to dominate teaching strategies in math, it is also important to consider the potential impact technology, and specifically PowerPoint, might have on students' knowledge acquisition within and attitudes towards mathematics.

In addition, the literature review reveals that not only can a dynamic change of instruction through the use of technology alter the potential outcome for the current study, but exposure to alternative multiplicative structures, as suggested by Confrey (1994), can impact whether or not students successfully understand logarithms as well.

CHAPTER TWO

GOALS

The purpose of the current study is to two-fold: to determine how effective the use of technology is when integrated with instructional strategies in Algebra II/Trigonometry courses, and how having experience with different counting structures (through exposure to geometric sequences and series) can impact the learning and understanding of logarithms. In addition, this study will look at a potential new approach and its effectiveness in teaching mathematics through the usage of PowerPoint as a delivery tool and the potential outcomes this has with a small sample of high school students.

The author's motivation for focusing on technology in this regard is twofold. First, as a high school teacher, the author has begun incorporating PowerPoint as a visual resource to complement lectures. As a result, the author has received positive feedback regarding use of this technology from students, parents, faculty, and administrators alike. Secondly, within the district where the author is currently employed, there is a desire to increase the usage of technology for all disciplines with the plans to eventually integrate distance or online learning into course offerings.

Technology is becoming more and more part of the educational environment and can be seen in other disciplines more commonly than in mathematics. It is a goal of the current study to explore whether or not PowerPoint can be used as an effective visual learning aid in combination with teacher lecture and in-class work. As evident in previous studies, examination of the use of technology in mathematics courses is quite limited, and even more so when specifically looking at K-12 education. It is critical for educators to be current with the needs and learning styles of their students. As younger generations enter the classroom, most of whom will not know what life was like prior to computers, cell phones and the internet, teachers must ensure they integrate strategies that will enhance the learning environment of these students to maximize their success in mathematics while maintaining the integrity of the subject matter.

A discussion on how to best do this with the study of mathematics has been intriguing, and in a project such as this, valuable data could be collected to provide insight as to whether using technology such as PowerPoint could enable students to learn math more effectively in a face-to-face classroom. This data can also provide insight as to whether or not PowerPoint resources significantly impact students' learning experience in mathematics by providing reliable empirical data that moves beyond anecdotal feedback that the researcher has received from previous students. Furthermore the results from the current study might reveal implications for additional areas such as distance learning and online learning resources.

To further complement this study, the researcher intends on studying the implication of teaching the unit of sequences and series prior to exposing his students to logarithms. The math faculty at the school where the researcher is employed have typically covered these units in the same order that they are listed in the textbook used by the department: logarithms first then series and sequences (three units later). Considering that this have been a long-standing tradition at the school, logs has unequivocally been taught before the series and sequences unit and logs also has the reputation for being the most difficult unit the students have in learning for the first time. This research has the potential to provide insight into whether or not having students exposed first to the concept of ratios and how they affect counting principles before being exposed to exponential functions and their counterparts of logarithms, could alter the order in which the units are taught systematically during the second semester of Algebra II and the first semester of Pre-Calculus courses.

The focal point of this project is to analyze whether or not, based on the research provided by Confrey (1994), having students exposed to a new counting principle based on repetitive multiplication would aid students in their understanding of exponential functions, which then would translate to increasing their understanding of logarithmic functions. In addition, this project will analyze whether or not it is plausible that the use of PowerPoint software as an instructional tool will develop stronger mathematical understanding of concepts relating to exponents and logarithms while at the same time increasing student efficacy about learning mathematics. The researcher anticipates that introducing students to sequences and series before logarithms along with using PowerPoint as an instructional tool will enhance students' learning of logarithms, resulting in higher assessment scores.

CHAPTER THREE

METHODOLOGY

Participants

Participants for the current study included 10^{th} through 12^{th} grade Algebra II/Trigonometry students at a large high school in Riverside County during the Spring 2012 semester. These students were enrolled in one of three Algebra II/Trigonometry classes taught by the same instructor. Participants had their quiz and exam scores analyzed for this study. They also took a survey after completing an end-of-unit exam that provided them the opportunity to give feedback anonymously regarding their experience learning a logarithm unit. The students in these three sections of Algebra II/Trigonometry varied in age, mathematical skills, overall grade point averages (GPA), ethnic backgrounds, socio-economic statuses, and genders as would be the expected demographics of any class chosen randomly for this study. The students enrolled in these classes met every other day as part of a block schedule the school follows. Data from students new to the classes in Spring 2012 will not be included in the participant pool.

Materials

The unit that was used for the current study focused on logarithms. Students in all three classes were presented with the same information and examples throughout the unit. The students were assigned the same daily homework assignments and had access to the same study guide materials that were found on the instructor's website.

Students were given the same mid-chapter quiz, end-of-unit assessment, and survey. The mid-chapter quiz covered topics in the first half of the unit. All of the questions on the quiz were free-response. The problems on the quiz ranged from solving exponential modeling problems, graphing logarithmic and exponential functions, and evaluating basic logarithms without the use of a calculator (See Appendix A). The end-of-unit assessment covered topics on the quiz as well the second half of the unit (See Appendix B). This latter portion covered topics involving solving logarithmic and exponential equations, and using natural logarithms. The problems on the end-of-unit assessment were a combination of free response and multiple-choice questions. Upon completion of the unit exam, participants completed a survey. Survey questions were developed by the researcher along with peer review and feedback as well as committee guidance and recommendations (See Appendix C).

Design and Procedure

During the fall semester, students were acclimated to having the instructor utilize PowerPoint slides during in-class lectures. They also had access via the instructor's website to PowerPoint presentations that are accompanied with an audio lecture (that repeats and complements information provided in the face-to-face setting). This allowed students to review material online as well as print copies of the slides should they wish to have this during in-class lectures to write notes. Students were aware that they could use computers on campus including the school library, at home as well as in public libraries to access these materials through the Internet. Additionally, it is important to mention that the PowerPoint files that the instructor incorporated went beyond simple bullet points and statements. Instead, all sets of slides included the following: animation, graphics, math symbols, and formulas as well as various colors to highlight major concepts.

For this study, the researcher used a unit on logarithms within Algebra II/Trigonometry. This unit was selected because it covered concepts that students had not encountered in previous mathematics courses, unless they were repeating the class due to a previous unsuccessful attempt. This unit included two assessments: one mid-chapter quiz and one end-of-unit exam.

The researcher used a quasi-experimental design such that there was a different condition for each of three Algebra II/Trigonometry classes such that each section received a different combination of PowerPoint instruction (or lack thereof) and timing of exposure to the sequences and series unit (i.e., either before or after the logs unit). One class received instruction on sequences and series prior to instruction on logarithms, which was taught using PowerPoint. A second class also received instruction on sequences and series prior to learning about logarithms, however while learning about logarithms they did not receive instruction using PowerPoint, as typically done by other math teachers at this particular high school. The third class was treated as every other Algebra II class at the high school where they learned about logs without the use of the PowerPoint presentation technique and then they learned about series and sequences afterward. The lectures for all classes covered identical material: the same definitions, examples, and problems in class. Upon completion of the assessments, analysis of the quiz and unit exam were itemized, as were results from the survey. In addition, the data was analyzed across the groups, comparing itemized scores between classes with particular attention paid to any variations between classes that received instruction using PowerPoint and those that do not. All of the students in the study were able to continue to access the online lecture materials and PowerPoint slides as they had in previous units during the Fall 2011 semester.

Participant data was also obtained through a survey that used a 5-point Likert Scale where "1" equals *Strongly Disagree* and "5" equals *Strongly Agree* (See Appendix C). Surveys were anonymous and addressed students' experiences with and without PowerPoint sources (both online and in-class). Questions measured students' attitudes toward math and how this might be impacted by the instructor's use of technological resources in class. Participants completed the survey following the end-unit-exam but prior to receiving their exam results. Summative data from all three classes were analyzed, with particular attention paid to comparing any statistical variations between classes that received instruction using PowerPoint versus those who received instruction using the whiteboard, as well as those classes that received the information of sequences and series prior to their exposure to logarithms.

CHAPTER FOUR

SIGNIFICANCE

The expectation is that through this particular study, students will be more capable of understanding and synthesizing new mathematical information if they are visually stimulated. In other words, learning should be more effective for students when the lectures are performed using PowerPoint when compared to traditional white board instruction. The researcher believes that the assessment results will be higher for those that have the PowerPoint lectures in the class with PowerPoint. The expectation is also that the students will have a more positive response to the lectures that use PowerPoint as opposed to the white board. These results will become evident through the results of the survey. Additionally, the results of the study might shed light as to whether or not learning about series and sequences beforehand will enhance students' knowledge acquisition of the logarithms unit.

The significance this particular study has for students is that it might provide insight for educators who are searching for a mode of delivery that might make mathematical understanding easier to grasp as well as for those who are interested in strategies that might help improve students attitudes towards and confidence level regarding mathematics. The results of this study might also provide the visual stimulation needed, particularly for visual learners as well as students who find mathematics challenging, to support them in overcoming common frustrations that surround the subject matter.

The results of this project could also motivate instructors and teachers to be more creative with how to reach students who struggle learning new mathematical concepts. The results from this project could positively impact the interaction between instructors and their students, and further improve how information gets shared and integrated into the classroom.

CHAPTER FIVE

RESULTS

In an attempt to gather as much data possible, the researcher distributed parent permission slips to all of the students enrolled in the Algebra II classes before the initiation of the project. Out of 77 students total, 75 students returned the parent permission slips. The two non-participants were in the group that received the instructional unit on sequences and series prior to learning about logarithms with using the whiteboard. Only the results of those 75 students have been accounted for in the results of this project. The researcher was aware of the two students that did not return the parent permission slip and made sure that they also did not partake in completing the anonymous survey. For further demographic information about the students involved in the project broken down by the participating groups see Appendix D.

Teacher Observations

While providing instruction to all three classes, the researcher observed a change in the behavior of the students and how they interacted with the instructor during the whiteboard or the respective PowerPoint instructional time.

For the classes that made the transition to the whiteboard instruction, the classes became less interested or engaged while working out examples. When the instructor was writing on the board and would occasionally look back at the class, he noticed that the students were more likely to be distracted by their cell phones and texting. He also observed that students were moving around in their seats more frequently to see around the students sitting in front of them and blocking their view. In addition, there were some students who took out their glasses who had never worn them in class before because they had difficulty reading the whiteboard. The instructor noticed also that when it came time to step away from the whiteboard in order to circulate around the classroom while the students were working on examples, the students that were not in the general vicinity of the teacher became off task more quickly than usual.

