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The impact of digital organization on retention in college algebra

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University of Northern Iowa

THE IMPACT OF DIGITAL ORGANIZATION ON RETENTION IN

COLLEGE ALGEBRA

An Abstract of a Dissertation

Submitted

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

Approved:

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Dr. Mary C. Herring, Co-Chair

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ABSTRACT

This study examined the impact of digital organization for developmental mathematics students using technologically mediated tools in Beginning Algebra to increase retention for successful completion of College Algebra. The focus of the digital organization was student improvement in study skills and academic self-confidence throughout Beginning Algebra. These are two non-academic factors literature suggests are related to college students' retention and performance. Study skills were measured by how students felt they could assess a mathematics problem, organize a solution and successfully complete assignments. Academic self-confidence was measured by student belief of the ability to perform well in mathematics. Mixed methods were used to interpret the perspectives of the students in terms of the effect the technologically mediated tools had on the factors. Students felt that the technologically mediated tools in Beginning Algebra provided digital organization that impacted retention and successful completion of College Algebra.

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DEDICATION

Thank God for my loving husband, John, always believing in me and being my rock of support and my beautiful children Ann, Steve and Charlie. Your compassion during this time in my life and always makes me very proud to be your mom.

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INTRODUCTION

Developmental Mathematics Students in College

Developmental mathematics students make up a struggling student population in college. These students are interested in acquiring a college degree and lack the mathematics background to enroll in a college level mathematics course. Since most college majors require at least one mathematics course for graduation the students are placed in remedial mathematics courses. These developmental courses are prerequisite to the required college mathematics courses and the credits do not apply toward graduation.

Generally, these students have been exposed to the mathematics required to enter college level mathematics courses but have not successfully mastered the content. This may help to generate a feeling of low self-esteem about learning mathematics among students. Their study skills for learning mathematics have not worked to retain the material they tried to learn. Tools for practice and homework were primarily pencil and paper and students were required to organize the course work manually.

College Mathematics Teachers of Developmental Students

Similarly, college teachers of developmental mathematics students struggle to provide pedagogical strategies to enhance learning in developmental mathematics courses. Strategies to help students successfully complete the developmental course and increase the retention for successful completion of the required courses are important to the pedagogical instruction methods used by the instructor. The required mathematics courses are expected to supplement the college major courses. Hence, college teachers of mathematics try to provide the service of helping students to meet mathematics needs of their major course requirements. The researcher is one of these struggling mathematics teachers trying to understand how to help developmental students succeed in mathematics courses and successfully complete a college degree.

Mathematics: Is That the Problem?

Currently, the researcher is an Assistant Professor of Mathematics at a private midwestern university. Previously, she taught college preparatory mathematics at a public high school. In both realms of teaching mathematics the researcher has observed developmental mathematics students under pressure to learn mathematics. At college level, students express feelings of despair from previous experiences trying to understand mathematics concepts in the content courses required in high school.

Mathematics teachers strive to provide instruction that helps students to succeed and attain the mathematical ability required for jobs in their field of study. However, developmental mathematics students may suffer frustration as they try to work through difficulties understanding mathematics that is required to complete college major degree programs. Although, on the surface it may seem that mathematics content is the issue, there may be other underlying problems that are the real cause of the frustration.

As a teacher, the researcher understands that not all students learn mathematics concepts using the same strategies. However, it seems all students are expected to become proficient in study skills and organization based on the tools they use for completing coursework. They are expected to take notes, participate in class, study, review corrected assignments, apply what they have learned and perform when assessed.

Students who perform well on assessments may acquire self-confidence about their skill level of mathematics. However, students who are unsuccessful may risk a feeling of low self-esteem about learning mathematics. While some students may spiral upward and reach a high level of academic self-confidence, developmental students may spiral downward lacking acceptable assessment outcomes. They may feel less confident about their mathematical ability and study skills as assessments show low results.

Today's college students have grown up in a rapidly changing society expecting growth in mathematics content knowledge and quantitative literacy. Mathematics content knowledge refers to mathematical ability to solve problems using mathematics. Quantitative literacy refers to critical thinking that infers competency and comfort in working with numerical data. Technology use is included in the expectations of 21st century skills necessary for some jobs. Developmental students unable to complete College Algebra face stressful situations to complete a college degree and find work in the future workforce.

Technology and Content Is Not Enough

The researcher noticed a societal pressure on teachers to incorporate technology into classrooms. From a social point of view it may seem that technology makes learning easy. Educational materials may have improved as vendors offer technological options for use of the products. The researcher has always been a strong advocate for the incorporation of technology in the classroom. However, she found that technology used to simply focus on content was not the solution for developmental students having trouble grasping the mathematical concepts. It seemed as though something was missing.

Pedagogically, What Is Needed?

As a teacher, the researcher continued to incorporate technology tools to provide a means for increasing content knowledge and quantitative literacy in her courses. She was always looking for ways to provide students with strategies to learn the concepts that were the basis of the content knowledge. For instructional purposes, the researcher found that technology allowed her to provide more digital options for students to communicate with her. Screen sharing, availability of notes and screen captured videos allowed her to offer a digital connection to her students. Digital notes recorded during class created an efficient atmosphere for students to collect and receive course materials.

The technology for the researcher was more than a tool, she used it to organize her coursework and have quick access to all the course information in one place. She referred to her pen-enabled tablet PC as a mother board because it contained her local files and provided her with ubiquitous access to all her files on drives through wireless internet. The software included allowed her to teach showing notes by projection or screen sharing.

Realizing that developmental students were not coming to college with the necessary skills to be successful, the researcher wondered if technology could help her students to be successful in mathematics courses. More importantly, she wondered how technology might help developmental mathematics students to learn. She worked with her colleagues to get approval to study one class of developmental Beginning Algebra students using technologically mediated tools to contribute to success in Beginning Algebra enough to retain the mathematical content knowledge through College Algebra.

More importantly she wanted to see if by using the technology the pedagogical link to help students learn mathematics would surface.

Integrating Technology for Instruction: A Journey

Technologically mediated tools are defined as a pen-enabled tablet PC, Microsoft Office OneNote, presentation software/hardware and a course management system. In the past, the researcher experimented with technologically mediated tools for instructional purposes. By using the technology tools, she was able to offer more flexibility and optional strategies for her students. They were able to stay digitally connected to the coursework and receive her help more easily than prior to using the technology. During study halls it was easier for the researcher to access coursework to reinforce strategies practiced during class with students requesting help. The digital connections that she could provide for students seemed to create a more productive learning environment both in and out of the classroom.

Over the last ten years the researcher has been using a tablet PC to meet instructional needs. The tablet PC with Microsoft Office OneNote and wireless internet has replaced the need of a chalkboard and paper copies for students. She has been writing on the computer screen with a stylus pen and digitally saving the course work as a pdf. The researcher has used a lecture capture program in order to offer the screen sharing video captured during classes. Both forms of communication are available and stored in the class management system for student access after class.

To present new material and provide for guided practice, the researcher projects notes through a projector allowing her to face her students during instruction. During the chalkboard era, she felt that less eye contact with students led to more behavior problems with less focus on mathematics. To provide class notes from a chalkboard meant finding someone in class that took good notes or providing students with a copy of the researcher's notes. The researcher's notes for instructing were not as complete as the notes covered with students during class.

Technology helped the researcher to organize coursework and keep it accessible in a portable unit. The tablet PC is convenient allowing the researcher to be mobile for teaching and helping students in different learning experiences. With digital storage accessible to students she feels that fewer restrictions to course material apply for students. As the researcher experienced successful instruction using technologically mediated tools, she felt a need to investigate student use of the technology as a tool to help developmental students learn mathematics content knowledge and concepts necessary to retain the content.

Since the tablet PC allowed the researcher a cluster of technology options to incorporate into the instruction, she researched and discussed options that might be beneficial to students trying to retain mathematics as they moved through the sequential courses. Software, such as, digital notebooks, digital homework, digitally recorded sessions were options. Because of the hardware and software, active engagement of the students digitally interacting with the teacher and others in large group and small group seemed possible. The technology tools that the researcher selected for students were chosen to support a more student-centered learning environment.

Rationale

The researcher felt that students who arrive to take Beginning Algebra realize a high risk of importance in meeting the learning outcomes of the course. Due to placement test scores, they have been placed in Beginning Algebra, the prerequisite to College Algebra that is required for their major. It is important for the students to acquire the mathematics content knowledge necessary to successfully complete Beginning Algebra and retain the knowledge to successfully complete College Algebra.

Beginning Algebra does not count as credit for the college degree and the course will cost as much as if it did count for credit. By meeting admission requirements to the college, it is expected that the material in the Beginning Algebra course is familiar to incoming students. The researcher is interested in providing students with technologically mediated tools that may help them to organize the Beginning Algebra course information helping to increase their study skills and academic self-confidence to successfully complete Beginning Algebra and College Algebra. Since the strategies for learning in the past had not proven successful for acquiring the mathematics knowledge to enroll in a college mathematics course, the researcher wished to use technologically mediated tools to enhance learning.

Technology had helped the researcher to instruct students. She wanted to see if organizational strategies using technologically mediated tools in Beginning Algebra would impact developmental mathematics students contributing to an increase in their study skills and academic self-confidence enough to successfully complete College

Algebra. Could technology provide a pedagogical link that may be important to help students understand and successfully reach the appropriate mathematics ability level?

The researcher selected technologically mediated tools for the developmental students who had helped her to organize mathematics instruction. Fortunately, the mathematics faculty and University IT agreed to allow her to issue each student in her Beginning Algebra course a tablet PC with Microsoft Office OneNote included.

Digitally modeling, providing immediate feedback, facilitating discovery, actively engaging students, and flexibility of digital recall had increased the researcher's productivity level in the classroom. She wanted students to experience similar options in learning as they adapted the technology to meet their needs of individual learning styles. The options needed to be immediately accessible. Tablet PCs afforded students the mobile availability of digital options to submit and access student assessments and feedback. Software (e.g., Microsoft Office OneNote) supports student interactivity with course materials to enhance learning.

Study skills and academic self-confidence were topics discussed in classes and the researcher wondered how closely they relate to retaining mathematical content knowledge. Multiple options are learned for solving similar problems in mathematics. She wondered how to provide students ways to improve recall of problem solving techniques and success in choosing the most efficient one to solve a problem. Student use of technologically mediated tools created a setting for the study to research what impacts the improvement of student study skills and self-confidence when facilitated by technologically mediated tools in a remedial beginning algebra course to increase retention in a college mathematics course.

Study Goal and Research Questions

The overall goal of this study was to examine the impact of digital organization on study skills and academic self-confidence in a remedial beginning algebra course facilitated with technologically mediated tools on retention in a college algebra course. The following questions will be addressed:

1. Did student self-confidence and study skills improve during a remedial beginning algebra course facilitated with technologically mediated tools?
2. Did the use of technologically mediated tools contribute to an increase in study skills and self-confidence in a remedial beginning algebra course?
3. Did an improvement in student study skills and self-confidence in a remedial beginning algebra course facilitated with technologically mediated tools contribute to successful retention in a college algebra course?

CHAPTER 2

REVIEW OF LITERATURE

In reviewing the literature for the study, the researcher wanted to understand how the students in a developmental Beginning Algebra course learn in general. This meant a look into the expectations of the students most commonly enrolled in Beginning Algebra. Expectations for instruction defined in the Teaching, Learning and Technology Principles set by the National Council of Teachers of Mathematics (NCTM) provided instructional guidelines for the study.

To justify the use of technologically mediated tools in Beginning Algebra, the researcher investigated technology use by students and teachers in the learning environment. For success in the sequential College Algebra course, she included research on factors suggested as important for college retention. Since the study included an innovation, she reviewed change theory and Stages of Concern (SoCQ), a dimension of a Concern-Based Adoption Model (CBAM; Hall, 1987).

The innovation for the study was a set of technologically mediated tools used by the students during Beginning Algebra. The technologically mediated tools used by students included pen-enabled tablet PCs, Microsoft Office OneNote, presentation software/hardware and a course management system. The researcher examined studies that incorporated student use of tablet PCs for learning. This research provided the groundwork for the study.

Teaching, Learning and Technology Principles

To effectively teach mathematics, teachers must understand what students know and need to learn. Students must be challenged and teachers must support the learning so students learn well. It is important that students understand and actively build mathematics knowledge from experience and retained knowledge (Ferrini-Mundy, 2000; National Council of Teachers of Mathematics [NCTM], 2000). NCTM notes that

> Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning. Selecting and using suitable curricular materials, using appropriate instructional tools and techniques to support learning, and pursuing continuous self-improvement are actions good teachers take every day (NCTM, 2000, p. 11).

They also note that it is the teacher's responsibility to create an intellectual learning environment where critical mathematical thinking is the norm.

> Effective teaching requires deciding what aspects of a task to highlight, how to organize and orchestrate the work of students, what questions to ask students having varied levels of expertise, and how to support students without taking over the process of thinking for them (NCTM, 2000 p. 25)

Instructional Strategies, Student Learning Needs and Technology

Technology's Impact on Student Learning

In classrooms where student engagement remains high, interdisciplinary, project-based instruction is provided by teachers who consider student individual differences in interest and ability (Sandholtz, 1997). To contribute to an empirically grounded theory of the teaching and learning of functions in classrooms where there is a technologically rich learning environment, research was done under the umbrella of the RITESMATHS project. Teacher conceptualization of the task of teaching linear functions was impacted with the use of a real world interface using technology for student analysis. Teachers not integrating the real world interface realized a need for students to understand the relationship of functions with real world algebraic representations. Mathematics achievement and engagement was enhanced by using technology to support real world problem solving and lessons of high cognitive demand in secondary mathematics classrooms (Brown, 2004).

Early research identified aspects of successful technology specific to mathematics. Kaput (1992) found that the unique potential of technology in mathematics lies in the prospect of being able to create radically innovative notation systems. When focusing on computer-based notation, it can be vibrant, support multiple linked images, and capture processes. Modeling capabilities of technology brings together simulation and visualization with strong empirical tools in ways that create new pedagogical possibilities. Successful use of technology for learning cultivates a deep understanding of the yields of technology in education (Kaput, 1992).

<u>Interactivity and Technology</u>

Actively participating in doing mathematics rather than passive listening is essential to learn mathematics. Providing structure for the course and guiding students in active learning is a principle of success for students. Accommodations for diverse learners with available help are especially critical to success of students who are not comfortable with mathematics. Technology allows connection to resources that provide connection to people and work (Thiel, Peterman & Brown, 2008).

Data modeling is a topic that receives high attention since it is often used in research. New technologies are found to be easy for young students due to the straight forward extensions of basic ideas in geometry and graphing. Students are able to test theories readily, allowing for extensions of problems (Lesh, Caylor, & Gupta, 2007). Designers of mathematical tools are aware of the demand for interactivity (Sedig & Sumner, 2006).

Naftaliev and Yerushalmy (2013) explored changes in technology that had implications for teaching and learning of school mathematics including the creation of Narrating IDs (NIDs). Similar to a teacher's voice the NIDs are designed to call for action in a specific manner that supports the construction of the principal ideas of the task. The evidence showed that NIDs can be a form of instruction toward the development of new mathematical knowledge for students. NID designs limit the student's action and so support guidance, and at the same time remain an open space for student ideas.

When technology tools are incorporated into the curriculum, multitasking options during problem solving become readily available. The brain performs in a state of rapid alterations between tasks. Woodman and Luck (1999) found by electrophysiological tracking the moment-by-moment distribution of attention, direct evidence that visual search involves rapid shifts in the distribution of attention among objects.

Student Feedback and Technology

Effective feedback is that which indicates to students what they have done well and relays that which must be done to improve their work (Denton, Madden, Roberts & Rowe, 2008). Using the digital ink of a tablet PC to provide hand written feedback allows teachers to efficiently provide precise feedback. Students indicate that feedback provided with a tablet PC contains clear information similar to a human touch. Teachers report the ease of using tablet PC technology increases the efficiency with which they can provide detailed digital feedback to students (Steinweg, Williams & Warren, 2006)

Technology aids in allowing teachers to perform feedback rapidly to multiple students. The communication link with the student benefits both the teacher and the student. Students respond favorably to human interaction (Healy, 1999). With the use of the technology as a teaching and learning tool, teachers may model the use of adaptive reasoning by applying conceptual understanding to unfamiliar situations when preparing students for the future.

Guided Instruction and Modeling

Expert problem solvers derive their skill by drawing on the extensive experience stored in their long-term memory. These problem solvers quickly select and apply the best procedures for finding solutions (Kirschner, Sweller, & Clark, 2006; Trilling & Hood, 1999). Supervised practice is a high priority of a learner since people learn by making and correcting mistakes. If a learner is trained without errors occurring during the training, a false reading of competence by the trainer may be assumed (Bjork, 1994). It is crucial for a learner to be allowed to make mistakes and correct them. Teachers need more time with each student to provide guided practice and discovery, while creating efficient ways to communicate (Furner, Yahya, & Duffy, 2005).

Importance of Trial and Error Using Technology Tools

Research in the use of technology provides more proof of how trial and error increases learning (Nemirovsky, Kaput, & Roschelle, 1998). Focusing on an important new affordance of technological learning environments, the ability to generate and not merely to model phenomena, the researchers found it enabled the learners to collect their data within phenomena that can be controlled and interacted with in new ways. This allowed for experimental discoveries to emerge when analyzing the data. The learner was able to make mistakes and correct them as conjectures were accepted or rejected (Nemirovsky et al., 1998).

Retention

Research findings indicate that the strongest factors that had a positive relationship to college retention and performance are academic-related skills, academic self-confidence, and academic goals. Academic related skills include study skills, time management skills, and study habits. Self-confidence is defined as the belief in one's ability to perform well in school. Study skills are defined as the extent to which you believe you know how to assess an academic problem, organize a solution, and successfully complete academic assignments (Lotkowski, Robbins, & Noeth, 2004).

Students in remediation are more likely to persist in college in comparison to students with similar test scores and backgrounds who were not required to take the remedial courses. They are less likely to transfer to a lower-level college and more likely to complete a bachelor's degree (Bettinger & Long, 2009). Non-academic and academic factors both alone and together influence a student's decision to stay in or leave college (Robbins et al., 2004).

A freshman-level college math course showed statistically significant positive differences in course assessment scores when mobile computing was implemented over the same timeline (Hawkes & Hategekimana, 2009). The essence of learning math is doing math, rather than passively listening. It is important to provide a structure for the course that guides students in their active learning. It is important to provide sufficient time on task and enforce deadlines (Thiel et al., 2008). Evidence supports that students should have the opportunity to take home a computer in the same way they would a textbook. Providing a laptop for every schoolchild creates equality between those who have computers at home and those who don't (Ross & Rosenberg, 2007).

Another important factor affecting college retention is the quality of interaction a student has with a concerned person on campus (Habley & McClanahan, 2004). Activities that bring together students make possible the growth of social and learning communities and cultivate a shared consensus regarding institutional goals that promote persistence (Mangold, Bean, Adams, Schwab, & Lynch, 2002). Research defines academic integration as the development of a strong affiliation with the college academic environment both in and out of class (Cabrera, 1993). Connections that the technology provides for teachers and students are important. Both personal and environmental characteristics interact in the prediction of persistence of students to remain in college (Pascarella & Terenzini, 1980).

Non-academic Factors Related to College Retention

The ACT Policy Report (Lotkowski et al., 2004) was designed with the purpose to identify which academic and non-academic factors had the greatest effect on college students' retention and performance. The two strongest non-academic factors were academic-related skills, study skills and academic self-confidence. Study skills are defined as the extent to which you believe you know how to assess an academic problem, organize a solution, and successfully complete academic assignments. Academic self-confidence is defined as the belief in one's ability to perform well in school (Lotkowski et al., 2004).

Academic Self-Confidence

Academic self-confidence is defined in an American College Testing (ACT) study as the belief in one's ability to perform well in school (Lotkowski et al., 2004). When the belief in one's own abilities, perceived as self-efficacy, is high, a person will approach a difficult task as a challenge to be mastered rather than a threat to be dodged (Bandura, 1997). A student who perceives learning mathematics concepts as beyond his capability may dwell on obstacles blaming perceived deficiencies.

To help overcome low self-confidence, students experienced success or mastery in overcoming obstacles when they observed others whom they perceived as similar to themselves succeed. This persuaded them to believe in themselves (Bandura, 1997). Teachers play a role in persuading students to believe in themselves. It is important to build a mathematics curriculum, including appropriate use of technology that brings success to students and avoids placing them in situations prematurely where they are likely to fail (NCTM, 2000). Self – confidence has predictive power over objective measures such as past performance on academic tasks (Chemers, Hu & Garcia, 2001).

Study Skills

Study skills are defined as the extent to which you believe you know how to assess an academic problem, organize a solution, and successfully complete academic assignments (Lotkowski et al., 2004). Effective learners must have a variety of study strategies available and know how and when to use them to accomplish academic tasks. Implementation of strategy instruction and how to promote effective studying habits remains a high priority in research (Gettinger & Seibert, 2002). In a study on computer – assisted instruction (CAI) on study skills, the effectiveness of CAI on students' behaviors and attitudes reflected an increase in scores of an experimental group. The control group did not have access to CAI. The results showed that students in the CAI program effectively presented the information on effective study skills and how to develop such skills (Gadzella, 1982).

Connectivity, multiple approaches, and technology build skills within the real world (Levin & Calcagno, 2008). Good study skills minimize failure and enable students to take advantage of learning opportunities (Gettinger & Seibert, 2002). Study skills are fundamental to academic competence. In their study, Gettinger and Seibert found students were expected to exhibit high standards of study skills. The hardware and software provided in the study were appropriate resources to meet expectations. The expectation of the teacher to connect with the students and provide feedback to increase self-confidence in students was easily attainable with the use of technology as a resource in the study. A key to effective study-strategy training was to help students guide their own thinking, organizing, and study behaviors.

Assessment

When dealing with the human cognitive architecture, problem solving makes heavy demands on the working memory (Sweller, 1988). Hands-on use of technology in a computerized environment can incorporate more experiences, experiments, discovery, and connection to the real world assisting in the learning of mathematics (Arcavi & Hadas, 2000). Complex interactions between formative assessment, technology, and classroom practices can help teachers to effectively improve the learning environment for students. It can help fill in pre-post assessment studies. The flexibility of the classroom environment to the introduction of different tools has implications for distribution of curricula. Explicit attention to tools and the social context in which they are used can help in the design and improvement of tools for the classroom (Price, 2012).

Either student work samples or assessments that are aligned to the content taught during technology-rich lessons provide valuable data related to student learning outcomes. When lessons were observed in a technology-rich environment, student work samples were collected. Preliminary analyses indicated that students' artifacts reflected higher levels of thinking and a deeper understanding of mathematics during technology-rich lessons and higher-level task enactments (Polly & Hannafin, 2011).

Technology As a Teaching and Learning Tool

While technology use has been empirically linked to student achievement in mathematics (Wenglinsky, 1998), teachers struggle to effectively integrate technology in ways that improve student learning (Lawless & Pellegrino, 2007). Educational technology researchers (Mishra & Koehler, 2006; Niess, 2005) agree that effective technology integration requires teachers to have knowledge of technology, pedagogy, content.

Technological, pedagogical and content knowledge (TPACK) is the basis of good teaching with technology and requires an understanding of the representation of concepts using technologies. It includes pedagogical methods that use technologies in valuable ways to teach content. TPACK includes knowledge of what makes concepts difficult or easy to learn and how technology can help find solutions to some of the problems that students face. It is important to use the knowledge of students' prior understanding and theories of epistemology. For learning to occur one must understand how technologies can be used to build on present knowledge and to develop new epistemologies or strengthen old ones (Mishra & Koehler, 2006)

Change Process

The change process in education is important to be able to assess student learning enhancement and whether or not experiences with change increase subsequent capacity to deal with future changes (Fullan, 2007). Capacity building is defined as any strategy that increases the collective effectiveness of a group to raise the bar and close the gap of student learning. It involves helping to develop individual and collective knowledge and competencies, resources, and motivation (Fullan, 2005). Supporting people in change is critical for learning to take place. One model for change is the Concerns-Based Adoption Model (CBAM). It applies to anyone experiencing change, including teachers, parents, students and policy makers (Hall, 1987).

The model holds that people considering and undergoing change evolve in the kinds of queries they ask and in their use of the change innovation.

> In general, early questions are more self-oriented: What is it? How will it affect me? When these questions are resolved, questions emerge that are more task-oriented: How do I do it? How can I use these materials efficiently? How can I organize myself? Why is it taking so much time? Finally, when self- and task concerns are largely resolved, the individual can focus on impact. Educators ask: Is this change working for students? Is there something that will work even better? (Hall, 1987, p. 55)

Hall (1987) created the Stages of Concern Questionnaire (SoCQ), to help identify how individuals are reacting to the change process. Individuals can experience many of the Stages of Concern (SoC) throughout the process of the change implementation. Or they may remain stationary at one stage (See Table 1).

Table 1

Stages of Concern

Stage	Expression
0. Awareness	I am not concerned about it.
1. Informational	I would like to know more about it.
2. Personal	How will using it affect me?
3. Management	I seem to be spending all my time getting materials ready.
4. Consequence	How is my use affecting learners? How can I refine it to have more impact?
5. Collaboration	How can I relate what I am doing to what others are doing?
6. Refocusing	I have some ideas about something that would work even better

The SoC model identifies and provides ways to evaluate seven stages of concern, which are displayed in Table 1. These stages have major inferences when implementing an innovation. By monitoring stages of concern of individuals implementing an innovation, evaluations of acceptance allow for informed decisions to be made about the success of the implementation. Rapid movement through the stages of concern would show acceptance of innovation.

Teacher Training

Similarly, technology will not live up to its promise when teachers fail to focus on improving student learning (Glennan & Melmed, 1996). A variety of studies indicate that technology will have little effect unless teachers are adequately and appropriately trained (Coley, Cradler, & Engel, 1997). In a report that examined the results of over 300 studies of technology use, researchers concluded that teacher training was the most significant factor influencing the effective use of educational technology to improve student achievement. Specifically, the report stated that students of teachers with more than ten hours of training significantly outperformed students of teachers with five or fewer training hours (Sivin-Kachala & Bialo, 2000).

Student Technology Use

Technology is vital in teaching and learning mathematics; it impacts the mathematics that is taught and enhances students' learning. Research has solidly established the importance of conceptual understanding in becoming proficient in a subject. When students understand mathematics, they are able to use their knowledge adaptably. They combine factual knowledge, procedural ability, and conceptual understanding in powerful ways (NCTM, 2000).

> Computers are reshaping the mathematical landscape, and school mathematics should reflect those changes. Students can learn more mathematics more deeply with the appropriate and responsible use of technology. They can make and test conjectures. They can work at higher levels of generalization or abstraction. In the mathematics classrooms envisioned in Principles and Standards, every student has access to technology to facilitate his or her mathematics learning (NCTM, 2000, P. 24).

NCTM also reminds that the instructor is responsible for creating an intelligent environment in the classroom where student engagement in critical mathematical thinking is the standard.

> Effective teaching requires deciding what aspects of a task to highlight, how to organize and orchestrate the work of students, what questions to ask students having varied levels of expertise, and how to support students without taking over the process of thinking for them (NCTM, 2011, p. 25).

In studies of students learning with the use of technology, teachers have reported that technology allows the teacher to be more student-centered, more open to multiple perspectives on problems, and more willing to experiment in their teaching. In technology-rich classrooms, students become more engaged and more active learners (Knapp & Glenn, 1996). Technology use provides greater emphasis on inquiry and less on drill and practice (Bozeman & Baumbach, 1995; Sandholtz, 1997). It also encourages student collaboration, project-based learning, and higher-order thinking (Penuel, Yarnall, & Simkins, 2000). Technology supports the kinds of changes in content, roles, organizational climate, and effect of constructivist educational reform movements (Means et al., 1993). If technology is to realize its full potential, explicit attention to learners' opportunities will be necessary. Learners will need to recognize when computer solution methods are beneficial (Dugdale, 1999).

Purposeful study skills and documentation of the practice of study skills using technology allow students to recall and practice as needed. The availability of optional practice selection with variable technology allows students to choose what best fits their needs. According to Graetz (2006), when students were encouraged to increase study skills, students preferred Microsoft OneNote over Microsoft Word when given the option of choosing between either of the two software selections or Microsoft Journal. There were references to organization and digital markup. Students were able to choose between OneNote, Word, and Journal.

Tablet PC

Using a tablet PC allows students to incorporate multiple software and hardware tools for modeling mathematics in lessons. A tablet PC is defined as a pen-enabled laptop computer. Visualization improves the student's ability to make conjectures (Barabash, 2003). The appropriate incorporation of spreadsheets in the mathematics curriculum is not obvious for students. Guidance for the inclusion raises educational problems (Haspekian, 2005). A quantitative survey at Penn State involving 31 engineering faculty from eleven different disciplines using tablet PCs for tools of instruction and learning reported that the effects on student learning were overwhelmingly positive in all areas addressed. The three areas surveyed were student preference, TPC (tablet PC) effects on student learning, and TPC effects on instructor (Wise, Toto, & Lim, 2006).

Huettel et al. (2007) found that when asked about the impact of various instructor uses of the tablet PC in class, students nearly unanimously reported positive effects of the instructor's writing on the tablet PC, providing feedback to students by working problems on the tablet PC, drawing non-textual information, posting copies of lectures online after class, using colors while writing on the tablet PC, and switching between software applications during class. In all, 96% of the students preferred the use of tablet PCs to the blackboard and would select a tablet PC using version of a course, all other factors being equal.

One of the most novel activities made possible by the tablet PCs was interactive classroom problem solving. Students who had the opportunity to participate in such activities reported overwhelmingly (92%) that the use of software available was helpful. Students responded positively at a (90%) level that using tablet PCs to run software applications in the laboratory was helpful.

Results of a study in a college science recitation class indicate that student learning seemed to be positively affected by the use of engagement strategies. The recitation classes were small breakout classes of approximately 20 students who met twice a week associated with a large science class that met twice a week for 50 minute lectures. The recitation classes met for 50 minutes twice a week for discussion group work pertaining to the lectures. The study was conducted in one of the recitation classes. Students in the study were engaged using the Tablet PC, and the Classroom Presenter software during the recitation class beginning after the first exam. Students in the recitation class using Tablet PCs performed significantly better than students in recitation classes not using tablet PCs for coursework (Koile & Singer, 2006).

Use of tablet PCs and recording/narration technology enabled learners to process complex material easily and motivated them to contribute their results to other students consistently and effectively. Integrating effective technology into an instructor's pedagogy further enhanced the learning environment and promoted a dynamic, student-centered learning atmosphere where the emphasis is on learning by doing rather than learning by note taking (Motschnig-Pitrik & Holzinger 2002). Positive outcomes can result as long as the curriculum and the students possess a degree of openness that enable learners to build on prior knowledge and experiences (Radosevich & Kahn, 2006).

Tablet PCs can create an environment that can maximize student learning opportunities, empowering both student and teacher. If used to its full potential it captures clear and recordable mathematical thinking in action and can provide purposeful and timely feedback. As university lecturers and other teachers move into flexible teaching and learning environments, the Tablet PC is an essential tool (Galligan, Loch, McDonald & Taylor, 2010).

After reviewing the literature, the researcher selected pen-enabled tablet PCs, Microsoft Office OneNote, presentation software/hardware and a course management system as the technologically mediated tools used with students in the Beginning Algebra course. The tools were incorporated as an intervention to provide data for surveys and interviews to study the impact of retention and successful completion of College Algebra.