For the one class that kept the PowerPoint instruction for the logarithm unit, the instructor was able to simultaneously walk around, talk and progress through the notes with the aid of a remote presenter while circulating amongst the students. He also noticed that a couple of students were using their cell phones and electronic tablets to look at the PowerPoint files online to get ahead of the class taking notes so that they were able to just listen to the instructor and focus their attention on the instruction as opposed to writing and listening at the same time.

Quiz Results

While using a rubric, the researcher graded each and every quiz that the students took in all three sections. The results from the quiz were coded and tabulated into a spreadsheet and then were analyzed using IBM's SPSS software. The Cronbach alpha value for the entire quiz was $\alpha = 0.72$, thus showing the assessment to be reliable. To simplify the discussion of the groups, the groups will be labeled and discussed as the following: 1) Group 1 will represent the class that was taught logs first without the use of PowerPoint, then sequences and series; 2) Group 2 will represent the class that was instructed sequences and series before learning about logarithms without the PowerPoint; and 3) Group 3 will represent the class that was taught sequences and series before learning about logarithms while using PowerPoint software. All instruction of sequences and series concepts included the use of PowerPoint.

While performing the data analysis, the omnibus test (F-test of all 3 groups considered simultaneously) was not significant (see Table 1). However, when looking at the means, the results from each group showed that students who were exposed to the content from the sequences and series unit prior to the logs unit performed better than the group that did not (see Table 2). However only Group 3 results were statistically significant when compared to the results from Group 1 (see Appendix E).

Table 1. ANOVA Table of Results from Quiz Questions 7 and 8

Source	df	F	p	η^2
Group	2	2.616	0.80	.068
Error	72			
Total	74			

Table 2. Quiz Descriptive Statistics

Group	Mean	Standard Deviation	*N*
1	27.4483	9.48904	29
2	31.5417	8.91008	24
3	33.4091	9.54518	22
Total	30.5067	9.54559	75

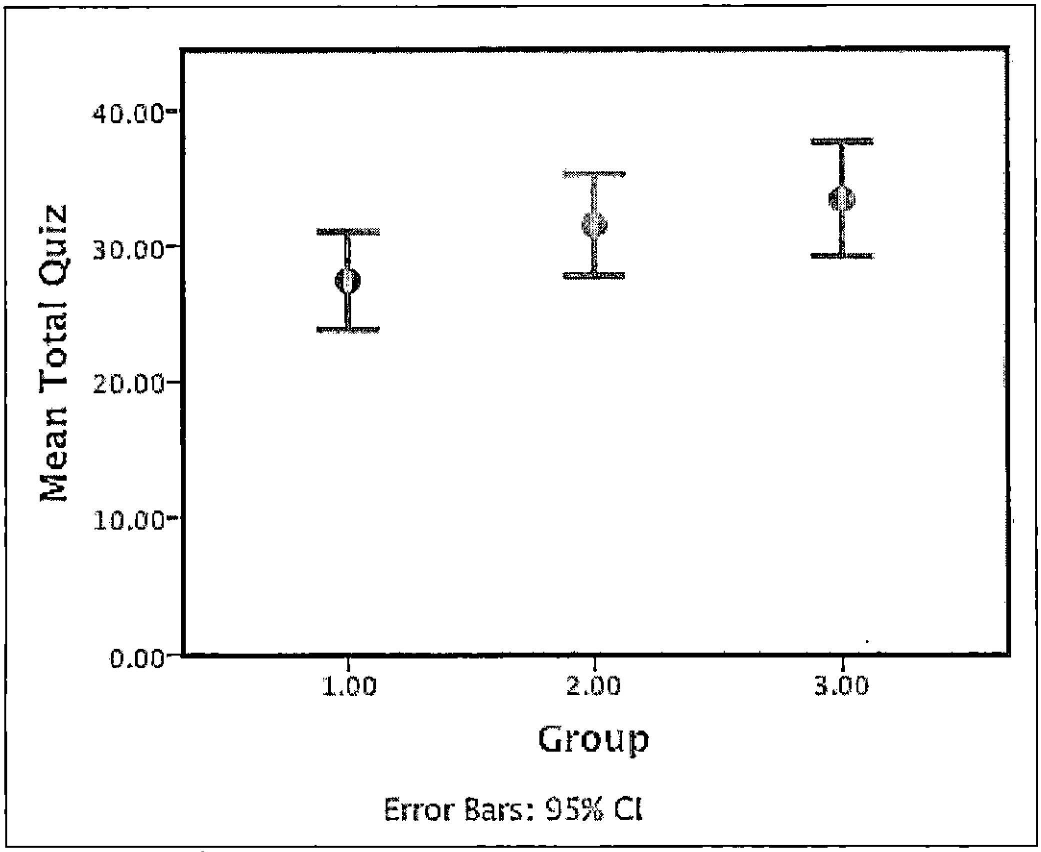


Figure 1. Quiz Means Across Groups

The researcher also performed some exploratory factor analysis and discovered a connection between the first two questions on the quiz, however again when looking at the omnibus test of all three groups considered at the same time there was a lack of significance. These questions were word problems related to exponential growth and decay scenarios. It is possible that students who were exposed to the sequences and series unit were better prepared for these problems as they had more practice working with exponents and repeated multiplication.

The factor analysis also showed that there was a connection between problems seven and eight on the quiz which tested the students ability to transform a logarithm expression into its equivalent exponential expression and vice-versa. The ANOVA table shows that when considering all groups simultaneously there is a lack of significance (see Table 3), but when comparing groups 1 and 3 there is significance (see Table 4). It is possible that group 3 excelled on these two problems as they had more exposure to the vocabulary used with exponential notation (i.e., base and exponent/power) and were more comfortable with accurately locating these items while transforming them from one type of expression to the other.

Table 3. ANOVA Table for Questions 7 and 8

Source	df	F	p	η^2
Group	2	2.616	0.80	.068
Error	72			
Total	74			

Table 4. Group Comparison of Quiz Questions 7 and 8

Group	Comparative Group	Mean Difference	Standard Error	Significance	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	2	-.3736	.30350	.222	-.9786	.2314
	3	-.7069	.31095	.026	-1.3268	-.0870
2	1	.3736	.30350	.222	-.2314	.9786
	3	-.3333	.32463	.308	-.9805	.3138

The error term is Mean Square (Error) = 1.210

In addition to performing factor analysis the researcher investigated the cluster of the types of problems associated with the quiz. As with all of the previous analysis, when looking at the F-test of all the groups combined, there was a lack of significance. When looking at the ANOVA table results from all of the word problems from the quiz combined, there does seem to be a statistical significance between the Group 1 and Group 3 (see Appendix E). This could possibly be tied to Group 3 having more experience working with exponents from the sequence and series unit as well. As with any data analysis it is worthy to note that although the omnibus test for the entire quiz, the analysis of questions 1 and 2, the analysis of questions 7 and 8, as well as the analysis of all the word problems together failed to show significance when considering all groups simultaneously. However when broken into groups, there was a significance shown between groups 1 and 3 in the previously mentioned analysis of the overall quiz results, the results of questions 7 and 8 as well as the cluster of word problems.

Test Results

As with the quiz, the researcher used a rubric to score the test results from each section used in this study. In addition, the exact same process was used with transcribing the individual and itemized responses into a spreadsheet, which were then analyzed by SPSS. The Cronbach alpha score for the test was $\alpha = .89$ thus showing that it is a reliable assessment to be used for this project. Much like the results of the quiz, when comparing the groups simultaneously (F-test) there is a lack of significance (see Table 5). However, by looking at the data for the individual groups, based on the means, the results showed that on average Group 3 obtained the best results (see Table 6). The statistical analysis shows that the results are significant when comparing Group 3 and Group 1 (significance level of .027), and marginally significant when compared Group 3 to Group 2 (significance level of .069) (see Appendix F).

Table 5. ANOVA Table for Total Test Results

Source	df	F	p	η^2
Group	2	2.402	0.98	.063
Error	72			
Total	74			

Table 6. Test Descriptive Statistics

Group	Mean	Standard Deviation	*N*
1	69.1724	18.54352	29
2	69.5000	15.52277	24
3	78.6364	15.53964	22
Total	72.053	17.08160	75

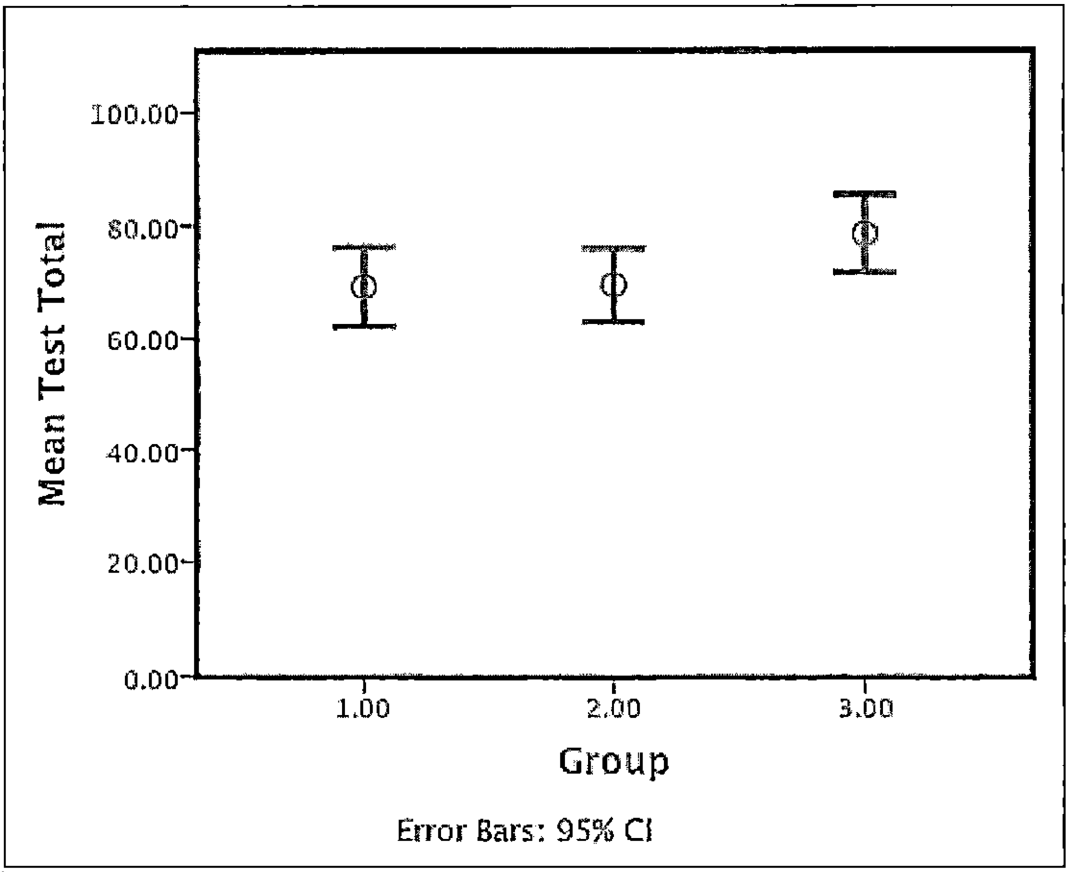


Figure 2. Test Means Across Groups

The researcher performed exploratory factor analysis with the test results and found that some of the sets of problems were related to how the students performed. The factor analysis showed that there was a positive correlation to how students performed while answering the questions based on evaluating logs to how they performed on graphing the exponential and logarithmic functions. The link of performing well when given the task of evaluating logs could be because of the extra experience working with exponents those students had from the sequences and series unit. The same could be said in terms of graphing exponential functions as perhaps some students used their properties to make function tables to plot coordinates for the graphs (as well as the inverse graphs for the logarithmic functions). In addition, the factor analysis showed that there was a link to how students performed with free response questions and its multiple-choice counterparts. However when running the data for ANOVA tables, there was no statistical significance of the factors across the groups.