Instruments chosen to collect the data were based on questionnaires and surveys developed in the literature or by the researcher.

CHAPTER 3

METHODOLOGY

The overall goal of this study was to examine the impact of technologically mediated tools to contribute to student study skills and academic self-confidence in a remedial beginning algebra course to increase retention in a college algebra course. A mixed methods approach incorporating both quantitative and qualitative methods was used in this study. Quantitative methods were used to provide a mathematical analysis based on Quantifiable Affective Survey results, successful completion of Beginning Algebra and College Algebra and College Algebra Exit Interviews. Measurements of SRI variable scores and Stages of Concern Questionnaires were analyzed using quantitative methods. Equally significant was the importance of using qualitative methodologies to interpret the perspectives of the participants in terms of the effect the technologically mediated tools had on the variables.

Research Questions Developed for This Study

Research Question 1: Did student self-confidence and study skills improve during a remedial beginning algebra course facilitated with technologically mediated tools?

Research Question 2: Did the use of technologically mediated tools contribute to an increase in study skills and self-confidence in a remedial beginning algebra course?

Research Question 3: Did an improvement in student study skills and self-confidence in a remedial beginning algebra course facilitated with technologically mediated tools contribute to successful retention in a college algebra course?

Participants

The participants in this study were 14 developmental mathematics students enrolled in Beginning Algebra, an eight-week semester course, during the fall term of 2011 at a private midwestern university. The participants for this study were selected using a convenience sampling technique since they enrolled in a section of the Beginning Algebra course offered in the fall of 2011. Enrollment for the course was based on student scores achieved on a University approved placement test for mathematics.

The Courses

College Algebra is a mathematical ability course. Mathematical ability is the content and procedural fluency to deal with quantitative situations. This course is a prerequisite to Precalculus. The topics covered in College Algebra are algebraic equations and inequalities, functions and graphs, zeros of polynomial functions, exponential and logarithmic functions and systems of equations. College Algebra focuses on calculation and manipulation of mathematical representation providing the mathematical basis for quantitative reasoning.

College Algebra is a required mathematics course for most majors at the University. To meet the prerequisites of this course, students must successfully complete Beginning Algebra or score above 45 out of 100 on the placement exam required by the University for incoming students. Students with scores greater than 32 and less than or equal to 45 are encouraged, but not required, to enroll in Beginning Algebra, which is considered remedial at this institution. If students score less than or equal to 32 on the placement test, they must successfully complete Foundations of Mathematics as a prerequisite to Beginning Algebra. Currently, 30% of the incoming students are encouraged to take Beginning Algebra based on their placement test scores.

Beginning Algebra is designed to help students become proficient using mathematical concepts that should have been mastered prior to entering college. In this course, attention to improving study skills is a specific goal to enhance learning and to contribute to their future success in college. The class size is limited to 15 to allow the teacher to provide individual instruction when needed. Academic self-confidence in performing mathematical calculations and problem solving is generally weak.

Prior to this study, teachers of Beginning Algebra used a tablet PC for instruction; primarily to present new material and provide guided instruction. However, student use of tablet PCs was limited to time in class, provided the class was held in a tablet PC lab. The tablet PC lab was available for one year prior to the study. Eighty percent of the Beginning Algebra classes were taught in the lab. The use of tablet PCs in the lab was not received well by students based on observation of the students.

At first students were allowed to use the tablet PCs for note taking during class. However, there was no formal introduction or directions on how to use the tablet PCs. Students were not familiar with the technology and did not seem interested in the technology. An attempt was made to provide students with a digital notebook similar to the one that the participants in this study used. Students were given a flash drive with the notebook included. They were expected to load it to the tablet PC and keep a copy on the flash drive for use overnight. Due to the unavailability of the tablet PC outside of class, homework was done using paper and pencil. Moreover, students were not expected to submit homework digitally. Therefore students had to wait for feedback until after the instructor graded the assignments and returned them to students during class time.

Technologically Mediated Tools

Technologically mediated tools used in this study are defined as standard pen enabled tablet PCs loaded with software including Microsoft Office OneNote, an interactive notebook created for the course. These tablet PCs were used by the instructor (also the researcher) and students. Standard pen enabled tablet PCs are defined as tablet PCs with a Windows 7 Operating System. Installed applications included Microsoft Office 2010, Microsoft Office OneNote, and a scientific calculator. The tablet PCs had wireless internet access.

Digital Notebook

A Microsoft Office OneNote notebook, created by the instructor to provide resources for interactive coursework, was loaded on each student’s tablet PC. Students used course management software that included a dropbox to upload assignments and download graded assignments. Student homework was completed using the stylus to digitally create electronic documents and store them as a pdf for uploading. The Internet connectivity allowed the student to have access to a course management system.

An interactive classroom environment was developed for this class due to the remedial nature of the learners. For all students to participate in the interactive environment, it was important to provide students with immediate access to all course materials. For this study the tablet PC was the tool of choice. The digital notebook was critical in establishing this environment. It was used to enhance the interactive classroom environment with the inclusion of example problems already set up for guided practice of skills covered in the course. The guided practice examples increased in difficulty throughout each lesson. The tablet PCs provided students with the ability to share solutions with each other during class by connecting to the projector to display their work.

Efficient Use of Class Time

By using the digital notebook to complete assignments digitally, students were able to submit an original copy and receive a corrected copy through the dropbox in the course management system. No time was needed during class for collecting and handing out assignments. Since papers were returned outside of class time, students had time to view the corrections prior to class meetings. This provided for an efficient use of class time. The digital notebook also provided students with the option of storing notes, assignments and graded or corrected work all in one place. Options within the notebooks allowed students to develop their own organization of sections and pages to meet their individual needs.

The digital notebook was used as a tool for problem solving during instruction, collaborating and organizing coursework. In developmental courses it is important for students to have time to try problems and see how others solve them. The digital notebooks included problems set up for guided practice and problems set up for individual work. When students worked individually, there was extra time provided to share results with classmates in small and large group settings. Then immediate feedback provided by the instructor gave students the opportunity to learn from other students and correct mistakes.

Instruments

Instruments used in the study to answer the research questions included the Student Readiness Inventory (Academic College Testing, 2008), Stages of Concern Questionnaires (SoCQ), a dimension of Concern-Based Adoption Model (CBAM; George, Hall, & Stiegelbauer, 2006), Quantifiable Affective Surveys, documentation of successful completion of Beginning Algebra and College Algebra courses, and College Algebra Exit Interviews completed after the completion of College Algebra done by the researcher. Each instrument was used to address one or more of the research questions. Some instruments provided both quantitative and qualitative data for analysis. The SRI, Quantifiable Affective Surveys and SoCQ were used as pre- and posttests (See Table 2).

Table 2

Instruments

Instrument	SRI Pre and Post	Quantifiable Affective Surveys Pre and Post	Stages of Concern Questionnaire Pre and Post	Successful Completion of Beginning Algebra	Successful Completion of College Algebra	College Algebra Exit Interviews
Question 1	Quantitative	Quantitative				Quantitative
Question 2		Qualitative	Quantitative			Qualitative
Question 3				Quantitative	Quantitative	Quantitative and Qualitative

For Research Question 1, surveys, exit interviews and the SRI provided quantitative data to examine whether student study skills and academic self-confidence improved after taking the beginning algebra course facilitated with technological tools. The Quantifiable Affective surveys revealed whether students felt their study skills and academic self-confidence had increased during the beginning algebra course in the first question of the survey (See Appendix C). It was important to collect this information after Beginning Algebra was completed and after College Algebra was completed. The College Algebra Exit Interviews provided the data after the College Algebra course in the last two questions of the interview (See Appendix D).

The SRI provided measurements of student study skills and academic self-confidence before and after the beginning algebra course. Individual raw scores on the pretest and posttest for individuals were used for quantitative analysis. Quantitative analysis was obtained using the Pearson r correlation coefficient using pretest scores as the independent variable and posttest scores as the dependent variable.

For Research Question 2 the SoCQ provided a measurement of student stages of concern for the innovation used in the beginning algebra course. Using the SoCQ, the researcher was able to measure student concerns about the use of the technologically mediated tools. The data analysis revealed whether the use of the innovation was a high level of concern for students in the class. It was not. The affective surveys and the exit interviews provided qualitative data to establish that the use of technologically mediated tools in Beginning Algebra contributed to improved study skills and self-confidence.

For Research Question 3, records of student successful completion of Beginning Algebra and College Algebra were collected. These records were provided by the institution. College Algebra Exit Interviews provided data to analyze if students felt Beginning Algebra facilitated with technological tools contributed to successful completion of College Algebra.

Data collected from the SRI were submitted to and analyzed by ACT. Quantitative data collected from the Quantifiable Affective Surveys, documentation of successful completion of courses, and College Algebra Exit Interviews after completion of College Algebra were analyzed using quantitative descriptive methods to interpret categorical data as defined by researchers, (Alreck & Settle, 2004). Qualitative data collected from the Quantifiable Affective Surveys and College Algebra Exit Interviews were coded using categories developed by the researcher based on emerging patterns (Patton, 2007). Reliability was reached by having a second analyst trained to use the codes that re-analyzed these data and compared to the researcher's initial analysis (Patton, 2007). Data collected from the CBAM Stages of Concern Questionnaire were analyzed using the process designed by CBAM (George et al., 2006).

Quantifiable Affective Surveys

The Quantifiable Affective Survey (See Appendix C) was used as an instrument to address Research Question 1 to determine if and why academic self-confidence and study skills improved upon the completion of a beginning algebra course facilitated with technologically mediated tools. The affective survey was used as a pretest and posttest. It was given to students during weeks four and eight of Beginning Algebra.

The data for Research Question 1 were collected from the first question of the Affective Survey: Do you feel that technologically mediated tools affect your study skills and self-confidence? Technologically mediated tools were defined for students in the IRB form that they signed to participate in the study. Responses for the first question of the survey were recorded as yes-positively, yes-negatively, or no. Quantitative descriptive analysis as defined by Alreck and Settle (2004) was used to analyze categorical data from the Affective Survey.

The Affective Survey was also used as an instrument to answer Research Question 2 to determine if technologically mediated tools contributed to an increase in academic self-confidence and study skills. The qualitative data were collected from the responses to the Affective Survey questions.

The researcher developed a coding scheme using emerging patterns of comparison (Patton, 2007). Following the process, a second analyst was instructed to code the responses and consensus between the researcher and analyst was reached for substantive significance. The codes developed to analyze the Affective Survey pretest were:

- organization
- color coding
- self-confidence
- learn new things
- blaming
- disorganized
- tech problems

- physical discomfort

The codes for the posttest were:

- organized
- used them to help
- learned tech
- more lazy
- no suggestions
- fix the bugs
- math is fun.

College Algebra Exit Interview

The College Algebra Exit Interview (See Appendix D) was used as an instrument to answer all three research questions. In Research Questions1 and 2 the exit interview was used to determine if a beginning algebra course facilitated with technologically mediated tools contributed to improved academic self-confidence and study skills. Qualitative data were collected via audio recording and scripted. Responses to the questions were collected and a coding scheme using emerging patterns of comparison (Patton, 2007). A second analyst was instructed to code the responses and consensus was reached for substantive significance (Patton, 2007). The coding scheme developed for the exit interview included:

- organized and efficient
- color helps
- wanted them back

- learned new thing
- changed my attitude toward math
- beneficial to write on
- built self-confidence
- instant feedback

Quantitative descriptive analysis as defined by Alreck and Settle (2004) was used to analyze categorical data.

In Research Question 3, the College Algebra Exit Interview was used to determine if taking a beginning algebra course facilitated with technologically mediated tools contributed to retention for successful completion of a college algebra course. Data for qualitative analysis were collected from student responses to the interview questions conducted with seven participants after successfully completing College Algebra. The interviews were audio tape recorded and scripted.

Student Readiness Inventory (SRI)

The SRI (See Appendix A) was used as an instrument to answer Research Question 1 to determine if academic self-confidence and study skills improved upon the completion of Beginning Algebra facilitated with technologically mediated tools. The 108 question SRI is designed to measure 10 psychosocial factors related to college retention. Two of the factors measured were academic self-confidence and study skills. This provided data for two measures of comparison of pretest and posttest raw scores used by the researcher for analysis to help answer Research Question 1. The SRI was used as a pretest and posttest. It was given to students during week one and week eight of Beginning Algebra.

The analysis of the SRI data was completed by ACT producing individual raw scores for the 10 psychosocial factors on the pretest and posttest. An instrument is considered internally reliable if the scores on similar items are related given the same general construct. Internal consistency was achieved when the SRI was calculated through the use of Cronbach's coefficient alpha (See Appendix B.) The SRI instrument has been determined to have high internal consistency when it is used as a pretest to measure the factors related to college retention. The analysis from ACT included individual student scores for each of the 10 psychosocial factors related to college retention. For the purpose of this study, the researcher used only study skills and academic self-confidence because of their strong relationship to college retention.

The researcher used the student raw scores to calculate the rate of change and measure the Pearson r correlation coefficient. These methods were used to measure the change in study skills and academic self-confidence of the participants in the beginning algebra course facilitated with technologically mediated tools. To calculate the Pearson r correlation, pretest scores of participants were used as the independent variable and the posttest scores as the dependent variable.

Stages of Concern Questionnaire (SoCQ)

The Stages of Concern Questionnaire (SoCQ), a dimension of (George et al., 2006) was used as an instrument to answer Research Question 2 to determine if technologically mediated tools contributed to an increase in academic self-confidence and study skills. The SoCQ was given as a pretest and posttest during week one and week eight to measure participant concerns about the innovation students were expected to implement. In the questionnaires the innovation was defined as Technologically Mediated Tools: Tablet PC, Microsoft Office OneNote, presentation software/hardware-video projector, and the course management system,

The data analysis provided with the SoCQ was used to classify the stage of concern during week one and week eight of each participant. A statistical analysis was performed based on the process outlined in the Stages of Concern manual (George et al., 2006). The two highest stages of concern were analyzed for the group during the pretest and posttest. The analysis is based on seven stages of concern (See Table 1). The interpretations of the results were intended to be treated as hypotheses to be confirmed by the respondents. The hypotheses were confirmed using the data collected in the College Algebra Exit Interviews.

The initial stage of awareness is characterized as no concern. This is interpreted as the innovation is not the only concern. By measuring the two highest levels of concern during a pretest and posttest, progression through the levels was denoted for both the highest and second highest stage of concern at two points in time.

Successful Completion of College Algebra

Documentation of successful completion of College Algebra was used to answer Research Question 3 to determine if Beginning Algebra facilitated with technologically mediated tools contributed to successful completion of College Algebra. Successful completion of Beginning Algebra and College Algebra was determined as passing the course. The data was provided by the institution.

Multiple Uses of Instruments

The instruments included in the study, the Quantifiable Affective Surveys, College Algebra Exit Interviews, the SRI, SoCQ, and retention to successfully complete College Algebra provided quantitative and qualitative data for analysis. Several instruments provided data for multiple research questions. In reporting the findings the data analysis is organized by research question.

CHAPTER 4

FINDINGS

This study focused on the impact of technologically mediated tools in Beginning Algebra to enhance study skills and academic self-confidence to increase retention in College Algebra. Quantitative and qualitative methodologies were used to address the following research questions:

> Research Question 1: Did student self-confidence and study skills improve during a remedial beginning algebra course facilitated with technologically mediated tools?
>
> Research Question 2: Did the use of technologically mediated tools contribute to an increase in study skills and self-confidence in a remedial beginning algebra course?
>
> Research Question 3: Did an improvement in student study skills and self-confidence in a remedial beginning algebra course facilitated with technologically mediated tools contribute to successful retention in a college algebra course?

Fourteen students enrolled in a developmental beginning algebra course in the fall term of 2011 at a private Midwestern private university agreed to participate in the study. Each student was issued a tablet PC loaded with a digital notebook software package, Microsoft Office OneNote. A digital notebook containing partial notes created by the instructor was stored in the tablet PC. This provided students with course material ready for use in an interactive classroom environment. The tablet PC including the notebook along with presentation software/hardware and a course management system were considered technologically mediated tools.

Students' Introduction to Technologically Mediated Tools

Initially the students were unfamiliar with tablet PCs. They had not experienced pen enabled tablet computers. They had never used a stylus as a pen to write on the surface of the screen. During the first two days of the class, the students were introduced to ways to digitally take notes and perform tasks during class. During the eighth and final week of the class, 50% of the students classified themselves as intermediate users and 25% felt they were Old Hands at using the technologically mediated tools. This was an increase from the first week of class prior to the introduction of the innovation when 67% of the students responded that they were non-users. The classification came from the demographic data collected in the SoCQ (See Table 3).

Prior to the first assignment, students were encouraged to organize the notebook to include tabs for pages to store digital homework. This included saving homework assignments in pdf form and uploading them to the course management system. Students learned to retrieve corrected assignments using the course management system.

The partial notes provided in the digital notebook included course objectives and practice problems prepared in advance for students to participate in guided practice. Similar problem sets allowed students opportunities to solve and receive immediate feedback during class. The notebook included the syllabus, assignment sheet for the term and final review. The Beginning Algebra Day 1 Agenda included a practice guide to use the stylus pen on the tablet PC. It was used to familiarize students with the tools. It was included in the student notebook (See Appendix F).

Table 3

SoCQ Demographic Data

1. How long have you been involved with the innovation, not counting this year?

	PRETEST	POSTTEST
Never	92%	67%
1 yr		33%
2 yr	8%	
3 yr		
4 yr		
5 yr		

2. In your use of the innovation do you consider yourself to be a:

	PRETEST	POSTTEST
Non user	67%	8%
Novice	25%	17%
Intermediate		50%
Old Hand	8%	25%
Past user		

Practice Using a Digital Notebook

All students were expected to become familiar with the tabs used for organization of the course sections. The students were instructed to follow the practice sheet trying out options that existed within the menus of the digital notebook. Included in the menus were ways to change the color of the pen, use the pen as a highlighter, insert space, convert handwriting to text, etc. The menus existed in a ribbon at the top of the notebook page.

Each student opened up a quick access toolbar above the ribbon to use for switching the pen color, and using undo and redo quickly. After the first couple of days, the class proceeded as normal with notes, guided practice, opportunities to master the concepts individually or working with others. Students were expected to use the tablet PC and digital notebook software as a tool to efficiently complete the tasks for the course.

Research Question 1 Results

Research Question 1: Did student self-confidence and study skills improve during a remedial beginning algebra course facilitated with technologically mediated tools?

To answer Research Question 1, quantitative data was collected and analyzed from three instruments. The instruments used were: (a) Quantifiable Affective Surveys, (b) College Algebra Exit interviews, and (c) Student Readiness Inventory (SRI; Academic College Testing, 2008). Pre and posttests were given for data collection of the Quantifiable Affective Surveys and the SRI.

Quantifiable Affective Surveys Quantitative Data Analysis

Results from the data collected from the first question of the Quantifiable Affective Survey indicated an increased percentage of students responding that technologically mediated tools positively affected their study skills and self-confidence from pretest to posttest. Quantitative descriptive analysis as defined by Alreck and Settle (2004) was used to analyze categorical data from the Quantifiable Affective Survey. Quantitative Responses for the first question of the survey were recorded as yes-positively, yes-negatively, or no (Figure 1 and Figure 2).

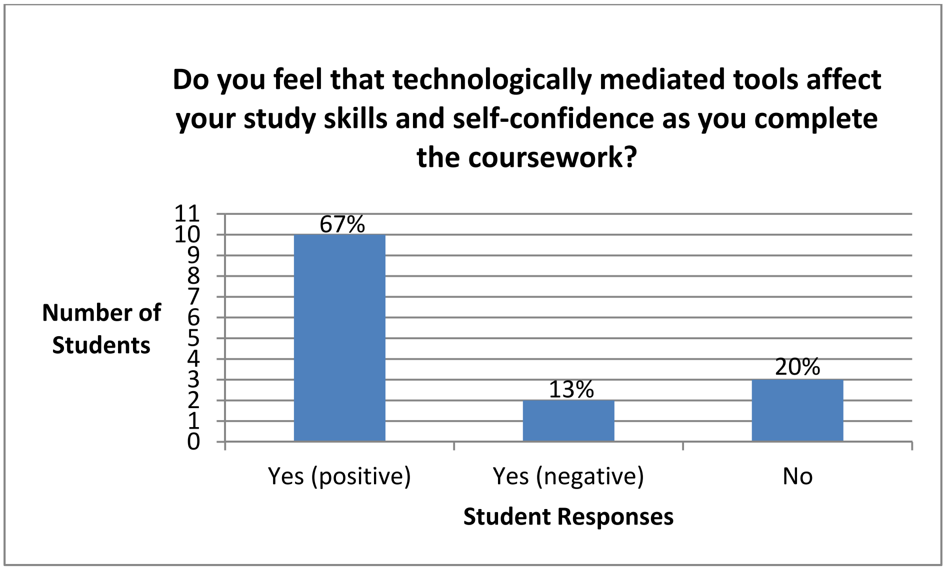

Figure 1. Quantifiable Affective Survey Pretest Quantitative Results.

The quantitative data from the Quantifiable Affective Survey pretest were collected from participant responses to the first question of the survey (See Figure 2). Results of the pretest indicated 67% of the students felt technologically mediated tools positively affected their study skills and self-confidence while 13% of the responses indicated a negative effect on study skills and/or self-confidence. Responses totaling 20% indicated that students felt there was no effect on their study skills and/or self-confidence due to technologically mediated tools. The pretest was given to the students during the fourth week of the class to ensure that students had experience using the technologically mediated tools prior to the survey request.

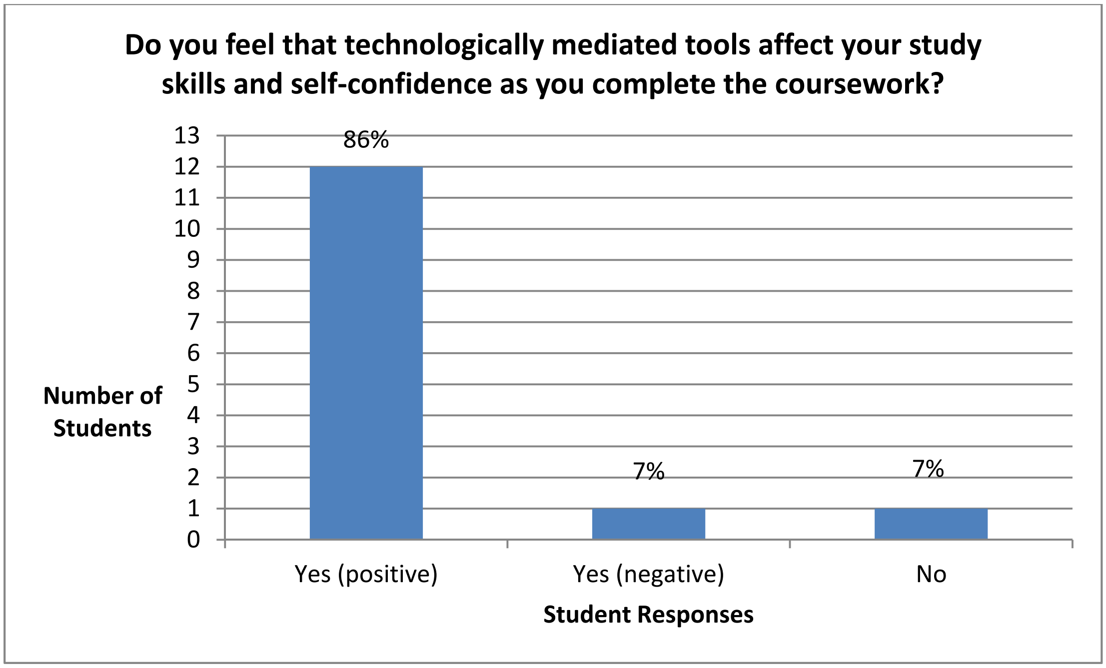

Figure 2. Quantifiable Affective Survey Posttest Quantitative Results

Although there were 14 participants, one student responded twice to the first question of the pretest. Both responses were included in the analysis. The student cited that the tablet PC made it easier to stay organized. However, she disliked dealing with technology problems. It was felt by the researcher that both answers should be accepted. Agreement to include both quantitative responses was reached by a second analyst when consensus was reached over comments that were accepted for analysis. This occurred in the analysis of qualitative data collected for Research Question 2 using a coding scheme developed by the researcher with emerging patterns of comparison (Patton, 2007).

Quantifiable Affective Survey Posttest Results

The quantitative data from the Quantifiable Affective Survey posttest were collected from participant responses to the first question of the survey (See Figure 2) given during the final week of Beginning Algebra. The results indicated that 86% of the students felt the technologically mediated tools positively affected their study skills and self-confidence during the course. One student responded that the effect was negative representing 7% of the participants. Another student responded that there was no affect accounting for the remaining 7% of the participants. All 14 participants responded to the posttest.

Research Question 1 results are dependent upon showing the increase in study skills and academic self-confidence based on quantitative data collected from the instruments. The quantitative analysis showed an increase in study skills and academic self-confidence. The qualitative responses to the Quantifiable Affective Surveys add depth to the study and are discussed in the results of Research Question 2.

College Algebra Exit Interview Quantitative Data Analysis and Results

The quantitative data from the College Algebra Exit Interview were collected from participant responses to the last two questions of the interview (See Table 4). Seven students participated in the exit interview after successfully completing College Algebra. The results indicated that 100% of the students felt the technologically mediated tools in a beginning algebra course helped them to improve their academic self-confidence. Similarly, 86% felt technologically mediated tools helped them to sharpen their study skills.

Table 4

College Algebra Exit Interview Quantitative Results

1.	Do you think taking a Beginning Algebra course facilitated with technologically mediated tools contributed to your success in College Algebra?			
	Yes	7	students	100%
	No	0	students	0%
2.	Do you think taking a Beginning Algebra course facilitated with technology mediated tools helped you to sharpen your study skills?			
	Yes	6	students	86%
	No	1	student	14%
3	Do you think taking a Beginning Algebra course facilitated with technology mediated tools helped you to improve your academic self-confidence? Please explain.			
	Yes	7	students	100%
	No	0	students	0%

One student responded he was unsure if the tools helped to sharpen his study skills representing 14% of the participants. The student attempted to qualify his answer by stating his previous dislike of studying mathematics. He then reported the digital organization of the course notes prevented a frantic search of old papers when he studied. He continued to list how having everything in one place stored for reference was a good thing. This information adds depth to the quantitative results that were used to answer Research Question 1 and are discussed in the qualitative analysis in Research Questions 2 and 3.

SRI Data Analysis of Correlation Coefficients

Results from the SRI analysis of psychosocial factors, study skills and academic self-confidence indicated no significant increase from the pretest to the posttest scores. The Pearson Moment Correlation Coefficient Table of Critical Values was used to determine the measure of strength of the linear association between the pretest and posttest scores (See Table 5). There was not a statistical significant increase in study skills or academic self-confidence based on the Pearson Moment Correlation Coefficient.

Table 5

Results of Pearson Correlation Coefficient for SRI Pretest and Posttest

SRI Scale	Pearson Correlation Coefficient	Analysis of the strength of a linear association between SRI pretest and posttest
Academic Discipline	0.394	
Academic Self-Confidence	0.455	
Commitment to College	0.408	
Communication Skills	0.580	Significant increase in skill α = 0.05*
General Determination	0.779	Significant increase in skill α = 0.05
Goal Striving	0.581	Significant increase in skill α = 0.05
Social Activity	0.460	Significant increase in skill α = 0.10**
Social Connection	0.611	Significant increase in skill α = 0.05
Steadiness	0.398	
Study Skills	0.378	

Research Question 2 Results

Research Question 2: Did the use of technologically mediated tools contribute to an increase in study skills and self-confidence in a remedial beginning algebra course?

To answer Research Question 2, data was collected and analyzed using three instruments. The instruments were: (a) Quantifiable Affective Surveys, ((b) College

Algebra Exit Interviews, and (c) Stages of Concern Questionnaire (SoCQ), a dimension of Concerns-Based Adoption Model (CBAM; George et al., 2006). Qualitative data analysis from the Quantifiable Affective surveys and the College Algebra Exit Interviews indicated that students felt technologically mediated tools contributed to an increase in study skills and self-confidence by helping with digital organization. Quantitative data analysis of the SoCQ indicated that students consistently had no concern about the innovation. This indicated other concerns with tasks or activities. Pretests and posttests were given for data collection of the questionnaires and surveys.

Quantifiable Affective Surveys Qualitative Data Analysis and Results

Results of the qualitative data collected and analyzed from the Quantifiable Affective Survey indicated most often that using the technologically mediated tools helped improve study skills and academic self-confidence by providing digital organization of course information and notes (See Figure 3 and Figure 4). Some students felt using something new boosted self-confidence and had a positive effect on how they felt about mathematics. From the pretest to the posttest, an increase in responses centering on organization was the most recorded reason for the increase in study skills and self-confidence using technologically mediated tools.

Responses to the Quantifiable Affective Surveys were collected and a coding scheme was developed by the analyst with emerging patterns of comparison (Patton, 2007). A second analyst was instructed to code the responses and consensus was reached for substantive significance (Patton, 2007).