In analyzing the clusters of the types of problems that were asked on the test, there was one cluster that was statistically significant. That cluster of questions involving the concept of evaluating logs without the use of a calculator was shown to be significant for the F-test across all groups (see Table 7) as well as the individual comparison between groups 1 and 2 (see Table 8).

Table 7. ANOVA Table for Evaluation Problems from Test

Source	df	F	*p*	η^2
Group	2	3.070	0.53	.079
Error	72			
Total	74			

Table 8. Group Comparison of Test Evaluation Questions

					95% Confidence Interval	
Group	Comparative Group	Mean Difference	Standard Error	Significance	Lower Bound	Upper Bound
1	2	.2965	.12487	.020	.0475	.5454
	3	.0528	.12794	.681	-.2023	.3078
2	1	-.2965	.12487	.020	-.5454	-.0475
	3	-.2437	.13356	.072	-.5099	.0226

The error term is Mean Square (Error) = .205

Survey Results

Students were asked to complete an anonymous survey, after the end-of-unit exam but before receiving their scores. This survey consisted of four parts. The first part was based on twenty-one questions where the response was limited to a 5-point Likert scale to understand the preference or opinion of the students in terms of how they learn math in regards to using PowerPoint or using the whiteboard for instruction. The second portion of the survey was to gain insight into how students have come to understand the connection between exponential expressions and concepts involving logarithms. The answers to these questions were completely free response. Some questions even had two parts: one involving solving or simplifying a mathematical expression and the other providing an explanation as to why that process works. The results from this portion of the survey were coded for data analysis. The third portion of this survey determined how much the students used the resources provided to them on the researcher's website. The students were asked if they used the PowerPoint files without audio and if so, how many times they used those files. They were also asked the same questions in regards to using PowerPoint files that had audio lectures included. Lastly, the students were provided the opportunity to share any thoughts they had in regards to learning mathematics with PowerPoint and with using the whiteboard. The Cronbach alpha score for the survey was $\alpha = .95$ thus showing the survey to be a reliable source of data.

The overall results for each portion of the survey were very lopsided to supporting the belief that students preferred using PowerPoint not only as a tool for learning mathematics in the classroom, but as a resource to have access to at home via the instructor's website as well (see frequency table in Appendix G). The results from statements that supported using PowerPoint (i.e., questions #1 and #11) had an overwhelming response of 89% and 80%, respectively for those who answered agree to strongly agree.

Besides the questions that showed support for using PowerPoint as an instructional tool, four particular statements from the survey distinctly show how using PowerPoint can impact students. For item 3, whether or not PowerPoint helps students complete their assignments 77% of the students agreed or strongly agreed that it did. With item 14, stating whether or not students used the PowerPoint files at home to review for quizzes or tests 78% of the respondents agreed or strongly agreed that they did. For item 17 that allows the students to express if they are more comfortable with math because PowerPoint slides are easier to read and understand, 75% agreed or strongly agreed with the statement. Lastly, with item 18 where the students can state that they are more confident in their math abilities than they were before this particular class, 72% responded from the agree to strongly agree responses.

The results also showed that students who were exposed to the sequences and series first as well those who were taught logs using PowerPoint (i.e., Groups 2 and 3) fared better on the free response questions that showed their understanding of exponential and logarithmic expressions. Out of the eleven questions that were asked to show how students understood the concepts relating to exponential and logarithmic expressions, Group 1 only marginally outperformed the other two groups on one occasion (Q#5) (See Chart 3). For the other ten questions, Group 2 or Group 3 performed significantly better. The comparison between Groups 1 and 3, as well as Groups 2 and 3 were shown to be statistically significant (see Appendix G).

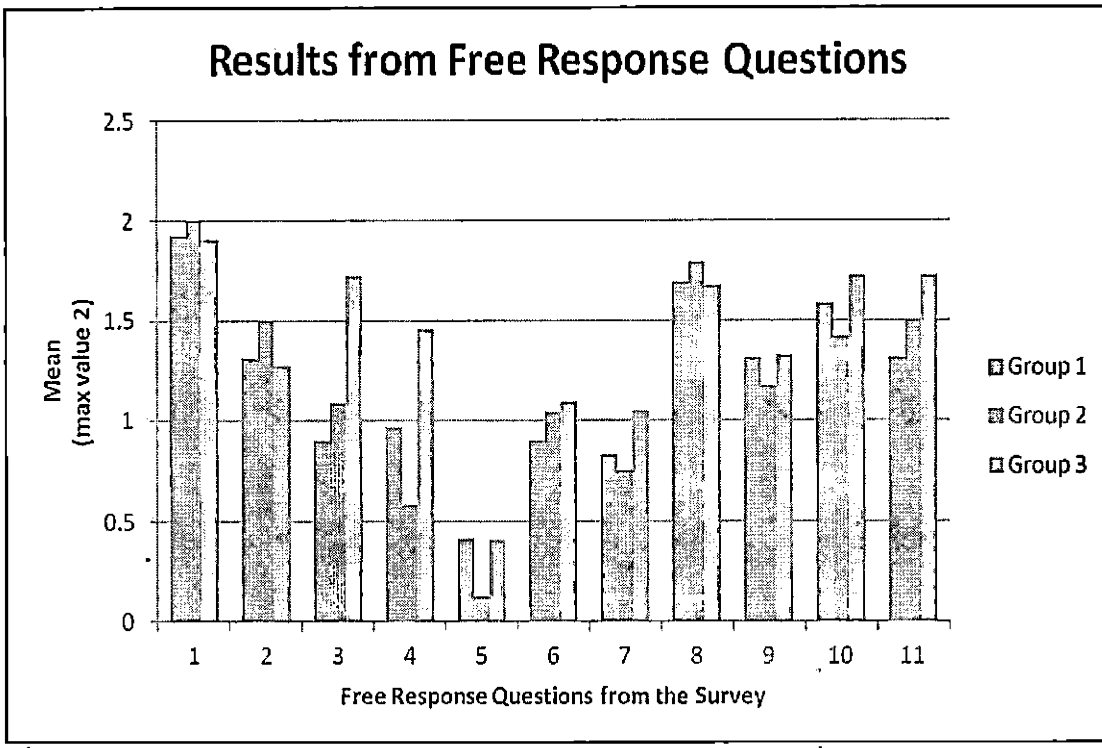


Figure 3. Results from Free Response Questions

In addition to this statistical analysis of the survey, the results of the open-ended question at the end of the survey were analyzed. This question provided students an opportunity to share their opinions about learning mathematics using the whiteboard or using the PowerPoint software. Analysis of students' written responses revealed four themes: 1) Whiteboard is preferred; 2) PowerPoint is preferred; 3) Whiteboard challenges; and 4) Beneficial aspects of PowerPoint.

Whiteboard is Preferred

Student comments ranged from simply stating that they felt whiteboard was a better mode of instruction as reflected in the sample comments below:

- Student 2 (Group 1): "Whiteboard is better" (Student 2; Group 1, Personal Survey, March 2012)
- Student 3 (Group 2): "I like the whiteboard better" (Student 3; Group 2, Personal Survey, March 2012)

Other written responses provided further explanation as to why whiteboard was ideal:

- Student 11 (Group 1): "I like the whiteboard better because the instructor goes slower" (Student 11; Group 1, Personal Survey, March 2012)
- Student 17 (Group 2): "I feel like we go too fast with the PowerPoint" (Student 17; Group 2, Personal Survey, March 2012)
- Student 19 (Group 2): "Whiteboard shows examples a bit better" (Student 19; Group 2, Personal Survey, March 2012)

So it appears for at least some students whiteboard instruction allowed them to move at a more comfortable pace through the topics. Additionally comments reflecting a preference for whiteboard came from only Groups 1 and 2. Out of a total number of 35 students who provided written comments, 7 expressed a preference for whiteboard.

PowerPoint is Preferred

A total of 13 students expressed a preference for PowerPoint with at least one student coming from each group. Some comments merely stated that they liked PowerPoint better:

- Student 14 (Group 1): "I love the PowerPoints" (Student 14; Group 1, Personal Survey, March 2012)
- Student 10 (Group 2): "PowerPoint is much better than the whiteboard" (Student 10; Group 2, Personal Survey, March 2012)
- Student 11 (Group 3): "I like using PowerPoints better than using the whiteboard" (Student 11; Group 3, Personal Survey, March 2012)

Additionally some responses explained as to why students felt this way:

- Student 3 (Group 1): "PowerPoints are easier to take notes with" (Student 3; Group 1, Personal Survey, March 2012)
- Student 7 (Group 2): "PowerPoints are more organized to me" (Student 7; Group 2, Personal Survey, March 2012)

So for other students PowerPoint appeared to provide a clearer, more appealing visual delivery of information and allowed for at least some students to take better notes while in class.

Whiteboard Challenges

Most of the comments related to this theme expressed how it was difficult for students to view the information either due to their inability to comprehend the instructor's writing or not having a good view of the whiteboard (i.e., students or the instructor blocking their view and/or sitting toward the back of the room). A total of 9 students made such comments and included at least two students from each group.

- Student 23 (Group 2): "...when the teacher is writing on the whiteboard information gets blocked so it takes longer to get the notes written" (Student 23; Group 2, Personal Survey, March 2012)

- Student 2 (Group 3): "On the whiteboard you can't read their [teachers] writing" (Student 2; Group 3, Personal Survey, March 2012)
- Student 19 (Group 3): "The whiteboard can be messy, unlegible (sic), and hard to understand" (Student 19; Group 3, Personal Survey, March 2012)

An additional student felt that using whiteboard made instructors more prone to not catching errors they might make:

- Student 14 (Group 3): "I feel as if when the teacher freehands it on the whiteboard or makes a mistake, they won't remember" (Student 14; Group 3, Personal Survey, March 2012)

Another student commented on how the whiteboard was a slower, longer process:

- Student 24 (Group 2): "It takes longer cause the students can't write until they see the notes or hear him speak" (Student 24; Group 2, Personal Survey, March 2012)

So there was a variety of aspects that made whiteboard a challenge for some students from visual accessibility to the quality and pace of instruction.

Beneficial Aspects of PowerPoint

Within this theme students provided clearer reasons as to why PowerPoint was beneficial to their learning of mathematics. One student response stated how using PowerPoint helped to keep their attention more effectively:

- Student 15 (Group 2): "Its (sic) more interesting and attention keeping" (Student 15; Group 2, Personal Survey, March 2012)

Others expressed how it was helpful to have access to PowerPoint not only in class but that they were able to view them from home as well:

- Student 9 (Group 2): "Having powerpoints available is useful at home" (Student 9; Group 2, Personal Survey, March 2012)
- Student 4 (Group 3): "I struggle in math so having these resources available really helps" (Student 4; Group 3, Personal Survey, March 2012)

It also assisted students with being better organized and easier to take notes with:

- Student 10 (Group 3): "Using the PowerPoint is easier to read and knowing exactly what to write down and in what format" (Student 10; Group 3, Personal Survey, March 2012)

- Student 14 (Group 3): "It's much more organized and neater" (Student 14; Group 3, Personal Survey, March 2012)

Lastly, students shared how PowerPoint was a more effective visual teaching tool:

- Student 5 (Group 3): "PowerPoint helps students who are visual as well as audio learners. Helped me understand logs so much more" (Student 5; Group 3, Personal Survey, March 2012)
- Student 17 (Group 3): "The PowerPoint it's easy to read and easy to follow" (Student 17; Group 3, Personal Survey, March 2012)
- Student 21 (Group 1): "Colors on PowerPoint are more appealing" (Student 21; Group 1, Personal Survey, March 2012)

At least one student from each group provided a statement related to this theme with a total of 10 student comments discussing the benefits of PowerPoint. So it appears for at least some students PowerPoint assist in students being more attentive and engaged, and presented the information to students in a clearer format.

Other Student Comments

While there were some student responses did not fit into the four previously discussed themes, they are noteworthy. There were three students who stated that the instructor was a "great" teacher (from Groups 1 and 3) while another one shared how it was the best grade they have earned in a math class (from Group 3). Additionally one student (Group 3) stated they did not like math.

Summary of Results

While looking at the results of all three measuring tools: the quiz results, the test results, and the survey results, it shows that perhaps just switching the sequences and series unit alone does not have a significant impact on the learning of exponential and logarithmic functions. However when put in combination with using PowerPoint software, students performed better on both assessments (i.e., mid-chapter quiz and unit test). Additionally they displayed a greater understanding of the fundamental concepts as shown in the free-response portion of the survey. The survey results also showed that students prefer learning with PowerPoint as opposed to learning with using the whiteboard for numerous reasons.

In addition, the four themes revealed in the student responses on the survey showed important considerations for both PowerPoint and whiteboard instruction. While some students preferred traditional whiteboard instructions, others felt that PowerPoint was more effective in visual delivery of information as well as in assisting with note-taking and attention maintenance. Additionally as reflected in the instructor's observations, PowerPoint instruction might also allow teachers to maintain greater eye contact and dialogue with their students since they are not facing the whiteboard during the bulk of time spent on lectures.

Discussion

Introduction

This study was intended to investigate the impact of two modifications on students' understanding of exponential and logarithmic functions: 1) teaching a unit of sequences and series prior to teaching a unit on logarithms; 2) and using PowerPoint as an instructional tool. In addition to looking at the effectiveness of these modifications, the research examined students' perception of math, their attitudes towards learning math, and if there was a preference for learning math with technology (specifically PowerPoint).

Themes

While performing this study, the researcher was unsure of what the results could be from the two assessments and the survey across the three groups and how it would be interconnected.

By investigating the results from the quiz and the test, it does appear that students who were first exposed to more exponential situational problems within the sequences and series unit earned higher assessment scores in comparison to those who learned about sequences and series after the unit on logarithms. When the data analysis was broken down amongst the individual groups it appears that Group 3 outperformed the other two groups overall, with very few exceptions. The differences in scores between Groups 1 and 3 were statistically significant.

The data also showed that the difference between Group 2 and Group 3 was not significant. However one characteristic of Group 2 that has to be acknowledged that could potentially impact students' results was the number of absences during the course of the instructional time on the logarithms unit. There were twice as many absences in

Group 2 during the same period of time when compared to the number of absences to Groups 1 and 3.

While investigating the results from the survey, many themes were present. It was clear that through student open-ended responses that the students preferred PowerPoint as an instructional tool when compared to use of the whiteboard. These were for various reasons from the ability to more easily read information on slides to the fact that it kept them more engaged to the lecture feeling more organized. Likert scale responses also overwhelmingly showed support for PowerPoint instruction over whiteboard usage. A large number of students used the PowerPoint files that were available online when outside the classroom as an additional resource. Almost 70% of the students used the PowerPoint files without audio to review or study the material, which was much higher than the researcher anticipated.

Implications for Theory and Practice

While the data is not overwhelming significant as all major F-tests failed to show significance, this study does have implications for a potential shift in the ordering of how the units taught in Algebra II are currently organized. It is evident that the students who were provided information about sequences and series before logarithms fared better than those who did not. As reflected by the means of the results for both the quiz and the test, Group 3 performed significantly better than Group 1. This could be directly connected to not only having the knowledge of a new or unfamiliar counting principle, but also the clarity of knowledge disseminated via PowerPoint. The fact that mean scores of Groups 1 and 2 were relatively similar might discourage instructors from reordering the units. However it must be taken into consideration that there were twice as many absences in Group 2 than in Group 1 during the time that the same information was covered. This could explain why Group 2 scores were lower than might have been expected.

This project also provides some validation to previous studies (based on student responses from the survey to the free response questions where rational and reasoning was required) that stated when lectures are more interesting, visually stimulating can impact student understanding (Szabo & Hastings, 2000). In addition the results from the survey support the idea that students should have access to as many resources at home because it could prove to beneficial to student performance (Kitsantas et al., 2011).

Conclusions

The results from this study as reflected in the assessments as well as the survey responses confirm the researcher's expectation that instruction using PowerPoint along with teaching sequences and series before logarithms would improve student performance and understanding of logs. Furthermore the findings of the present study are connected to previous research in various aspects.

In the current study, the majority of students expressed a preference for PowerPoint over the whiteboard because of its ease of use and comprehension. As with the findings of Szabo and Hastings (2000) students in the present study found the PowerPoint lectures to be more engaging, interesting, and organized. This was reflected consistently in students' survey responses.

Previous studies also showed a diversity of implications that technology could have on students' assessment scores. While Taylor (2008) found that students' mean scores increased as a result of the use of technology (i.e., ALEKS), studies examining specifically the impact of PowerPoint usage on tests scores (Amare, 2006; Susskind, 2005) did not reveal any implications on such scores. However the current study did in fact find that PowerPoint makes a difference as reflected by Group 3 assessment scores, which were statistically significant in comparison to Group 1. Furthermore the current study provides support for the fact that an effective PowerPoint presentation that integrates animation, graphics, and color variation can make a difference regarding students' learning and performance (Susskind, 2005; Taylor, 2008).

The present study provides support for Confrey's (1994) assertions as well. Students who were exposed to sequences and series before the unit on logarithms performed better on logs overall. This in part can be attributed to Confrey's (1994) belief that having students become more familiar with exponential counting principles and having them receive sufficient practice with these concepts will allow students to create a better understanding of logarithms and how they work.

In addition it is important to emphasize that PowerPoint alone or the switching of units alone is not enough. Rather it is the combination of teaching sequences and series before logarithms along with disseminating information and concepts using PowerPoint the ultimately lead to students' performance. This is evidenced by the fact that the only statistical significance that was consistent between groups were those scores between Groups 1 and 3. This study also supports previous researchers who stated that PowerPoint alone is not necessarily sufficient in improving student learning. Rather, in order to have its greatest impact PowerPoint must be in conjunction with other effective teaching strategies such as instructor enthusiasm, knowledge, and teaching style (Susskind, 2005; Taylor, 2008). Therefore a more comprehensive instructional approach is necessary.

Lastly this study was interested in exploring whether or not the use of PowerPoint during instruction would result in greater self-efficacy regarding math among students. The majority of students felt "comfortable with math" (i.e., 56 out of 75 *Agreed* to *Strongly Agreed*) and were "more confident with their math abilities" (i.e., 54 out of 75 *Agreed* to *Strongly Agreed*) as reflected by their survey responses. These findings are in keeping with the results from previous studies where students felt more comfortable with the subject matter and developed greater confidence in their abilities when technology was incorporated into the classroom (i.e., ALEKS, PowerPoint) (Amare, 2006; Susskind, 2005; Taylor, 2008).

In conclusion, the researcher believes that while there is more work to be done, the evidence is compelling enough to make the instructor reorder the curriculum so that the sequences and series unit comes before the logarithm unit. In addition, using PowerPoint software will help engage students more effectively while in class, and at the same time provide them with an additional resource to access from home.

Recommendations for Future Studies

The researcher believes there are some modifications that should be looked at to further examine how the order of curriculum as well as instructional tools (i.e. PowerPoint) might enhance student understanding of mathematics. To expand this research, using a larger population may provide more insight. It might be interesting to also investigate using PowerPoint with different types of units besides logarithms, such as something with more visual concepts. In addition, it might be prudent to look at how using PowerPoint could impact other courses in math besides Algebra II, including Geometry or Calculus.

Another fundamental change to take into consideration in a future study would be the inclusion of a fourth group where the order of the curriculum does not change (from the typical order of logarithms then sequences and series), but where students are instructed on logarithms using PowerPoint to isolate the results on the effect of using PowerPoint. Since most of the data was significant between Groups 3 (received sequences and series first and logs with PowerPoint) and 1 (received logs first without PowerPoint, then sequences and series following), having a fourth group where students learned logs first using PowerPoint and sequences and series following would have been another important comparison group to help determine if PowerPoint and unit ordering truly made a difference. This would provide a more comprehensive group comparison.

In addition, a future study could also investigate another variable: the quality of the actual PowerPoint presentations. Being that the PowerPoint slides used this study were uniquely made by the researcher, it should be investigated how the quality of the PowerPoint presentations can shape what the students come to learn and understand. A possible comparison could be if one class is instructed using PowerPoint software with a variety of animation and color and another class that also receives instruction with PowerPoint but where there is no animation and no color is incorporated. Another aspect that could be studied is the design of the PowerPoint lecture and how the actual layout of the PowerPoint presentation can impact student learning.