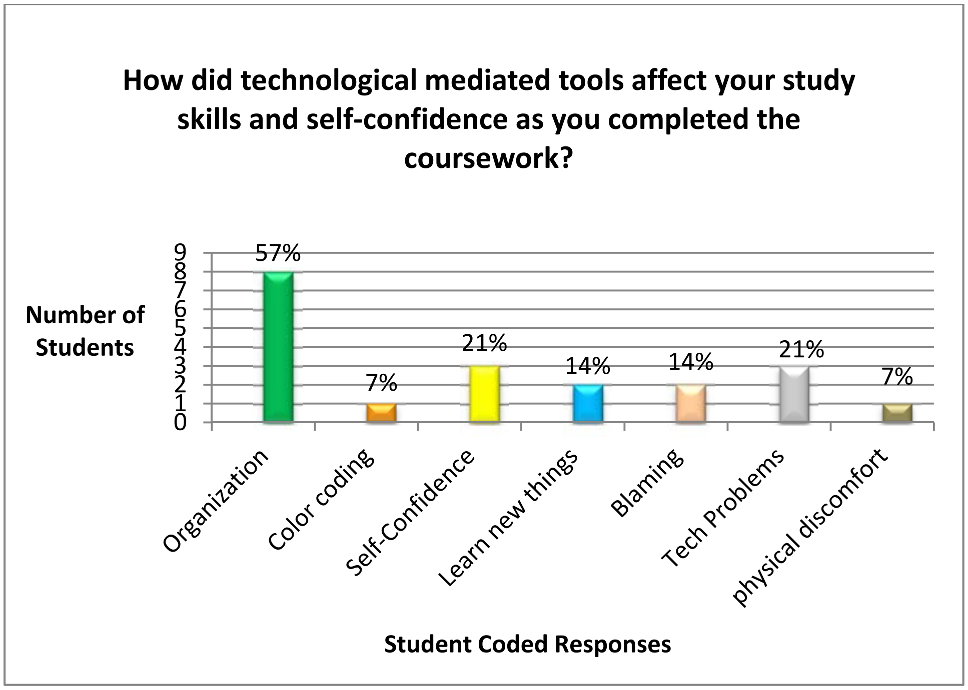

Figure 3. Quantifiable Affective Survey Pretest Qualitative Results

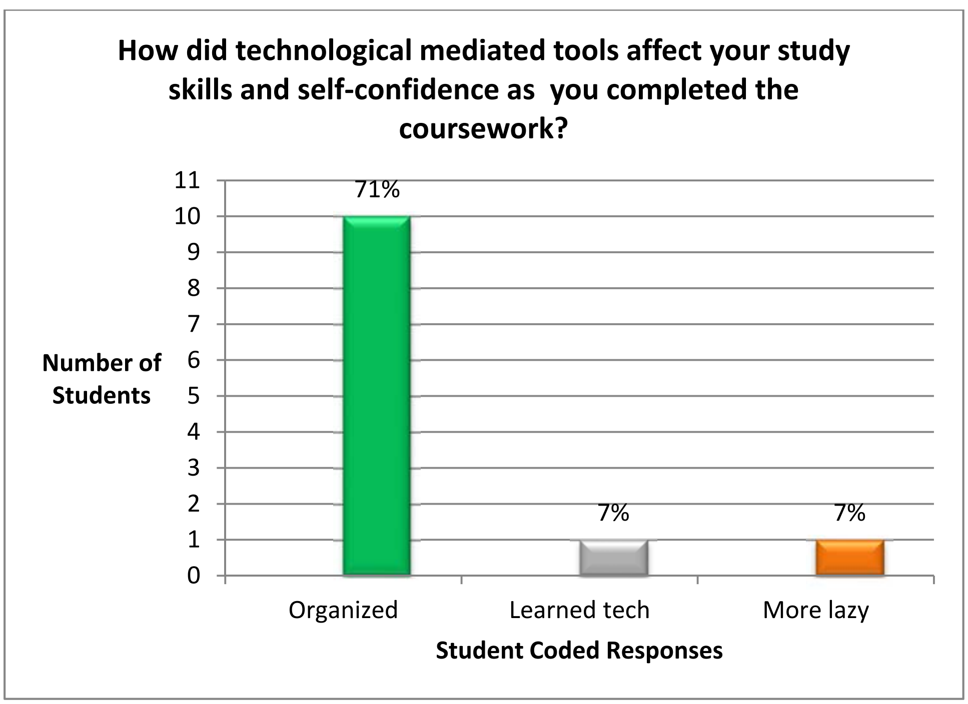

Figure 4. Quantifiable Affective Survey Posttest Qualitative Results

The coding scheme for the pretest included:

- organization
- color coding
- self-confidence
- learn new things
- tech problems
- physical discomfort

The coding scheme for the posttest included:

- organization
- learned technology
- more lazy

From typical responses the researcher inferred the importance of organization to help improve study skills and self-confidence. Students expressed satisfaction at being able to find course materials for studying. One student referred to digital organization for study as a metaphor to a picked up house when vacuuming.

> It is much easier to vacuum if the house is picked up just like it is much easier to study if your notes are all organized. (Student 1)

Organization was generally accompanied with the satisfaction of having everything in one place for quick reference whether it is notes or homework.

> I feel that the computers are awesome to have. If you have the computer you have the notes you took in class with you at all times. It's really nice to have such an organized system to look back at when doing homework assignments. (Student 8)

> Absolutely, I feel that the tablets really help boost your confidence because everything you need to help ya with an assignment is right at your fingertips. (Student 7)

> …more organized in my work. I also think the convenience of having all my work in one location right in one location was very helpful. (Student 6)

> Yes, I think using the tablets kept all of my work & notes more organized, & easily accessible. (Student 13)

Students commented on their increase in self-confidence. The comments indicated an increased comfort level and interest in learning mathematics.

> Yes, using something new has boosted my self-confidence. It also makes doing homework a little more fun (Student 11).

> Yes, it has a positive effect on how I feel about doing math (Student 12).

> Yes, they seem to help more, because learning to do something differently helps with self-confidence (Student 13).

Students commented on the opportunities to improve note taking by using the technologically mediated tools. Some students used color coding to highlight like terms when adding and subtracting polynomials, for example.

> Yes, it helps me because I have my homework and notes on how to complete the homework in front of me. My notes are better because I can color code each step that I do. (Student 1)

This study was the first approach at using the technologically mediated tools with students. Technical issues with the tools became an issue at times. Perhaps the most frustrating issue was solved by the persistence of one student in class. Microsoft Office OneNote had a glitch in it that would cause the writing to move or jump. The student worked with the researcher and the Information Technology department at the University to find a patch that fixed the problem. This issue had caused some frustration early in the study and was resolved by uploading the patch to the tablet PCs.

College Algebra Exit Interview Qualitative Data Analysis and Results

Results of the qualitative data collected and analyzed from the College Algebra Exit Interview (See Appendix D) indicated most often that using technologically mediated tools helped improve study skills by providing organization of course information and materials. The exit interview indicated that use of technologically mediated tools actually built self-confidence and provided organization of materials.

Most of the comments during the exit interview included comparisons of going from a course with technologically mediated tools to one with paper, pencil and notebooks. Organization still was commonly the key to improvement of study skills from the Beginning Algebra experience with technology. A student who was not too keen on starting out Beginning Algebra using the technologically mediated tool reflects on the experience of returning to the traditional classroom in College Algebra.

> Everything was right there it's in one unit, instead of like in College Algebra you had your book, your notes then you had your homework in your notebook and you had to flip back and forth between your notes and you had to look it up in your book. (Sometimes you had a handout) yeah it always made it a pain in the rear to where you just kinda didn't want to really do it that bad. I mean you're sick and tired of it and want to be done with it already. (Student K)

A group of four conservation management majors took their Beginning Algebra and College Algebra courses together. They were transfer students who moved to complete their degrees at the University. They lacked self-confidence in mathematics upon arrival to the Beginning Algebra class. When they entered the classroom on the first day of Beginning Algebra they all sat in the back of the room. They successfully completed the course using the technologically mediated tools and proceeded to College Algebra. Each one of them took a front seat in College Algebra. This was just one indication of an increase in self-confidence experienced by these students.

Here are some of their comments, sharing how important organization was to each of them when accomplishing a task. These comments were collected in the College Algebra Exit Interviews. All four students successfully completed College Algebra.

> It helped a lot with study skills because us four we just don't have the best study skills and round fall we usually are thinkin' about going outside and doing things. We were actually able to sit down and do it because it didn't take as long cause everything was right there. (Student L)

> Then for College Algebra, it made like determining the success it really helped build my self-confidence. I would say it did. And I understood the material but as we got into the newer stuff and had to do five pages of homework gradually my confidence went down and my grades started suffering pretty good towards the end of class. (Student L)

> Going into that class is kind of like what you said though; I mean you walk in the door and the first thing for a little while you feel good. You feel like you are ready to knock it out and I just started doing problems that take 3 full notebook pages or even more sometimes and you're flipping through and jottin stuff down here and here and here. It's not organized at all. (Student D)

> Like on the OneNote say you forgot to do something all you got to do is put a space in there and you can put whatever you want in there you know. And like on paper you are trying to cram something together you only got so much space but on there you can use whatever you want. (Student C)

> I think it made me way more confident in math after using that and then three to four weeks in College Algebra. I started losing confidence because it wasn't available to use. (Student L)

Comments about the use of color for organization and specific notes to oneself were mentioned in the responses.

> Like when we checked our paper in class. It was nice even just having it on your tablet and look at it step by step then you could look at it and say oh that is where I made my mistake and like highlight it and I could see it exactly what I did

> wrong and don’t have to do it next time. I really wanted to buy one after the class actually. (Student C)

> Like in the space with technology you can make a different ink color for something that you want to use to keep things separate and organize the way you want it so you know how to go back to your work to see how you got the answer and what not to instead of just being a pen and pencil. (Student L)

One student commented on how the examples, email and posted notes that were available online helped him.

> Yes, struggled in high school, getting behind. Examples, email, posting notes (helped). Feared taking tests, improved taking tests not scary not hard…. Communicate of class work together. (Student M)

In the exit interview one person explained that when you learn something new, you feel like you can learn other things. She felt that her ability to learn to use technologically mediated tools meant she could learn other things that she had never tried.

> Yes – using something new has boosted my self-confidence. It also makes doing homework a little more fun. (Student 11)

Results of the exit interviews showed a deeper reflection in the comparisons between a course facilitated with technologically mediated tools and a traditional paper, pencil and paper notebook mathematics course. Responses included the need for digital organization to improve study skills and academic self-confidence. Digital organization using technologically mediated tools successfully provided developmental students with the opportunity to improve study skills and academic self-confidence.

<u>Stages of Concern Questionnaire (SoCQ)</u>

The SoCQ, a dimension of CBAM measured levels of concern of the students who implemented the use of technologically mediated tools in Beginning Algebra. The

SoCQ was given as a pretest during the first week of the course and a posttest was given during the eighth week of the course. The innovation in this study was technologically mediated tools.

The SoCQ is designed to measure participant levels of concern with the implementation process of an innovation. (See Appendix E). The analysis was conducted using a process outlined by CBAM (George et al., 2006). The analysis of the pretest indicated that most students had no concern about the innovation (See Table 6) and secondly wanted more information about it (See Table 7). The analysis of the posttest indicated that there was still no concern about the innovation (See Table 8) and secondly students had intense personal concerns about the innovation and its consequences for them (See Table 9).

Table 6

SoCQ Pretest – Highest Level of Concern

Pretest Highest Stage of Concern	Not Con-cerned	Wants more information	Intense personal concerns	Concerns about logistics, time, mgmt	Concerns about conse-quences for students	Concerns about working with others using innovation	Strong ideas about doing things differently
Number of Students	8	0	2	1	0	1	1
Percent of Students	67.0%	0.0%	17.0%	8.0%	0.0%	8.0%	8.0%

Table 7

SoCQ Pretest – Second Highest Level of Concern

Pretest Second Highest Stage of Concern	Not Con-cerned	Wants more information	Intense personal concerns	Concerns about logistics, time, mgmt	Concerns about conse-quences for students	Concerns about working with others using innovation	Strong ideas about doing things differently
Number of Students	1	10	0	0	0	0	1
Percent of Students	8.3%	83.4%	0.0%	0.0%	0.0%	0.0%	8.3%

Table 8

SoCQ Posttest – Highest Level of Concern

Stages of Concern Posttest Highest Concern	Not Con-cerned	Wants more information	Intense personal concerns	Concerns about logistics, time, mgmt	Concerns about conse-quences for students	Concerns about working with others using innovation	Strong ideas about doing things differently
Number of Students	7	3	2	0	0	2	0
Percent of Students	50.0%	21.4%	14.3%	0.0%	0.0%	14.3%	0.0%

Table 9

Stages of Concern Posttest – Second Highest Level of Concern

Stages of Concern Posttest Second Highest Concern	Not Con-cerned	Wants more information	Intense personal concerns	Concerns about logistics, time, mgmt	Concerns about conse-quences for students	Concerns about working with others using innovation	Strong ideas about doing things differently
Number of Students	0	5	7	1	0	1	0
Percent of Students	*0.0%*	*36.0%*	*50.0%*	*7.0%*	*0.0%*	*7.0%*	*0.0%*

Throughout the process students were not concerned about using the technologically mediated tools since the highest concern was no concern. This indicated that respondents had other concerns with tasks or activities and the innovation was not the only concern. By analyzing the second highest concern, there was evidence that during the pretest students were interested in more information and during the posttest students had personal concerns.

A hypothesis based on the results of analysis of the SoCQ indicated students were not concerned about using the technologically mediated tools and as they gathered more information they became more focused on the personal concerns. Personal concerns are expressed as interest in how the innovation affects oneself. Data analyzed from the posttest surveys taken the last week of Beginning Algebra confirmed that student suggestions about how to use the innovation to improve study skills and academic self-confidence revealed the most common suggestion was to use them to help improve the factors (See Table 10).

Table 10

Quantifiable Affective Survey Posttest

Do you have any suggestions of how to use technologically mediated tools to improve study skills and /or self-confidence?

Coded Responses	Number of Responses
Use them to help	6
Organized	3
Fix the bugs	1
Math is fun	2

Statements about how students should use the innovation to help strengthen study skills and self-confidence addressed how the tools were used in the course.

> I think that every class should use the tablets with the one note program especially all math classes. (Student 6)
>
> Get as many as you can and get them to the students to use and the improved study skills/self-confidence will come. (Student 1)
>
> I think the best way would be to use them, just like we did in this class. (Student 13)

The results provided a measure of concern for the innovation that aligned with the qualitative results of the Quantifiable Affective surveys. The SoCQ was analyzed in multiple ways including demographic data and highest levels of concern.

<u>SoCQ Demographic Data</u>

The demographic data was calculated based on students self-reporting the data (See Table 3). Of the respondents, 92% never used the innovation prior to the study. While 67% considered themselves non users, 25% considered themselves novices. After taking the course, 50% considered themselves intermediate users of the innovation and 25% felt they were Old Hands at using the innovation. Old Hands is a classification between Intermediate and Past User.

The comfort level was evidenced when a student presented a problem during a class with the University President in attendance. The student proceeded to use the innovation as a tool to show the work as he completed the problem. The student considered himself an Old Hand at using the innovation.

<u>SoCQ Analysis of Highest Stages of Concern</u>

From the results of the pretest during week one, Stage 0 was the highest Stage of Concern for 67% of the students indicating no concern about the innovation (See Table 6). Stage 1 was the second highest Stage of Concern for 83% of the students indicating that students wanted more information about the innovation. From the results of the posttest during week eight, Stage 0 was still the highest Stage of Concern for 50% of the students and Stage 2 was the second highest Stage of Concern for 50% of the students (See Table 6). This indicated that students had no concern about the innovation along with intense personal concerns about the innovation and its consequences for them. These concerns did not necessarily indicate resistance.

Since the results showed the highest stage of concern in both the pretest and the posttest was no concern for the innovation it was evident that using the innovation did not affect the results of the qualitative data collected in the Quantifiable Affective surveys. Further the second highest stage of concern increased from wanting more information about the innovation to intense personal concerns about the innovation and its consequences for them combined with the results of the results of the surveys did not warrant that the change was due to resistance of the innovation.

The results showed minimal concerns about the effects of the innovation on students throughout the Beginning Algebra course. This aligned with the positive results of the qualitative data analysis from the Quantifiable Affective Surveys. It provided evidence that concerns about the innovation were not strong enough to contrast the data collected in the other instruments.

Research Question 3 Results

> Research Question 3: Did an improvement in student study skills and self-confidence in a remedial beginning algebra course facilitated with technologically mediated tools contribute to successful retention in a college algebra course?

To answer Research Question 3, quantitative and qualitative methods were used to analyze the collected data. Data were acquired from university student records and from the College Algebra Exit Interview. University student records were requested to record successful completion of the Beginning Algebra and College Algebra courses taken by the participants. The second source of data was the set of responses to questions asked in the interviews of participants after College Algebra was successfully completed. Seven participants were interviewed after successfully completing College Algebra. These interviews were audio tape recorded and scripted.

Successful Completion of Beginning Algebra and College Algebra

Using quantitative descriptive statistics, records of successful completion of Beginning Algebra and College Algebra were attained from the university. Passing the course with a D or better is considered successful completion of the course (See Figure 5).