Lastly, the researcher would also recommend that replication of this project use more comparable subjects. For instance results might prove to be more consistent if the classes used are all from the same time of day since within the current study the number of absences from the groups that met earlier in the day were much more prevalent than the groups that met later on as the day progressed.

APPENDIX A

MID-CHAPTER QUIZ

Chapter 8 Quiz **Name**________________

For problems 1 and 2, write an exponential function to model each situation. Then find each amount after the specified time.

1. Carl's weight at 12 yrs old is 82 lbs. His weight will increase at a rate of 16% each year. What will he weigh in 5 years? (Round answer to the nearest pound).

2. A motorcycle purchased for $9,000 today will be worth 6% less each year. For what could you expect to sell the motorcycle at the end of 6 yrs? (Round to the nearest dollar).

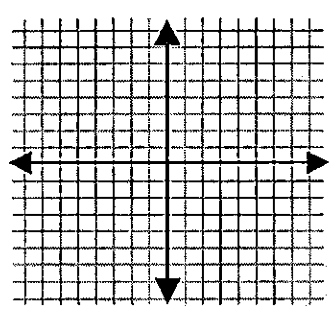
For problems 3 and 4, use the correct formula for compounded interest to find the solution.

3. $12,000 continuously compounded at 8% for 12 years.

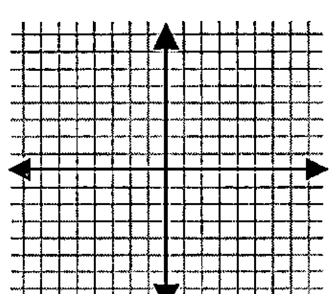
4. You deposit $4000 in an account that pays 3% interest that gets compounded quarterly. How much money will you have in 6 years?

For problems 5 and 6 graph the following equations.

5. $y = \left(\frac{1}{2}\right)^{x-2}$



6. $y = \log_2 x$



For problem 7, rewrite the expression as the equivalent logarithmic expression.

7. $2^5 = 32$

For problem 8, rewrite the expression as the equivalent exponential expression.

8. $\log_8 512 = 3$

For problems 9 and 10 evaluate the logarithm.

9. $\log_4 64$

10. $\log_5 5$

Developed by Robert Ward Kopp

APPENDIX B

END-OF-UNIT EXAM

Chapter 8 Test **Good Luck To** ____________________

Algebra II **Period** ______ **Date** ______________

NO CALCULATORS!!!!!

Write in logarithmic form.

1. $7^3 = 343$ 2. $9^{-\frac{1}{2}} = \frac{1}{3}$ 3. $e^3 \approx 20.1$

Write in exponential form.

4. $\log_4 64 = 3$ 5. $\log_5 1 = 0$ 6. $\ln 24 \approx 3.2$

Simplify.

7. $\log_5 5 =$ ______   8. $\log_2\left(\frac{1}{32}\right) =$ ______   9. $\log_3 81 =$ ______

10. $\log_7 1 =$ ______   11. $\log_9 3 =$ ______   12. $\ln e^3 =$ ______

Expand each expression.

13. $\ln \frac{7x^3}{22}$ 14. $\log_{10} x^2 y^{-3}$ 15. $\log_3\left(\frac{5}{2x}\right)$

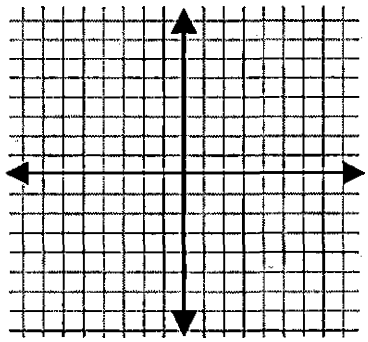
Condense each expression.

16. $5\ln w - 3\ln v$ 17. $\log_4 y + 4\log_4 3 + \log_4 x$

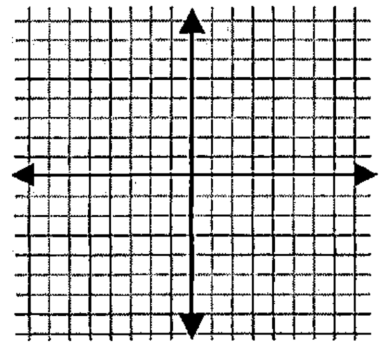
18. $\frac{1}{2}\log_3 4 - (2\log_3 y + 4\log_3 x)$

Graph the following equations.

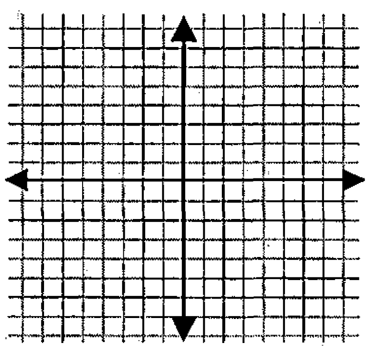
19. $y = 3^{x+2}$



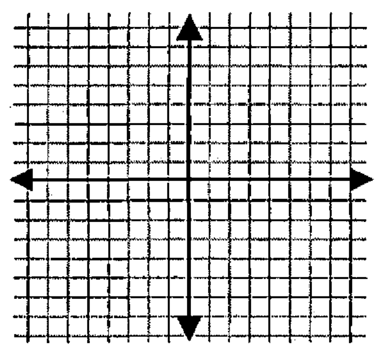
20. $y = \left(\frac{1}{2}\right)^x - 2$



21. $y = 2 + \log_2 x$



22. $y = -1 + \log_4 (x-3)$



Algebra II **Good Luck To** ______________________

Chapter 8 Test Form A **Period** __________ **Date** ______________

Part II—CALCULATORS REQUIRED

Solve the following equations. Approximate, when necessary, to three decimal places.

23. $\ln 7x = -3$

24. $\log x - \log 4 = -1$

25. $e^{3x+5} = 49$

26. $\log(2x+5) = \log(x+9)$

27. $\ln(x+3) = 1$

28. $5^{4x} = 23$

29. $7^{x+2} = 29$

30. $\log_4 8 + \log_4 x = 5$

31. $6e^x = 120$

Use exponential formulas to solve the following equations. Show all work.

32. Suppose you invest $35,000 in a continuously compounding account earning 7% interest. How much money will you have in 9 years?

33. The population of Great Britain is approximately 48 million people. It increases an average of 3% a year. What will the population be in 4 years?

34. You invest $6500 in an account that compounds interest at a rate of 4% on a quarterly basis. How much money will you have in 9 years?

35. The initial value of a truck is $14,000. It depreciates 9% a year. Estimate the value of the truck after 3 years.

MULTIPLE CHOICE

36. Which of the following is equivalent to $\log \frac{xy^2}{z}$?

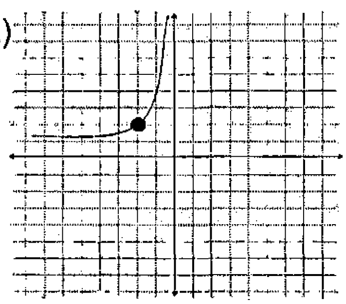
A) $\log x + 2\log y + \log z$ B) $\log x + 2\log y - \log z$

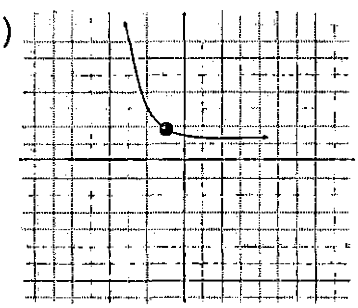
C) $\log z - \log x - 2\log y$ D) $2\log xy - \log z$

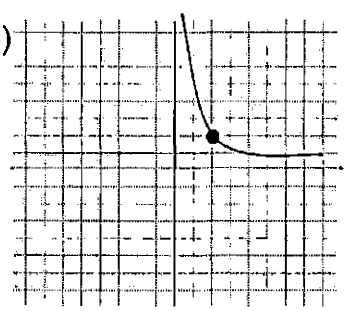
37. Which of the following is equivalent to $\log_b a = c$

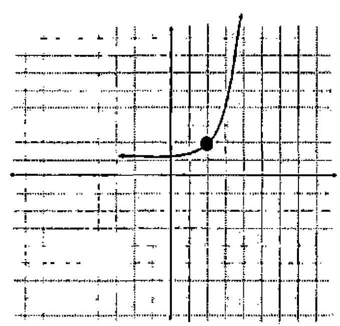
A) $a^b = c$ B) $c^a = b$ C) $b^a = c$ D) $b^c = a$

38. Graph: $y = 6^{x+2} + 1$

A) 

B) 

C) 

D) 

39. Write the expression as a single logarithm: $5\log_b q + 2\log_b y$

A) $\log_b q^5 y^2$ B) $(5+2)\log_b (q+y)$

C) $\log_b (q^2 + y^2)$ D) $\log_b qy^7$

40. Solve: $\log(4x+10) = 3$

A) $-\frac{7}{4}$ B) $\frac{495}{2}$

C) 250 D) 990

41. Solve: $\ln(2x-1)=8$ (Round to the nearest thousandth)

A) 1,489.979 B) 2,979.958
C) 2,981.458 D) 1,490.979

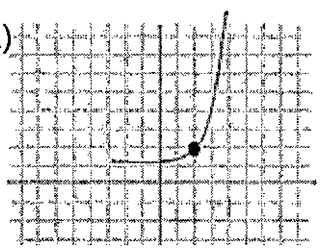
42. Solve: $e^{2x}=1.4$

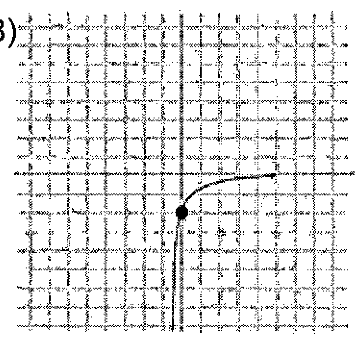
A) -1.664 B) 0.073
C) 0.168 D) 0.190

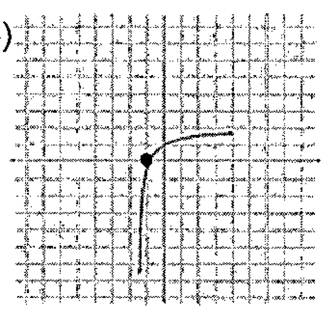
43. For an annual rate of change of -31%, find the corresponding growth or decay factor. (hint: what number would you use in a word problem?)