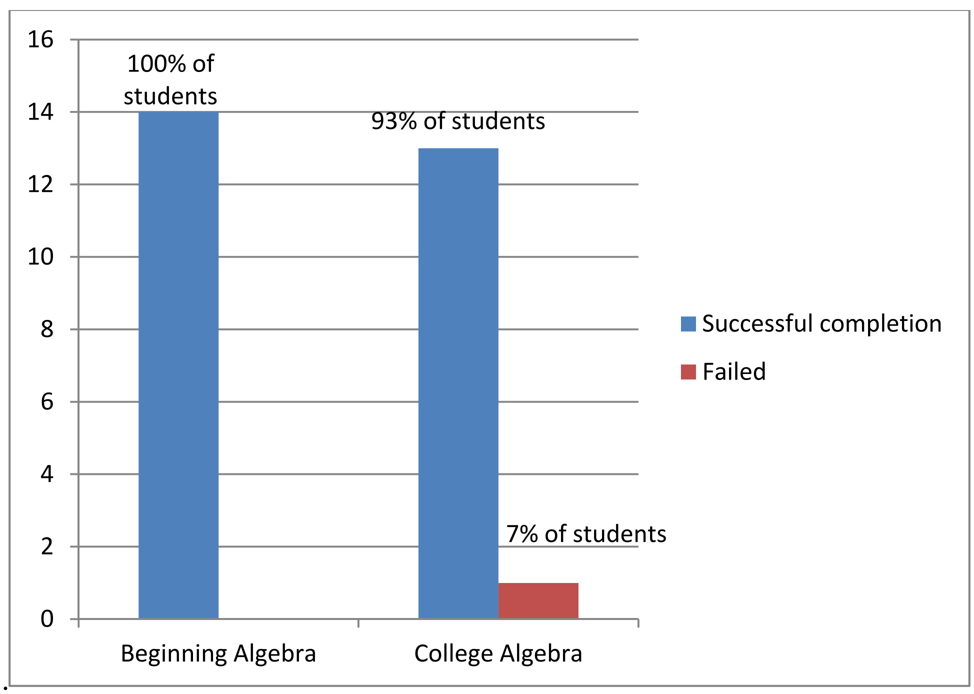

Figure 5. Beginning Algebra and College Successful Completion

Beginning Algebra does not count toward graduation for credit. The successfully completed College Algebra course counts toward graduation credit. All students passed Beginning Algebra. All except one student passed College Algebra.

Interviews After Successful Completion of College Algebra

Quantitative data analysis from interviews after successful completion of College Algebra indicated 100% of the students interviewed felt that a beginning algebra course facilitated with technologically mediated tools contributed to their success in College Algebra. The qualitative data analysis completed from the collection of the interview responses indicated that organization of course materials was most beneficial in increasing study skills and academic self-confidence contributing to retention in College Algebra.

Qualitative responses to the interview questions were collected and a coding scheme was developed by the analyst with emerging patterns of comparison (Patton, 2007). A second analyst was instructed to code the responses and consensus was reached for substantive significance (Patton, 2007). The coding themes developed were:

- organized and efficient
- wanted tablets back
- beneficial to write on
- color helps
- learned new thing
- built self-confidence

Students felt strongly that organization due to the use of technologically mediated tools in Beginning Algebra contributed to their success in College Algebra (See Table 11).

In the analysis of the College Algebra Exit Interview qualitative data (See Table 12), five students commented that they would have liked to have had tablet PCs to use in College Algebra. Students felt the tablet PCs were beneficial to write on. Students felt color coding helped with the organization that lead to success in College Algebra.

Table 11

College Algebra Exit Interview Data (Success in College Algebra)

Do you think taking a Beginning Algebra course facilitated with technologically mediated tools contributed to your success in College Algebra?			
Yes	7	students	100%
No	0	Students	0%

Students most commonly focused on how the use of technologically mediated tools in Beginning Algebra contributed to success in College Algebra because of the organization that the tools provided. The organization and use of the digital tools to retrieve information and manipulate it on the screen made students feel that the work was going faster.

> Yes Beginning Algebra you did not have to get out paper or anything it was really quick and we learned it really easy that way so then I did really well in Beginning Algebra so it really helped me in College Algebra because I hadn't taken Algebra II in high school so I feel like I got through it that way. (Student 11)

Table 12

College Algebra Exit Interview Data (Contribution to College Algebra)

Do you think taking a Beginning Algebra course facilitated with technologically mediated tools contributed to your success in College Algebra? Please explain.

Coded Responses	Number of Responses
Organized and efficient	9
Color	2
Wanted them back	5
learned new thing	1
beneficial to write on	3
built self-confidence	1

Some students included comments that showed reflections about the use of the technologically mediated tools wishing they had them in College Algebra. These students, also, noted that they were not necessarily in favor of them when they first received them in Beginning Algebra. This aligns with the student that stated how learning something new makes a person more self-confident about learning something else.

> I think it would have contributed more to my success in College Algebra if we would have had the notepads again. I started off completely against them. (Student 7)
>
> Yes helped a great deal it made it more accessible I was against them for the first week in Beginning Algebra then after that didn't want it any other way (Student 1)
>
> When you come into a class you don't know how to use stuff like the tablet and all of the sudden you learn it makes you more confident of the classes. When you come into new classes and you're like oh I don't know how to do this. And then you say oh I have done different things before … overcame it in other classes so it will help your self-confidence. (Student 11)

Eighty-six percent of the students felt that taking a beginning algebra course facilitated with technologically mediated tools helped to sharpen their study skills (See

Table 13). Fifteen comments included organization as an important factor in sharpening study skills. Students felt the technologically mediated tools helped them with organization. Two students commented that the tools were beneficial to write on.

Table 13

College Algebra Exit Interview Data (Increased Study Skills)

Do you think taking a Beginning Algebra course facilitated with technologically mediated tools contributed to sharpen your study skills? 86% yes 14% unsure

Coded Response	Response numbers
Organized and efficient	15
Color	1
Wanted them back	1
Learned new thing	1
Beneficial to write on	2

Students felt that technologically mediated tools made it easy to study. This referred to the prep work that goes with studying.

> It's the prep work that's so time consuming. So when I am ready to study I just open it up it's there because I'm just tweaking (with paper) … I have to rewrite those notes but I am not having the time because I'm doing the homework for the next time . And there is still that little bit where it's your notes and you remember where something may be placed on a page you can work from but it's still so messy and you still have to dig visually to find something whereas if I had the different colors it pops out. (Student 1)

> It helps with sharpening your study skills because it is so easy to study. In comparison to having a book and folder with some handouts and a notebook with some other stuff that you wrote down and everything is just right there you have multiple tabs open and bounce back and forth through stuff and its all laid out in problems. (Student 6)

From the seven students interviewed, eleven comments included references to the how the technologically mediated tools helped to improve academic self-confidence (See Table 14).

Table 14

College Algebra Exit Interview Data (Increased Self-Confidence)

Do you think taking a Beginning Algebra course facilitated with technologically mediated tools contributed to increase self-confidence?

Coded Response	**Response numbers**
Organized and efficient	10
Color	5
Wanted them back	1
Learned new thing	3
Changed my attitude toward math	3
Beneficial to write on	5
Built self-confidence	11
Instant feedback	4

Ten comments included the importance of organization to the students. Along with being beneficial to write on and use of color, students commented positively on the use of instant feedback and how the tools changed their attitudes toward mathematics. Students commented that learning a new thing (technologically mediated tools) helped to gain confidence to learn academics.

Students commented on previous experience in mathematics classes. With the placement in a developmental beginning algebra course in college students feel the pressure to succeed. It is difficult to overcome previous unsuccessful experiences in learning mathematics. These experiences provide deep reflections about the power of using technologically mediated tools to provide organization of materials for class. Overwhelmingly the students cited this organization as the most important strategy to improve study skills and academic self-confidence. With the organization tools they felt capable of successfully completing the mathematics courses.

Here a student comments on her experience with a change in attitude towards mathematics.

> Definitely, … I came in with the same attitude that math is not a strong point. I guess I am thinking that it had more than me being older and wiser and coming at the subject with a different attitude it's the computer. It's the OneNote. (Student 9)

Another student comments on an attitude change.

> When you come into a class you don't know how to use stuff like the tablet and all of the sudden you learn it makes you more confident of the classes. …. and then you say oh I have done different things before … overcame it in other classes. So it will help your self-confidence. (Student 11)

Here a student attributes the self – confidence in mathematics to the technologically mediated tool.

> I think it made me way more confident in math after using that (tablet PC) and then three to four weeks in College Algebra... I started losing confidence because I wasn't available to use it. (Student 1)

Students felt that the digital organization impacted retention allowing them to successfully complete College Algebra. By having all the coursework in one place that could be referenced with a click, the students were able to use the technology for recall of the coursework when completing assignments. They used the technology to create strategies for emphasizing importance using color and highlights. As the coursework provided an opportunity for group work in class, the indication is that the students felt comfortable in the setting and were able to stay focused to learn.

CHAPTER 5

DISCUSSION

Review of Study

This story began with a need to positively impact retention in College Algebra implementing change in the prerequisite Beginning Algebra. Careful review of the literature led the researcher to implement technologically mediated tools into Beginning Algebra to increase academic self-confidence and study skills to contribute to retention and successful completion of College Algebra, a course required for graduation. The findings indicated that the impact of digital organization of coursework using technologically mediated tools in Beginning Algebra contributed to the increase in study skills and academic self-confidence resulting in a 100% successful completion rate in Beginning Algebra and a 93% successful retention and completion rate in College Algebra.

Study skills were defined as the extent to which you believe you know how to assess an academic problem, organize a solution, and successfully complete academic assignments. Academic Self-Confidence was defined as the belief in one's ability to perform well in school. Quantitative and Qualitative data were collected via surveys and interviews throughout the study. Measurements of successful completion of both Beginning Algebra and College Algebra along with quantitative data and qualitative data showed a complementary analysis to reinforce the results of the study and show the positive impact of digital organization for developmental students in mathematics. Student levels of concerns about using the technologically mediated tools during

Beginning Algebra were analyzed showing no concern during a pretest and posttest. Further analysis indicated that students were interested in more information and how the tools would work for them.

Technologically mediated tools included tablet PCs with digital notebook software. One tablet PC was issued to each student. The researcher created a digital notebook with course materials that included references and interactive sets of problems of coursework presented as introductory, guided practice, individual and group work. The notebook provided storage space for all coursework which included assignments done by students and corrected copies returned with feedback. Although the original notebook was organized with digital tabs and digital pages for the course, students were encouraged to reorganize and set up tabs for assignment storage.

The research questions were:

Research Question 1: Did student self-confidence and study skills improve during a remedial beginning algebra course facilitated with technologically mediated tools?

Research Question 2: Did the use of technologically mediated tools contribute to an increase in study skills and self-confidence in a remedial beginning algebra course?

Research Question 3: Did an improvement in student study skills and self-confidence in a remedial beginning algebra course facilitated with technologically mediated tools contribute to successful retention in a college algebra course?

A mixed methods analysis was used to answer these questions. Surveys during Beginning Algebra and Interviews after College Algebra provided the quantitative and qualitative data. Quantitative data was analyzed using quantitative descriptive methods (Alreck & Settle, 2004). Qualitative data were analyzed using a coding scheme using emerging patterns of comparison (Patton, 2007). Reliability was reached with a second analyst following the coding scheme. The Stages of Concern Questionnaire (SoCQ) was used to determine the participant levels of concern during pre and post use of the technological tools.

Further quantitative analysis consisted of measurements of successful completion by participants of Beginning Algebra and College Algebra and a pretest – posttest Student Readiness Inventory (ACT, 2004) created to measure 10 psychosocial factors related to college retention including study skills and academic self-confidence as two of the factors. Correlation of the pretest and posttest scores as independent and dependent variables respectively was measured using Pearson Correlation.

Research Question 1 Implications

> Research Question 1: Did student self-confidence and study skills improve during a remedial beginning algebra course facilitated with technologically mediated tools?

Data analysis from the Quantifiable Affective Surveys produced a positive increase of yes responses to the question: Do you feel that technologically mediated tools affect your study skills and self –confidence as you complete the coursework? The results showed a positive increase in yes (positive) responses from the pretest (67%) to the posttest (86%). Similarly, the exit interviews revealed that 86% of the students felt that Beginning Algebra facilitated with technologically mediated tools helped to sharpen study skills, while 100% of the students felt the tools helped to improve academic self-confidence. The Pearson Correlation Coefficient for study skills was 0.378 and 0.455 for Academic Self-Confidence. These are not considered statistically significant increases. The implications from the surveys and exit interviews revealed that students felt their study skills and academic self-confidence increased and the technologically mediated tools in Beginning Algebra had contributed to the increase.

The Stages of Concern Questionnaire (SoCQ) data analysis showed that student's highest concern was no concern about using the technologically mediated tools in both the pretest and posttest. This indicated that the innovation defined as technologically mediated tools was not the only point of concern for the respondents. The pretest second highest level of concern indicated an interest in more information about the tools. The posttest second highest level of concern indicated a personal concern of how the tools affected an individual.

The changes in these second highest levels of concern showed students were quickly progressing through the levels of concern. There are implications of quick movement through the levels while maintaining the highest level of change as no concern. Maintaining the highest level of change as no concern may indicate that students adapt to the integration of technology into the curriculum rapidly. This would allow evaluation of the innovation to take place quickly and provide data for analysis to aid an informed decision making process about the use of the innovation.

In reflection, the interpretation of the ACT study asserting that the two strongest non-academic factors having the greatest effect on college students' retention and performance are academic-related skills including time management skills, study skills, and study habits and academic self-confidence may require a better measure than the SRI. The students' study skills and academic self-confidence scores measured by the SRI did not show a significant increase based on the Pearson Correlation Coefficient analysis. Students, however, reported feeling strongly in surveys and interviews that they increased their study skills and self-confidence. This indicates that the SRI may not be a good measure for study skills and academic self-confidence as a stand-alone quantitative measure when used as pretest and posttest. Clearly, students credited digital organization as important when increasing study skills and academic self-confidence.

Research Question 2 Implications

> Research Question 2: Did the use of technologically mediated tools contribute to an increase in study skills and self-confidence in a remedial beginning algebra course?

This study suggests that students felt that taking a Beginning Algebra course facilitated with technologically mediated tools helped them to sharpen their study skills and improve academic self-confidence. Specifically, 57% of the responses during the fourth week of the affective survey showed that organization positively affected study skills and self-confidence. Data recorded from the posttest survey concluded 71% of the respondents agreed that organization positively affected study skills and self-confidence in the Beginning Algebra course that was facilitated with technologically mediated tools.

Similarly, data analysis from the College Algebra Exit Interviews indicated 75% of the responses included organization and efficiency using the tools contributed to study skills while 79% felt the tools contributed to self-confidence. This implies that digital organization contributes to an increase in study skills and self-confidence when learning mathematics.

From the results of the SoCQ pretest during week one, Stage 0 was the highest Stage of Concern for 67% of the students indicating no concern about the innovation (See Table 6). Stage 1 was the second highest Stage of Concern for 83% of the students indicating that students wanted more information about the innovation (See Table 7). From the results of the posttest during week eight, Stage 0 was still the highest Stage of Concern for 50% of the students (See Table 8) and Stage 2 was the second highest Stage of Concern for 50% of the students (See Table 9). This indicated that students had no concern about the innovation along with intense personal concerns about the innovation and its consequences for them. These concerns did not necessarily indicate resistance. It did indicate a move within a short period of time showing adoption of the tools.

Since the results showed the highest stage of concern in both the pretest and the posttest was no concern for the innovation it was evident that using the innovation did not affect the results negatively of the qualitative data collected in the Quantifiable Affective surveys. Further the second highest stage of concern increased from wanting more information about the innovation to intense personal concerns about the innovation and its consequences for them. These results combined with the results of the surveys did not warrant that the change was due to resistance of the innovation.

The results showed minimal concerns about the effects of the innovation on students throughout the Beginning Algebra course. This aligned with the positive results of the qualitative data analysis from the Quantifiable Affective Surveys. It provided evidence that concerns about the innovation were not strong enough to contrast the data collected in the other instruments.

The implications of this analysis raise a question for teachers incorporating technology into the curriculum. If students do not see a technology innovation as high concern and show interest in more information, how concerned should teachers be about implementing new technology? In this study within four weeks the posttest survey indicated no concern of the technology and the second level of concern had moved from interest in more information to concern about how it affects oneself.

This implies that the students may move through the levels of concern rather quickly. As students may progress to become proficient at using the innovation quickly, teachers may find value in analyzing their concerns about implementing technology based on what is necessary to meet the needs of the students learning the curriculum. This may be preferred rather than trying to understand everything about the technology before incorporating the important options to meet pressing needs in education.