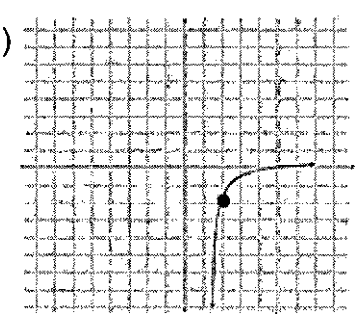
A) 0.31 B) 0.69
C) 1.31 D) 1.69

44. Graph: $y=\log(x+1)-2$

A) 

B) 

C) 

D) 

Developed by Robert Ward Kopp

APPENDIX C

SURVEY FOR STUDENTS

Algebra II/Trigonometry Survey

This is an anonymous survey, so please do <u>**not**</u> include your name. Use the following scale to respond to the statements below:

1 = Strongly Disagree
2 = Disagree
3 = Not Sure/Not Applicable
4 = Agree
5 = Strongly Agree

1.	Having in-class lectures with PowerPoint is helpful.	1	2	3	4	5
2.	Having access to the PowerPoint files online is helpful.	1	2	3	4	5
3.	The PowerPoint slides for this class help me complete my assignments.	1	2	3	4	5
4.	PowerPoint lectures are distracting and make learning more difficult.	1	2	3	4	5
5.	I do not like learning through PowerPoint presentations.	1	2	3	4	5
6.	Lectures using PowerPoint capture my attention better.	1	2	3	4	5
7.	PowerPoint lectures are more organized than presentations where the white board is used.	1	2	3	4	5
8.	PowerPoint lectures are more boring than lectures where the whiteboard is used.	1	2	3	4	5
9.	It would be better if the instructor just used the white board during lectures.	1	2	3	4	5
10.	It is easier to take notes when the lecture is done using PowerPoint.	1	2	3	4	5
11.	I prefer lectures with PowerPoint over the lectures using the white board.	1	2	3	4	5

12. PowerPoint lectures are more beneficial to learning mathematics (than lectures using the white board).	1	2	3	4	5
13. I prefer lectures using the whiteboard over lectures that use PowerPoint.	1	2	3	4	5
14. I have used the PowerPoint files provided online while at home to review for quizzes and tests in this class.	1	2	3	4	5
15. The instructor is organized and prepared.	1	2	3	4	5
16. Lectures using the whiteboard are more interesting than lectures using PowerPoint.	1	2	3	4	5
17. I feel more comfortable with math now than before I took this class because the PowerPoint slides are easier to read and understand.	1	2	3	4	5
18. I am more confident in my math abilities than I was before I took this class.	1	2	3	4	5
19. It is easier to take notes when the lecture is performed using the white board.	1	2	3	4	5
20. Lectures using PowerPoint help me stay more focused.	1	2	3	4	5
21. The teacher makes more of a difference than the PowerPoint slides.	1	2	3	4	5

Developed by Robert Ward Kopp

Please answer the following questions and answer as completely as possible.

What is 2^3?

What is $\log_2 64$?

What is $\log_x x$?

If we know that $\log_9 729 = 3$, what is $\log_3 729$?

What can $b^x b^y$ be simplified to? Why?

$\log_a x^r$ can be simplified to what? Why?

How can you express the square root of *x* as a power? Why?

Is $\left(\frac{1}{2}\right)^x$ an increasing function or a decreasing function? Why?

Is $(-3)^{10}$ a positive or negative number? Why?

Is 5^{14} an even number or an odd number?

How would you find $\log_5 78125$?

Did you use the PowerPoints on the website? If so, approximately how many times did you open the slideshows (without audio) while studying for this log unit?

Did you use the PowerPoints online that had the voiceovers (i.e. with audio)? If so, approximately how many times did you open those slideshows to listen to the lectures?

Is there anything else you would like to share about learning mathematics with PowerPoint or the whiteboard? Please share here:

Weber, K. (2002). *Students' understanding of exponential and logarithmic functions*. Unpublished manuscript, Mathematics and Statistics, Murray State University, Murray, KY. Available from ED. (477 690).

APPENDIX D

DEMOGRAPHIC DATA

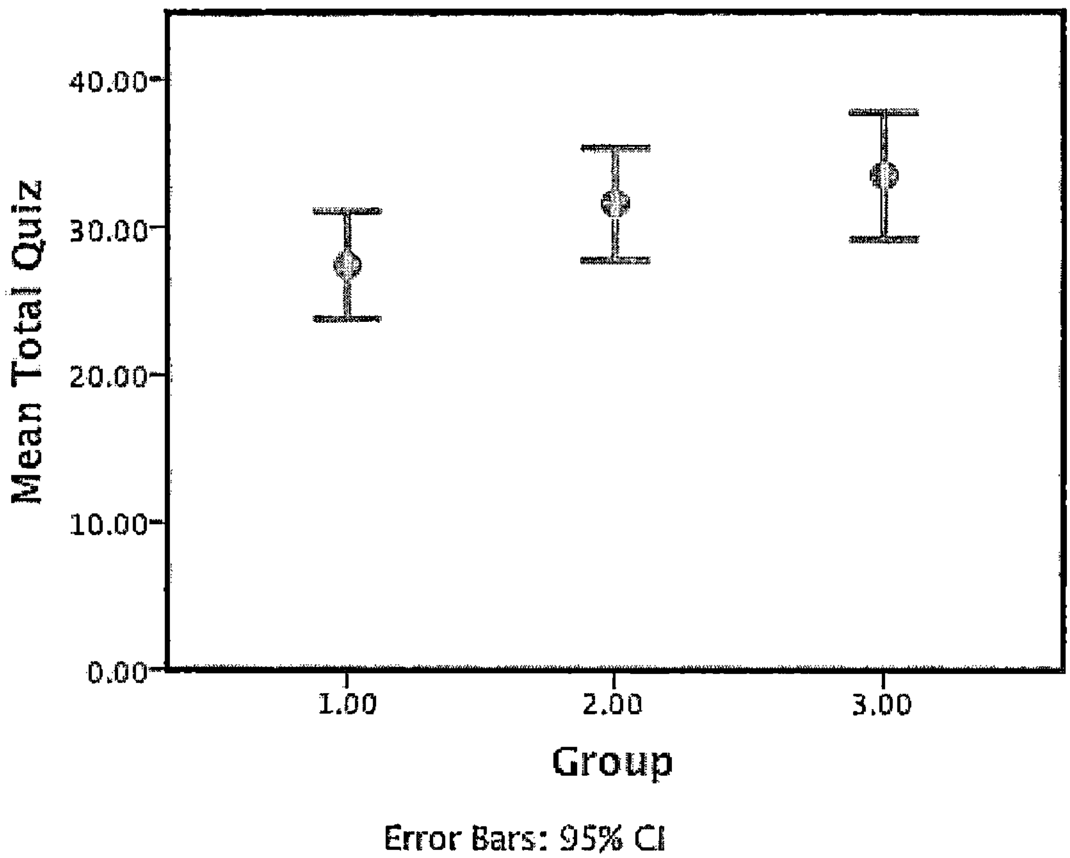
[redacted]	Females	Males	Grade Level of Students		First Semester Grades in Algebra II		
			10th Grade		A	7	24.1%
			12	41.4%	B	7	24.1%
Group 1	14	15	11th Grade		C	10	34.5%
	48.3%	51.7%	11	37.9%	D	4	13.8%
			12th Grade		F	1	3.4%
			6	20.7%			
			[redacted]				
			10th Grade		A	6	25%
			9	37.5%	B	10	41.7%
Group 2	16	8	11th Grade		C	6	25%
	66.7%	33.3%	11	45.8%	D	2	8.3%
			12th Grade		F	0	0%
			4	16.7%			
			[redacted]				
			10th Grade		A	7	31.8%
			11	50%	B	8	36.4%
Group 3	14	8	11th Grade		C	7	31.8%
	63.6%	36.4%	7	31.8%	D	0	0%
			12th Grade		F	0	0%
			4	18.2%			

APPENDIX E

TABLES AND GRAPHS OF DATA FROM THE QUIZ

Descriptive Statistics: Total Quiz

Group	Mean	Standard Deviation	*N*
1	27.4483	9.48904	29
2	31.5417	8.91008	24
3	33.4091	9.54518	22
Total	30.5067	9.54559	75


Mean Total Quiz
40.00
30.00
20.00
10.00
0.00
1.00
2.00
3.00
Group
Error Bars: 95% CI

ANOVA Table for Quiz Questions #1 and # 2

Source	Sum of Squares	df	Mean Square	F	p	η^2
Group	3.479	2	1.740	.339	.714	.009
Error	370.007	72	5.139			
Corrected Total	373.487	74				

Group Comparison of Quiz Questions #1 and #2

(I) Group	(J) Group	Mean Difference	Standard Error	Significance	95 % Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-.3247	.62556	.605	-1.5718	.9223
	3.00	-.5141	.64093	.425	-1.7918	.7636
2.00	3.00	-.1894	.6692	.778	-1.5233	1.1445

ANOVA Table for Quiz Questions #7 and #8

Source	df	F	p	η^2
Group	2	2.616	0.80	.068
Error	72			
Total	74			

Group Comparison of Quiz Questions #7 and #8

(I) Group	(J) Group	Mean Difference	Standard Error	Significance	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-.3736	.30350	.222	-.9786	.2314
	3.00	-.7069	.31095	.026	-1.3268	-.0870
2.00	1.00	.3736	.30350	.222	-.2314	.9786

The error term is Mean Square (Error) = 2.210

ANOVA Table for Quiz Word Problems

Source	Sum of Squares	df	Mean Square	F	p	η^2
Group	12.570	2	6.285	2.20	.118	.058
Error	205.666	72	2.856			
Corrected Total	218.237	74				

Group Comparison of Quiz Word Problems

(I) Group	(J) Group	Mean Difference	Standard Error	Significance	95 % Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-.7205	.46639	.127	-1.6503	.2092
	3.00	-.9346	.47785	.054	-1.8871	.0180
2.00	3.00	-.2140	.49886	.669	-1.2085	.7804

ANOVA Table for Total Quiz

Source	Sum of Squares	df	Mean Square	F	p	η^2
Group	482.298	2	241.149	2.773	.069	.072
Error	6260.449	72	86.951			
Corrected Total	6742.747	74				

Group Comparison of Total Quiz

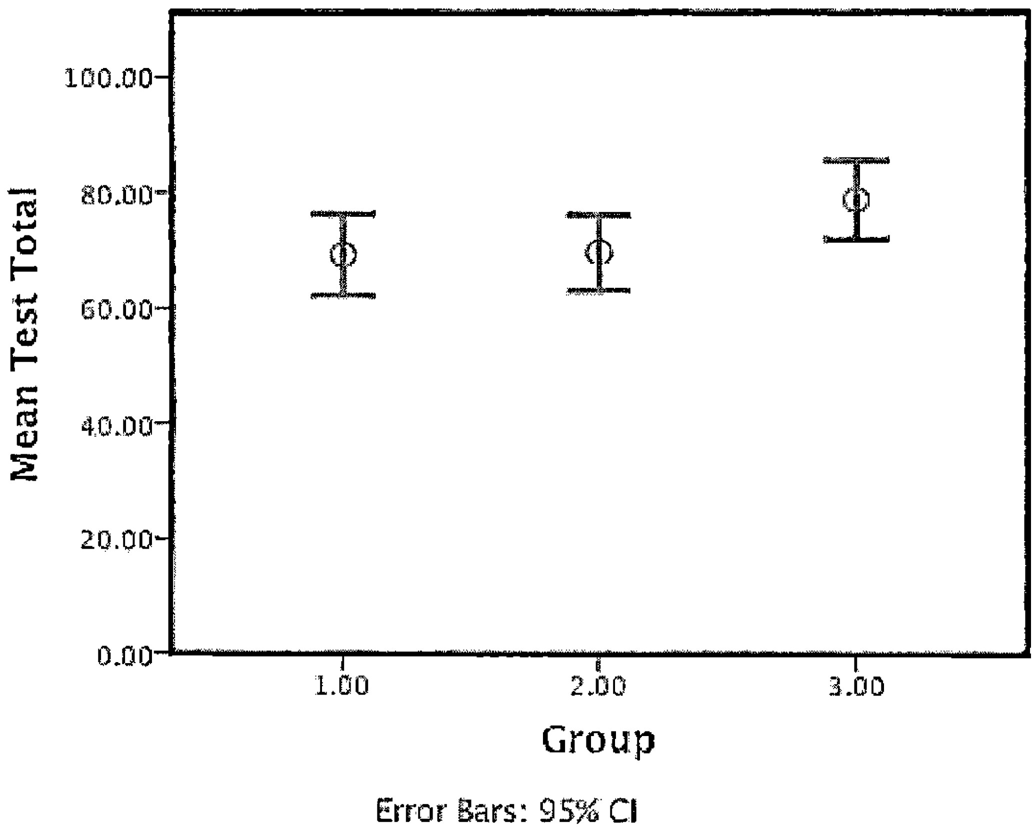
(I) Group	(J) Group	Mean Difference	Standard Error	Significance	95 % Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-4.0934	2.57318	.116	-9.2229	1.0361
	3.00	-5.9608	2.63640	.027	-11.2164	-.7052
2.00	3.00	-1.8674	2.75232	.500	-7.3541	3.6192

APPENDIX F

TABLES AND GRAPHS OF DATA FROM THE EXAM

Descriptive Statistics: Total Test

Group	Mean	Standard Deviation	N
1	69.1724	18.54352	29
2	69.5000	15.52277	24
3	78.6364	15.53964	22
Total	72.053	17.08160	75


100.00
80.00
60.00
40.00
20.00
0.00
Mean Test Total
1.00
2.00
3.00
Group
Error Bars: 95% CI

ANOVA Table for Test Evaluation Problems

Source	Sum of Squares	df	Mean Square	F	p	η^2
Group	1.257	2	.629	3.070	.053	.079
Error	14.743	72	.205			
Corrected Total	16.000	74				

Group Comparison of Test Evaluation Problems

(I) Group	(J) Group	Mean Difference	Standard Error	Significance	95 % Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	.2965	.12487	.020	.0475	.5454
	3.00	.0528	.12794	.681	-.2023	.3078
2.00	3.00	-.2437	.13356	.072	-.5099	.0226

ANOVA Table for Test Total

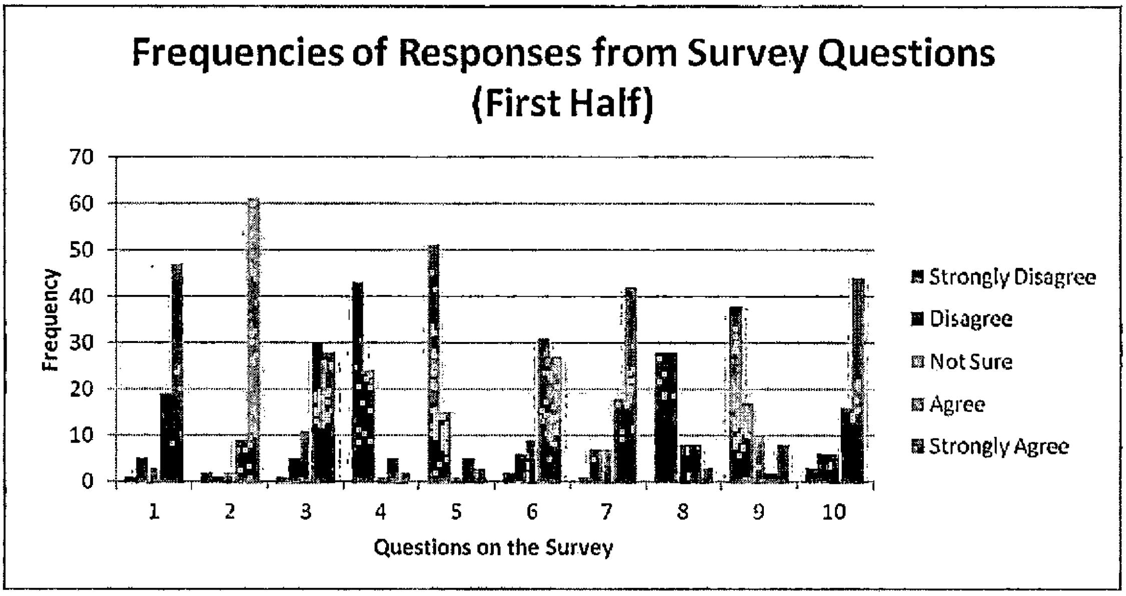
Source	Sum of Squares	df	Mean Square	F	p	η^2
Group	1350.558	2	675.279	2.402	.098	.063
Error	20241.229	72	281.128			
Corrected Total	21591.787	74				

Group Comparison of Test Total

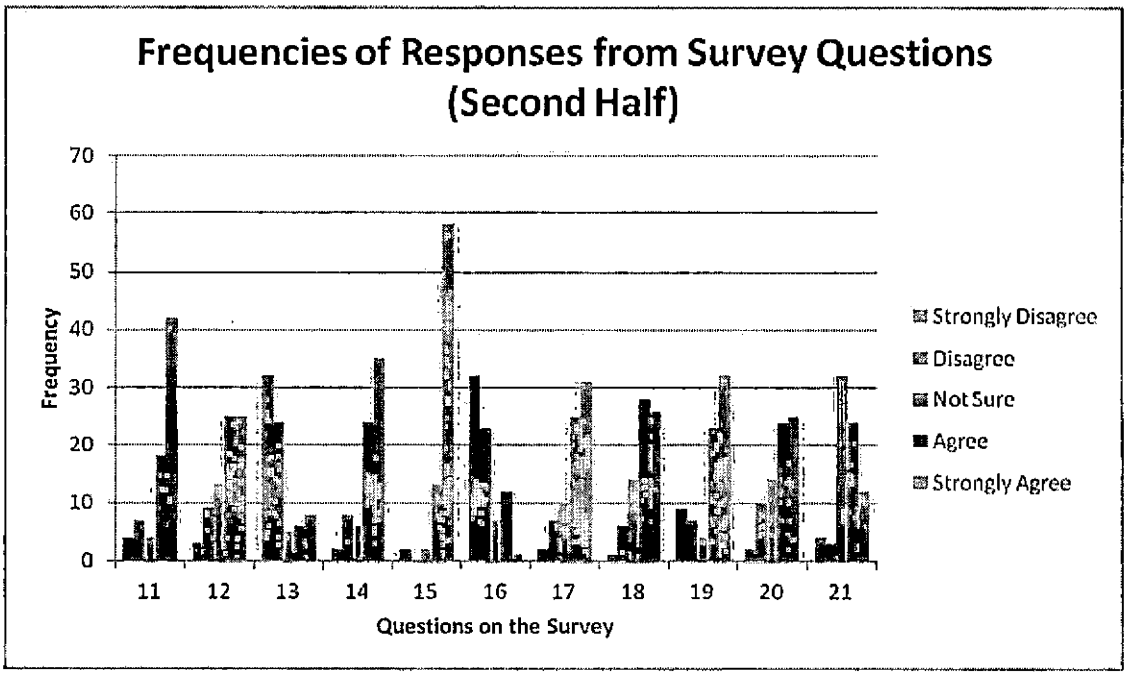
(I) Group	(J) Group	Mean Difference	Standard Error	Significance	95 % Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-.3276	4.62685	.944	-9.5510	8.8959
	3.00	-9.4639	4.74053	.050	-18.9140	-.0139
2.00	3.00	-9.1364	4.94896	.069	-19.0019	.7292

APPENDIX G

TABLES AND RESPONSES FROM THE SURVEY



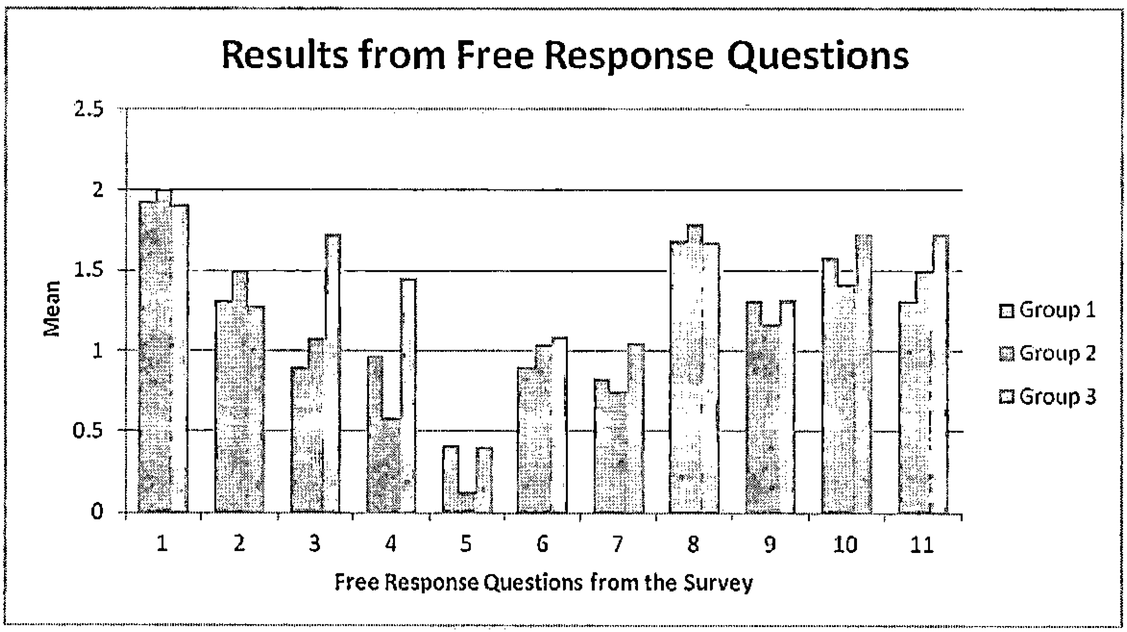
Frequencies of Responses from Survey Questions (First Half)
Frequency
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
Questions on the Survey
Strongly Disagree
Disagree
Not Sure
Agree
Strongly Agree