Research Question 3 Implications

Research Question 3: Did an improvement in student study skills and self-confidence in a remedial beginning algebra course facilitated with technologically mediated tools contribute to successful retention in a college algebra course?

Since 100% of the Beginning Algebra students successfully completed Beginning Algebra and 93% successfully completed College Algebra it is clear that the rate of retention was achieved to complete College Algebra. The success of retention was reiterated when 100% of the students who responded in the College Algebra Exit interview said that they felt the technologically mediated tools in Beginning Algebra contributed to their success in College Algebra. Qualitative data analysis from the interviews indicated 75% of the responses revealed organization and efficiency as a means to sharpened study skills. Similarly, 79% revealed organization and efficiency as a means to increase self-confidence. This implicates the positive impact of digital organization on retention in College Algebra. In this study, the use of technology to provide students with tools to help them to digitally organize coursework was revealed as a way to aid retention in College Algebra.

Conclusions Drawn from This Study

Conclusions including student interpretation of the need for digital organization as it relates to an increase in study skills and academic self-confidence when learning developmental mathematics are discussed here. This section is a description of how students used the technologically mediated tools to provide strategies to meet individual needs for successful retention and completion of Beginning Algebra that led to successful completion of College Algebra. The importance of digital organization as the pedagogical link between technology and content in developmental mathematics is a vital conclusion of the study.

Digital Organization Surfaces As the Pedagogical Favorite

Students commented on the value of digital organization to help sharpen study skills. In this study, it is evident that students felt digital organization helped them to focus on what was important to learn. They created ways to keep information digitally organized by creating space to insert details for focus. Often they would use color coding by tapping the stylus on the pen color or a digital highlighter to help when studying. This study highlights digital organization as a high priority for developmental students in mathematics courses.

These developmental students often commented on their frustration with paper and pencil when trying to find information. They seem to be frustrated with multiple paper notebooks keeping one for course notes and one for homework. With this in mind, it may be the case that measurements of study skills need to include more measures of organizational skills for developmental students in mathematics since students felt their study skills improved. Along with organization, students mentioned the ability to have everything in one place. With paperless homework, students were able to keep a copy and have the returned digital copy together in one notebook.

Students felt that the technologically mediated tools helped them to increase their self-confidence. Having everything in one place for quick reference gave them self-confidence about asking questions and proof of their knowledge to complete tasks. None of the students in the study had ever used a tablet PC with a digital notebook for class. A couple of students mentioned how learning to use the innovation helped them to have confidence to learn other new things. Four of the students walked into my office three days into College Algebra and wanted the tablet PCs back. In the interview following College Algebra they stated they felt their self-confidence gradually start to reduce and then slide down in the College Algebra course. They felt the disorganization of paper and pencil and lost the feeling of “knocking it out of the park” (Student L).

Other Findings

Ten factors measured in the SRI were:

- academic discipline
- academic self-confidence
- commitment to college
- communication skills
- general determination
- goal striving
- social activity
- social connection
- steadiness
- study skills

Four factors, communication skills, general determination, goal striving, and social connection showed a significant increase with $\alpha = 0.05$ from the SRI pretest to posttest. Social activity, also, showed significant growth with $\alpha = 0.10$. Since the SRI is an instrument to help students measure psychosocial factors to improve college retention, the findings of this study imply a relation between digital organization and the five factors showing significant increases between the SRI pretest and posttest. This indicates a need for further study of the link between digital organization and retention in college.

The SoCQ data analysis indicated that prior to using the technologically mediated tools and after using them, students had no concern about the innovation. The second highest level of concern to students in the pretest was an interest in more information. The second highest level of concern in the posttest was consequences for the individual. Although this questionnaire is often used for teachers adopting an innovation, its use with students in this study indicates the importance of how teacher decisions based on their concerns can affect student learning negatively. The results in this study show students are likely to adapt quickly to new technology that provides digital organization of the curriculum.

If teachers are over concerned about the adoption of a technological tool that presents no concern to students, decisions about the adoption may affect the ability of students to learn more effectively. This indicates that in further studies the SoCQ may be a good instrument to measure both teacher and student concerns with a new adoption. Comparison of the two groups may provide data to make more informed decisions about innovations in education.

Need for Future Study

In this study, developmental mathematics students shared the frustration of being unable to organize coursework with paper and pencil. They expressed a need to be able to increase space when working through problems so they can keep information in one place. Along with increasing space and the individual needs for color coding and highlights, developmental mathematics students may need access to technologically mediated tools that help them develop speed for implementing these organizational strategies during class.

Professional development for teachers in the use of tablet PCs with digital notebooks for instructional purposes including using the tablet PC as a hub for a technology cluster should be studied. With the tablet PC, Microsoft office OneNote can be used as a digital notebook. Lecture capturing software captures annotations from the screen of the tablet PC, teacher video and audio provides more records of the class. Notebook pages can be saved as pdfs.

The lecture captures and pdfs of the notes can be saved in class management systems for students to easily access. Student management systems can be used to store uploaded assessments of students work. Online homework software programs can, also, be introduced as they allow for students to try working problems multiple times with guided practice. Access to these technologically mediated tools should be studied for use with students in mathematics courses. Screen sharing software could be used for group discussions in face-to-face classroom settings and online for remote student participation.

The TPACK framework for teacher knowledge is described as a complex interaction among three bodies of knowledge: content, pedagogy, and technology. The interaction of these bodies of knowledge, both theoretically and in practice, produces the types of flexible knowledge needed to successfully integrate technology use into teaching and learning (Koehler & Mishra, 2009). There is a need to study the use of these technologically mediated tools by teachers and students to enhance pedagogical strategies to improve student learning.

As in this study, the change involved for teachers who incorporate technology into teaching and learning creates a high level of interaction with students in the classroom. It is important that teachers feel self-confidence in the use of the technology. Studies are needed to promote work with teachers to improve attitudes towards technology development in the classroom.

Students in this study performed well when they were given a tablet PC for use during the course. The students in this study never used a tablet PC with a digital notebook before this class. Many of them wanted them back. This shows a need for one-to-one studies of developmental students using tablet PCs for organization of coursework to improve study skills and increase retention in college.

There is a need to study the importance of precise annotation with a stylus that is available on tablet PCs. With some schools adopting technology without this feature, there is not enough evidence that students' needs are being met for learning. This study showed an organizational need for developmental mathematics students who included speed and accuracy in changing colors, and increasing space when writing with a stylus on a page.

Studies need to determine if it is economically feasible to purchase technologically mediated tools for students who do not meet the needs of all academic subjects. This study showed successful student outcomes in mathematics retention when student used technologically mediated tools that they felt helped to sharpen their study skills and improve academic self-confidence. Students felt the ability to use a stylus for annotating a computer screen, using color coding was important in providing organization strategies.

In this study there was a significant increase from the pretest to the posttest of the SRI in communication skills, general determination, goal striving, social connection and social activity. Communication skills are defined as attentiveness to others' feelings and flexibility in resolving conflicts with others. General determination is defined as the extent to which one strives to follow through on commitments and obligation. Goal striving is defined as the strength of one's efforts to achieve objectives and end goals. Social connections defined as one's feelings of connection and involvement with the school community. Social activity is defined as the comfort level one feels when meeting with others. General determination, communication skills and goal striving are considered measures of motivation and skills. These are personal characteristics that help students to succeed academically by focusing and maintaining energies on goal-directed activities.

In this study students commented most frequently on the ability to organize coursework using technologically mediated tools. They felt the digital organization helped to sharpen study skills and improve academic self-confidence. They felt this helped with retention in College Algebra. This study suggests that these factors may be the most important factors related to retention for developmental students in mathematics. Further studies are needed to test this theory measuring the increase in general determination, communication skills, and goal striving with developmental students using technologically mediated tools.

Two other significant increases from the SRI pretest to the posttest were recorded as the social connection factor and the social activity factor. These factors are considered social engagement and deal with interpersonal factors that influence students' successful integration or adaption into their environment. Further studies are needed to see if developmental students show an increase in social connections when technologically mediated tools are incorporated into their courses.

With significant increases in these factors with developmental students in mathematics, further studies are needed to focus on which of the ten factors seem to be the most important for retention of other subgroups of students. There is a need to find what students feel is the most important process for them to learn and retain knowledge. One issue that has surfaced in this study is the lack of knowledge of technologically mediated tools that exist. Within the small sample size of this study, no student had ever used a tablet PC with a stylus to annotate the screen.

This suggests that there may be an issue with educator awareness of options that can be made available to students to help sharpen study skills and improve self-confidence. Multiple variations of this issue warrant studies for future generations. There is a need to introduce options to educators for technology integration from the aspect of student learning rather than a marketing gimmick. Studies like this one suggest student needs for digital organization to improve retention. There is a need to help teachers increase awareness of options to meet student needs.

Fortunately, CBAM offers measures of stages of concern and levels of use of the innovation. The theory of TPACK provides a framework of teacher knowledge that is helpful in successfully integrating technology, pedagogy and content. It is important to tackle the issue of educator awareness and move in the direction of TPACK.

An example in this study is in response to students expressing a need for instant feedback. They experienced instant feedback during guided practice, individual and group work, student explanations, digital homework, and assessments. Teachers that are falling behind in the use of the TPACK framework in their classrooms may be missing opportunities to meet student needs efficiently.

Since the study, Beginning Algebra taught by the researcher has used one-to-one computing with the tablet PCs as designed in the study. Follow up to the study included software that allows students to wirelessly project their individual tablet PC screens to the main screen. This provides students with the opportunity to share their work with others. It allows students to view successful problem solving done by classmates with similar struggles learning mathematics.

Since this study, every time the researcher taught a beginning algebra course, tablet PCs were issued to each student in the class. There would seem to be a high risk factor in loaning students computers for the course. No problems with returns have occurred. The University does not require reimbursement for any lost or damaged machines. The success of the project with developmental students has gained support to increase the study to include more mathematics students and teachers. With the increase in numbers of students using the technology, there is a need for optional ways to provide the digital organization. . If students have access to the tablet PCs in labs, students could annotate with a stylus and save the notebook to SkyDrive for access from other computers. This may provide the digital organization that was important to the students in this study. Instant access outside the classroom to everything in one place may be an important contribution to retention. Future work at my university is planned to study this option for college level mathematics courses. The labs will include extra monitors for students to access eBooks during class. Last term a pilot using a homework software program in Elementary Statistics was, also, successfully implemented.

In mathematics many concepts build on previous concepts learned. The researcher observed student use of digital organization to relate new concepts to a previously learned concept when asking questions during class. Also, evidenced by the researcher was student reference to digitally stored material when asking a question. Improvement of the survey questions used in this study could provide more detailed evidence of the value of digital organization to students.

The researcher recorded a 97% attendance rate with students coming to class early which related to the SoCQ second highest stage of wanting to know more about the innovation. All tablet PCs were well taken care of and returned at the end of the course. Since this study, all tablet PCs used for this purpose are still available and none have been lost, stolen or damaged other than regular usage. This indicates student interest in the importance of using the technology and securing it for others to use during the following term. This data should be requested in future studies.

Researchers without the technology availability for students may find it difficult to conduct studies that use digital organization due to the cost of the technology. However, it should be noted that some money and time is saved by going paperless. The researcher in this study calculated a savings of 3000 sheets of paper based on student packets to provide partial notes for course work and homework being digital. No time was used during class to collect or hand back papers since it was done digitally using a student management system.

Millennial Generation and Learning

It may be important to investigate tendencies of college students in their approaches to learning. The millennial generation college students born between 1980 and 2002 appear to be techno-savvy team oriented confident multitaskers. With experience using rapidly changing technology, the millennial generation tends to use trial and error as a learning strategy. This generation more than any other learns most effectively when a large variety of instructional strategies are used (Wilson & Gerber, 2008).

Wilson and Gerber (2008) recommend that instructors of the millennial generation strive for clarity in course structure, assignment expectations and grading expectations. Students should have multiple opportunities to participate and provide student initiatives. Teachers should incorporate stress-reduction mechanisms and engage students in discussions on the ethical dimensions of taking a college class (Wilson & Gerber, 2008). Immediate feedback especially when it includes praise seems to be expected by this generation of students. The millennials tend to try to please authority as they have experienced rewards for participating at all levels so they are not accustomed to negative feedback (Howe & Strauss, 2009). In studies used in mathematics classes, it may be beneficial to collect more demographic information than mathematics placement in courses.

Summary

This study confirmed that technologically mediated tools incorporated into a developmental beginning algebra course impacted digital organization that enhanced study skills and academic self-confidence impacting retention in College Algebra. All fourteen participants successfully completed Beginning Algebra. Thirteen of the fourteen students successfully completed College Algebra. Students overwhelmingly responded that using technologically mediated tools in a beginning algebra course provided digital organization of course work and opportunities for color coding and increasing space that helped with study skills and academic self-confidence.

Quantitative analysis in this study showed that students incorporating technologically mediated tools into Beginning Algebra successfully completed College Algebra at a 93% rate. One student that did not successfully complete College Algebra was statistically an outlier. There was no statistical significant increase in study skills or academic self-confidence when measured using an SRI pretest and posttest. However, quantitative and qualitative data collected from surveys and interviews showed that students felt an increase in study skills and academic self-confidence in Beginning Algebra based on comparative significance with high reliability as defined by Patton.

Students expressed an improved attitude toward mathematics. Since they had never used tablet PCs with digital notebooks, they expressed how learning a new thing improved self-confidence. They felt that they would be able to learn other new things in the future. The students felt that experiencing ways to digitally organize coursework for instant access and feedback was helpful when studying. They liked being able to write on the computer screen to capture notes. They felt frustration was eliminated going paperless. They liked being able to color code and add space to create more detailed notes. At time color codes were used to define whether they understood the concept or needed more help. This helped when studying and asking questions.

Concluding Remarks

When the researcher began this study, she wanted students to use technology to help improve their study skills and self-confidence in mathematics. She wanted to incorporate the technology with developmental students because she felt they generally have experienced enough failure in mathematics to become frustrated and not trust that they are capable of succeeding. The most valuable discovery learned from this study is the importance of digital organization to impact study skills and academic self-confidence in Beginning Algebra leading to successful retention in College Algebra. The technology used in this study helped students to digitally organize their notes and categorize difficulties with color coding. By having ways to easily refer to the difficult material predetermined as questionable, students showed confidence in asking questions. Color coding made it easy for students to recall processes.

The digital notebook was flexible enough for students to choose the strategies for organization that best fit individual needs. The benefit of going paperless using digital organization provided a pedagogical reason for going green. The technologically mediated tools used in this study were beneficial for developmental mathematics students helping them to digitally organize work to enhance study skills and academic self-confidence to improve retention in College Algebra.

REFERENCES

Academic College Testing. (2008). *Student Readiness Inventory*. Iowa City: ACT.

Alreck, P. L., & Settle, R. B. (2004). *The survey research handbook*. (3rd ed.). New York, NY: McGraw Hill/Irwin

Arcavi, A., & Hadas, N. (2000). Computer mediated learning: An example of an approach. *International Journal of Computers for Mathematical Learning*, *5*(1), 25-45.

Bandura, A. (1997, March). Self-efficacy. *Harvard Mental Health Letter*, *13*(9), 4-6.

Barabash, M. (2003). Cycloids, billiards, lissajou: Using the computer to visualize irrational numbers, and what can this be good for. *International Journal of Computers for Mathematical Learning, 8*(3), 333-356.

Bettinger, E. P., & Long, B. T. (2009). Addressing the needs of underprepared students in higher education does college remediation work? *Journal of Human Resources*, *44*(3), 736-771.

Bjork, R. (1994). Memory and metamemory considerations in the training of human beings. In J. Metcalf, & P. Shimamura, *Metacognition: Knowing about Knowing*. 185-206. Cambridge: MIT Press.