Frequencies of Responses from Survey Questions (Second Half)
Frequency
70
60
50
40
30
20
10
0
11
12
13
14
15
16
17
18
19
20
21
Questions on the Survey
Strongly Disagree
Disagree
Not Sure
Agree
Strongly Agree

Report on Free Response Questions

Group		Q#1	Q#2	Q#3	Q#4	Q#5	Q#6	Q#7	Q#8	Q#9	Q#10	Q#11
1.0	Mean	1.93	1.31	.896	.965	.413	.896	.827	1.68	1.31	1.58	1.31
	Std. Dev.	.371	.967	1.01	1.01	.732	.900	.848	.660	.849	.824	.967
2.0	Mean	2.00	1.50	1.08	.583	.125	1.04	.750	1.79	1.16	1.41	1.50
	Std. Dev.	.00	.884	.928	.928	.448	.954	.794	.588	.963	.928	.884
3.0	Mean	1.90	1.27	1.72	1.45	.409	1.09	1.04	1.68	1.31	1.72	1.72
	Std. Dev.	.426	.984	.702	.911	.796	.921	.998	.716	.893	.702	.702
Total	Mean	1.94	1.36	1.20	.986	.320	1.00	.866	1.72	1.26	1.57	1.49
	Std. Dev.	.324	.939	.958	1.006	.681	.915	.875	.648	.890	.824	.875



ANOVA Table for Free Response Questions

Source	Sum of Squares	df	Mean Square	F	*p*	η^2
Group	.687	2	.344	2.774	.069	.072
Error	8.921	72	.124			
Corrected Total	9.609	74				

Group Comparisons of Free Response Questions

(I) Group	(J) Group	Mean Difference	Standard Error	Significance	95 % Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	.0163	.09714	.867	-.1773	.2100
	3.00	-.2023	.09952	.046	-.4007	-.0039
2.00	3.00	-.2187	.10390	.039	-.4258	-.0115

Number of Students Who Used PowerPoint Files Without Audio

Valid Responses	Frequency	Percent	Cumulative Percent
Did Not Use	23	30.7	30.7
Did Use	52	69.3	100.0
Total	75	100.0	

Number of Times Students Used PowerPoint Without Audio

# of Times Used	Frequency	Percent	Cumulative Percent
.00	30	40.0	40.0
1.00	5	6.7	46.7
2.00	20	26.7	73.3
3.00	8	10.7	84.0
4.00	2	2.7	86.7
5.00	2	2.7	89.3
6.00	1	1.3	90.7
8.00	1	1.3	92.0
10.00	5	6.7	98.7
12.00	1	1.3	100.0

Number of Students Who Used PowerPoint Files With Audio

Valid Responses	Frequency	Percent	Cumulative Percent
Did Not Use	45	60.0	60.0
Did Use	30	40.0	100.0
Total	75	100.0	

Number of Times Students Used PowerPoint Files with Audio

# of Times Used	Frequency	Percent	Cumulative Percent
.00	51	68.0	68.0
1.00	6	8.0	76.0
2.00	6	8.0	84.0
3.00	5	6.7	90.7
4.00	1	1.3	92.0
5.00	2	2.7	94.7
7.00	1	1.3	96.0
10.00	2	2.7	98.7
20.00	1	1.3	100.00

APPENDIX H

INSTITUTIONAL REVIEW BOARD

CALIFORNIA STATE UNIVERSITY
SAN BERNARDINO

Academic Affairs
Office of Academic Research • Institutional Review Board

January 9, 2012

CSUSB INSTITUTIONAL REVIEW BOARD
Full Board Review
IRB# 11041
Status
APPROVED

Mr. Robert Kopp
c/o: Prof. Matt Riggs
Department of Psychology
California State University
5500 University Parkway
San Bernardino, California 92407

Dear Mr. Kopp

Your application to use human subjects, titled "Teaching Mathematics with PowerPoint" has been reviewed and approved by the Institutional Review Board (IRB). The attached informed consent document has been stamped and signed by the IRB chairperson. All subsequent copies used must be this officially approved version. A change in your informed consent (no matter how minor the change) requires resubmission of your protocol as amended. **Your application is approved for one year from January 09, 2012 through January 08, 2013. One month prior to the approval end date you need to file for a renewal if you have not completed your research. See additional requirements (Items 1 – 4) of your approval below.**

Your responsibilities as the researcher/investigator reporting to the IRB Committee include the following 4 requirements as mandated by the Code of Federal Regulations 45 CFR 46 listed below. Please note that the protocol change form and renewal form are located on the IRB website under the forms menu. Failure to notify the IRB of the above may result in disciplinary action. You are required to keep copies of the informed consent forms and data for at least three years.

1) **Submit a protocol change form if any changes (no matter how minor) are made in your research prospectus/protocol for review and approval of the IRB before implemented in your research,**
2) **If any unanticipated/adverse events are experienced by subjects during your research,**
3) **Too renew your protocol one month prior to the protocols end date,**
4) **When your project has ended by emailing the IRB Coordinator/Compliance Analyst.**

The CSUSB IRB has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval notice does not replace any departmental or additional approvals which may be required.

If you have any questions regarding the IRB decision, please contact Michael Gillespie, IRB Compliance Coordinator. Mr. Michael Gillespie can be reached by phone at (909) 537-7588, by fax at (909) 537-7028, or by email at mgillesp@csusb.edu. Please include your application approval identification number (listed at the top) in all correspondence.

Best of luck with your research.

Sincerely, *Sharon Ward, Ph.D.*

Sharon Ward, Ph.D., Chair
Institutional Review Board

SW/mg

cc: Prof. Matt Riggs, Department of Psychology

909.537.7588 • fax: 909.537.7028 • http://irb.csusb.edu/
5500 UNIVERSITY PARKWAY, SAN BERNARDINO, CA 92407-2393

CALIFORNIA STATE UNIVERSITY
SAN BERNARDINO

College of Natural Sciences
Department of Mathematics

CALIFORNIA STATE UNIVERSITY, SAN BERNARDINO
INSTITUTIONAL REVIEW BOARD COMMITTEE
APPROVED 01/09/12 VOID AFTER 01/08/13
IRB# 11041 CHAIR [signature], Ph.

February 29, 2012

Dear Parent(s)/Guardian(s):

My name is Robert Kopp and I am currently your student's Algebra II/Trigonometry teacher at Vista Murrieta High School. I am also a graduate student at Cal State San Bernardino (CSUSB). As part of my graduate studies I am doing research under the supervision of Dr. Matt Riggs, Professor of Psychology at CSUSB. This study has been approved by the University's Institutional Review Board.

PURPOSE: I am doing research about the impact of Powerpoint on students' learning and attitudes towards mathematics. In addition, I will be performing research on whether having prior knowledge of sequences and series will impact how students understand exponential and logarithmic expressions and equations.

DESCRIPTION: I am offering participation in my study to students who are enrolled in all three of my Algebra II/Trigonometry sections classes. Each class will receive instruction as follows: 1) One class will be taught in the normal manner as would be expected in any other Algebra II class where they will be instructed on topics with logarithms using the whiteboard followed by the unit on sequences and series; 2) A second class will learn about sequences and series prior to the the unit on logarithms. (This particular class will also be instructed on logarithms using the white board as well.); and 3) The third class will receive instruction on sequences and series followed by the unit on logarithms, using PowerPoint instruction for both units. The information covered will be the same for all sections. Additionally, PowerPoint materials will continue to be available to students online. At the conclusion of the logarithms unit, I will analyze students' assessments and ask them to complete an anonymous survey about how they felt they performed and which presentation method they prefer.

PARTICIPATION: Involvement in this study is completely voluntary. Students may decline to participate. This means that while they will continue to attend class as usual, their assessment scores will not be included in the data reported in the research. Additionally they will not be asked to complete the anonymous survey. There will be no penalty or loss of benefit should a student decide not to participate or to withdraw from the study.

CONFIDENTIALITY: Only class averages for the assessments and survey will be reported. This means no student names will be mentioned nor will their name be reported with specific scores. Specific student records (i.e., assessments, scores and survey responses) will be stored in at least

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one of two locations: 1) a locked file cabinet in the classroom where the instructor is the only person with a key; and 2) the password-protected VMHS online grade book (Aeries).

DURATION: This study should be approximately four weeks long in the Spring 2012 semester.

RISKS: There are no risks to participate in this study.

BENEFITS: To determine whether or not PowerPoint has an impact on students' learning and attitudes toward mathematics.

CONTACT: Pertinent questions and concerns about this research and research subjects' rights in regards to this study can be directed to Dr. Matt Riggs at (909) 537-5574 or mriggs@csusb.edu.

Please sign below to indicate permission for your student's participation in this study and return the signed form to me by the end of the week.

Sincerely,

Robert Kopp

I, hereby grant permission for my student to participate in the aforementioned study.

__________________________ __________________________

Student Name (Please print clearly) Parent/Guardian Signature

Please sign here if you are over 18 years of age.

__________________________ __________________________

Student Name (Please print clearly) Student Signature

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CHILD ASSENT SCRIPT

Participation In Study

I would like to invite you to take part in this study. Your parents have agreed to your participation in this study. We will be learning about logarithms, and in addition, sequences and series for the next couple of weeks and I will be analyzing the effects of how teaching students with the whiteboard and/or with PowerPoint software has on your mathematical understanding and your opinion towards learning mathematics. At the same time I will be analyzing whether or not prior knowledge of sequences and series will aid in your understanding of exponential and logarithm expressions. Your data from the chapter quiz and the chapter test from the logarithms unit will be calculated with the results from everyone else in the class and at the conclusion of the unit you will complete an anonymous survey. Your scores will not be individually reported in this study. Your participation will not influence your class grade. You do not have to partake in this study if you do not want to. If you prefer that I not use your test scores in my research project, all you have to do is let me know and I will not use your scores. You will still participate in the class as usual, and will still be responsible for taking all assessments as they will count toward your grade in this class, but I will not include your scores in my study. If you make the choice not to participate, I will not hold that against you in any way and it will have no effect on your grade in this class. If you decide to withdraw from this study, you will also be excused from taking the anonymous survey at the end of the unit. Your participation is your choice. You are free to stop participating at any time. You do not have to participate just because your parents signed the form. If you have any questions at any time, please ask me. If you agree to participate, would you please raise your hand at this time?

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