Bozeman, W., & Baumbach, D. (1995). *Educational technology: Best practices from America's schools.* Larchmont, NY: Eye on Education.

Brown, J. (2004). Enabling teachers to perceive the affordances of a technologically rich learning environment of linear functions in order to design units of work incorporating best practice. In *Proceedings of the 9th Asian technology conference in mathematics*.

Cabrera, A. F. (1993, March - April). College persistence: structural equations modeling test of an integrated model of student retention. *Journal of Higher Education*, *64*, 123-140.

Chemers, M. M., Hu, L. T., & Garcia, B. F. (2001). Academic self-efficacy and first year college student performance and adjustment. *Journal of Educational Psychology*, *93*(1), 55.

Coley, R., Cradler, R., & Engel, P. (1997). *Computers and classrooms: The status of technology in U.S. schools.* Princeton, NJ: Educational Testing Service.

Denton, P., Madden, J., Roberts, M., & Rowe, P. (2008). Students' response to traditional and computer-assisted formative feedback: A comparative case study. *British Journal of Educational Technology*, *39*(3), 486-500.

Dugdale, S. (1999). Establishing computers as an optional problem solving tool in a nontechnological mathematics context. *International Journal of Computers for Mathematical Learning*, *4*(2-3), 151-167.

Ferrini-Mundy, J. (2000). Principles and standards for school mathematics: A guide for mathematicians. *Notices of the American Mathematical Society*, *47*(8).

Fullan, M. (2005). Change theory: A force for school improvement. *INTELLIGENT LEADERSHIP*, *27*.

Fullan, M. (2007). *The new meaning of educational change*. New York, NY: Teachers College Press.

Furner, J. M., Yahya, N., & Duffy, M. L. (2005). Strategies to Reach All Students. *Intervention in School and Clinic*, *41*(1), 16-23.

Gadzella, B. M. (1982). Computer-assisted instruction on study skills. *The Journal of Experimental Educational*, 122-126.

Galligan, L., Loch, B., McDonald, C., & Taylor, J. A. (2010). The use of tablet and related technologies in mathematics teaching. *Australian Senior Mathematics Journal*, *24*(1), 38-51.

George, A. A., Hall, G. E., & Stiegelbauer, S. M. (2006). *Measuring implementation in schools: The stages of concern questionnaire*. Austin, TX: Southwest Educational Development Laboratory.

Gettinger, M., & Seibert, J. K. (2002). Contributions of study skills to academic competence. *School Psychology Review*, *31*(3), 350-365.

Glennan, T. K., & Melmed, A. (1996). *Fostering the Use of Educational Technology: Elements of a National Strategy*. Lanham, MD: National Book Network.

Graetz, K. (2006). Homework and digital ink: a comparison of three methods for handwritten homework exchange using a tablet pc. In D. A. Berque, J. C. Prey, & R. H. Reed, *The impact of tablet pcs and pen-based technology on education* (pp. 67-71). West Lafayette, IN: Purdue University Press.

Habley, W. R., & McClanahan, R. (2004). *What works in student retention? Four-year private colleges.* Iowa City, IA: ACT, Inc.

Hall, G. E. (1987). *Change in schools: Facilitating the process*. Albany, NY: Suny Press.

Haspekian, M. (2005). An "instrumental approach" to study the integration of a computer tool into mathematics teaching: the case of spreadsheets. *International Journal of Computers for Mathematical Learning*, *10*(2), 109-141.

Hawkes, M., & Hategekimana, C. (2009). Impacts of Mobile Computing on Student Learning in the University: A Comparison of Course Assessment Data. *Journal of Educational Technology Systems*, *38*(1), 63-74.

Healy, J. M. (1999). *Failure to connect: how computers affect our children's minds--for better and worse*. New York, NY: Simon and Schuster.

Howe, N., & Strauss, W. (2009). *Millennials rising: The next great generation*. New York, NY: Random House Digital, Inc.

Huettel, L. G., Forbes, J., Franzoni, L., Malkin, R., Nadeau, J., & Ybarra, G. (2007). Using tablet pcs to enhance engineering and computer science education. In D. A. Berque, J. C. Prey, & R. H. Reed, *The impact of tablet pcs and pen-based technology on education beyond the point of tipping* (pp. 59-66). West Lafayette, IN: Purdue University Press.

Kaput, J. (1992). *Technology and mathematics education.* In D. A. Grouws, *Handbook of Research on Mathematics Teaching and Learning:A project of the National Council of Teachers of Mathematics* (pp. 515-556). New York, NY: Macmillan Publishing Co, Inc.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist*, *41*(2), 75-86.

Knapp, L. R., & Glenn, A. D. (1996). *Restructuring schools with technology*. Boston, MA: Allyn and Bacon.

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education*, *9*(1), 60-70.

Koile, K., & Singer, D. (2006). Development of a tablet-pc-based system to increase instructor-student classroom interactions and student learning. In J. Prey, D. Berque, & R. Reed, *The Impact of Tablet PCs and Pen-based Technology on Education: Vignettes, Evaluations, and Future Directions*. West Lafayette, IN: Purdue University Press.

Lawless, K. A., & Pellegrino, J. W. (2007). Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. *Review of Educational Research*, *77*(4), 575-614.

Lesh, R., Caylor, E., & Gupta, S. (2007). Data Modeling & the Infrastructural Nature of Conceptual Tools. *International Journal of Computers for Mathematical Learning*, *12*(3), 231-254.

Levin, H. M., & Calcagno, J. C. (2008). Remediation in the Community College An Evaluator's Perspective. *Community College Review*, *35*(3), 181-207.

Lotkowski, V. A., Robbins, S. B., & Noeth, R. J. (2004). The role of academic and non-academic factors in improving college retention. *ACT Policy Report*, *1*.

Mangold, W. D., Bean, L. G., Adams, D. J., Schwab, W. A., & Lynch, S. M. (2002). Who goes who stays: An assessment of the effect of a freshman mentoring and unit registration program on college persistence. *Journal of College Student Retention: Research, Theory and Practice*, *4*(2), 95-122.

Means, B., Blando, J., Olson, K., Middleton, T., Morocco, C. C., Remz, A. R., & Zorfass, J. (1993). *Using technology to support education reform*. Washington, DC: US Department of Education, Office of Educational Research and Improvement, Office of Research.

Mishra, P., & Koehler, M. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *The Teachers College Record*, *108*(6), 1017-1054.

Motschnig-Pitrik, R., & Holzinger, A. (2002). Student-centered teaching meets new media: Concept and case study. *Educational Technology & Society*, *5*(4).

Naftaliev, E., & Yerushalmy, M. (2013). Guiding Explorations: Design Principles and Functions of Interactive Diagrams. *Computers in the Schools*, *30*(1-2), 61-75.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics online*. Retrieved from http://www.nctm.org/standards/content.aspx?id=26809

Nemirovsky, R., Kaput, J. J., & Roschelle, J. (1998). Enlarging mathematical activity from modeling phenomena to generating phenomena. *PME CONFERENCE 3*, 3-287.

Niess, M. L. (2005). Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge. *Teaching and Teacher Education*, *21*(5), 509-523.

Pascarella, E. T., & Terenzini, P. T. (1980). Predicting freshman persistence and voluntary dropout decisions from a theoretical model. *The Journal of Higher Education*, 60-75.

Patton, M. (2007). *Qualitative research evaluation methods*. Thousand Oaks, CA: Sage.

Penuel, B., Yarnall, L., & Simkins, M. (2000). Do Technology Investments Pay Off? The Evidence Is In! *Leadership*, *30*(1), 18-19.

Polly, D., & Hannafin, M. J. (2011). Examining how learner-centered professional development influences teachers' espoused and enacted practices. *The Journal of Educational Research*, *104*(2), 120-130.

Price, E. (2012, February). Complex interactions between formative assessment, technology, and classroom practices. *AIP Conference Proceedings 1413*, 59.

Radosevich, D., & Kahn, P. (2006). Using tablet technology and recording software to enhance pedagogy. *Innovate Journal of Online Education*, *2*(6), 7.

Robbins, S. B., Lauver, K., Le, H., Davis, D., Langley, R., & Carlstrom, A. (2004). Do psychosocial and study skill factors predict college outcomes? A meta-analysis. *Psychological Bulletin*, *130*(2), 261.

Ross, A., & Rosenberg, S. (2007). *A laptop in every backpack*. Washington DC: NDN Globalization Initiative.

Sandholtz, J. H. (1997). *Teaching with technology: Creating student-centered classrooms*. New York, NY: Teachers College Press.

Sedig, K., & Sumner, M. (2006). Characterizing interaction with visual mathematical representations. *International Journal of Computers for Mathematical Learning*, *11*(1), 1-55.

Sivin-Kachala, J., & Bialo, E. (2000). *2000 Research report on the effectiveness of technology in schools 7th edition*. Washington, DC: Software & Information Industry Association.

Steinweg, S. B., Williams, S. C., & Warren, S. H. (2006). Reaching Through the Screen: Using a TabletPC to Provide Feedback in Online Classes. *Rural Special Education Quarterly*, *25*(2), 8.

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, *12*(2), 257-285.

Thiel, T., Peterman, S., & Brown, M. (2008). Addressing the Crisis in College Mathematics: Designing Courses for Student Success. *Change: The Magazine of Higher Learning*, *40*(4), 44-49.

Trilling, B., & Hood, P. (1999). Learning, Technology, and Education Reform in the Knowledge Age or" We're Wired, Webbed, and Windowed, Now What?" *Educational Technology*, *39*(3), 5-18.

Wenglinsky, H. (1998). Does it Compute? The Relationship Between Educational Technology and Student Achievement in Mathematics. *Educational Testing Service*. Princeton, NJ: Policy Information Center.

Wilson, M., & Gerber, L. E. (2008). How generational theory can improve teaching: Strategies for working with the "Millennials." *Currents in Teaching and Learning*, *1*(1), 29-44.

Wise, J. C., Toto, R., & Lim, K. Y. (2006, October). Introducing Tablet PCs: Initial results from the classroom. *Frontiers in Education Conference, 36th Annual* (pp. 17-20). IEEE.

Woodman, G. F., & Luck, S. J. (1999). Electrophysiological measurement of rapid shifts of attention during visual search. *Nature*, *400*(6747), 867-869.

APPENDIX A

STUDENT READINESS INVENTORY

Student Readiness Inventory

ACT

P.O. Box 168, Iowa City, IA 52243

A NAME
(Please print your name on the line below using a No. 2 pencil only.)

Last Name First Name MI (Middle Initial)

B NAME
(Please complete your name using the grid below.)

Last Name | First Name | MI

DIRECTIONS

- Use a No. 2 pencil only. **Do not** use ink or ball-point pen.
- Fill in the appropriate ovals completely.
- Make your marks heavy and dark and keep within the ovals.
- To change an answer, erase completely and then mark your new choice.

Correct Mark:

Incorrect Marks:

C Student ID Number
(If not known, provide SSN)

Start here.

D What is your date of birth?

Month | Day | Year

Jan.
Feb.
March
April
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.

E What is your gender?

Female
Male

F RACE/ETHNICITY BACKGROUND

F1. Please indicate if you are of Hispanic or Latino background.

- Yes
- No
- Prefer not to respond

F2. Please indicate your race. Mark all that apply. Leave blank if none of these apply to you.

- American Indian/Alaska Native
- Asian
- Black/African American
- Native Hawaiian/Other Pacific Islander
- White
- Prefer not to respond

G What is your current grade level?

- 11th Grade
- 12th Grade
- 1st Year College (Freshman)
- 2nd Year College (Sophomore)
- 3rd Year College (Junior)
- 4th Year College (Senior)

H What is (was) your overall high school grade point average?

- (A- to A) 3.5 and above
- (B to B+) 3.0-3.4
- (B- to B) 2.5-2.9
- (C to B-) 2.0-2.4
- (C- to C) 1.5-1.9
- (D to C-) 1.0-1.4
- (D- to D) 0.9 or lower

I If you have taken the ACT and/or SAT college entrance exams and know your Composite Score(s), enter them here.

ACT Comp. | SAT Comp.

J If you have taken COMPASS placement tests and you know your scores, enter them here. For Mathematics, first mark your "Placement Domain" and then enter your score for that test.

Writing Skills Score | Reading Score | Mathematics Placement Domain | Mathematics Domain Score

- Pre-Algebra
- Algebra
- Coll. Algebra
- Geometry
- Trigonometry

PLEASE DO NOT WRITE IN THIS AREA.

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PAGE 1

DIRECTIONS: Listed below are statements you might use to describe your behaviors, opinions, interests, feelings, and other characteristics.

- Read each statement and indicate how well it describes you by filling in the appropriate oval preceding each statement. Use the disagree/agree scale listed above the ovals to select your answer.
- Read each statement carefully, but do not spend too much time deciding on any one answer.
- Although some items may seem similar, answer each without considering your other answers.

Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree	
○	○	○	○	○	○	1. I'm a responsible person.
○	○	○	○	○	○	2. I feel part of this college.
○	○	○	○	○	○	3. I know attending college is the best choice for me.
○	○	○	○	○	○	4. I have difficulties keeping up academically with my classmates.
○	○	○	○	○	○	5. I often feel out of control.
○	○	○	○	○	○	6. I don't know if I want to stay in college.
○	○	○	○	○	○	7. When confronted with a problem, I try to be flexible in my decision making.
○	○	○	○	○	○	8. My nervousness interferes with my performance on tests.
○	○	○	○	○	○	9. I turn in my assignments on time.
○	○	○	○	○	○	10. I avoid activities that require meeting new people.
○	○	○	○	○	○	11. I do my best to fulfill my commitments.
○	○	○	○	○	○	12. I'm not performing to the best of my academic abilities.
○	○	○	○	○	○	13. I am a capable person.
○	○	○	○	○	○	14. I have a sense of belonging when I am on campus.
○	○	○	○	○	○	15. At social gatherings, I mix well with people.
○	○	○	○	○	○	16. I'm a fast learner.
○	○	○	○	○	○	17. I have a sense of connection with others at school.
○	○	○	○	○	○	18. I achieve little for the amount of time I spend studying.
○	○	○	○	○	○	19. I'm confident I will succeed in school even if I need help.
○	○	○	○	○	○	20. When confronted with a problem, I weigh the pros and cons of various solutions.
○	○	○	○	○	○	21. I organize my thoughts before I prepare an assignment.
○	○	○	○	○	○	22. I do my best in my classes.
○	○	○	○	○	○	23. I'm committed to finish college regardless of obstacles.
○	○	○	○	○	○	24. I get upset when criticized.
○	○	○	○	○	○	25. I lose control when things go wrong.
○	○	○	○	○	○	26. A college education will help me achieve my goals.
○	○	○	○	○	○	27. I'm motivated to get a college degree.
○	○	○	○	○	○	28. It's very important for me to do well in school/college.
○	○	○	○	○	○	29. I regularly do things with friends.
○	○	○	○	○	○	30. I give my undivided attention to something important.
○	○	○	○	○	○	31. I enjoy spending time with others.
○	○	○	○	○	○	32. I am a trustworthy person.
○	○	○	○	○	○	33. I rank in the top 20% on academic ability among students my age.
○	○	○	○	○	○	34. If I don't feel like going, I skip classes.
○	○	○	○	○	○	35. If a problem is very large, I divide it into smaller parts that I can handle.
○	○	○	○	○	○	36. I'm a disciplined student.

Continue on the next page.

Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree	
O	O	O	O	O	O	37. I stay calm in difficult situations.
O	O	O	O	O	O	38. I feel isolated.
O	O	O	O	O	O	39. I manage my frustration well.
O	O	O	O	O	O	40. Others consider me a hard-working student.
O	O	O	O	O	O	41. I'm a patient person.
O	O	O	O	O	O	42. I'm thoughtful in my career planning.
O	O	O	O	O	O	43. People count on me to get a job done.
O	O	O	O	O	O	44. I tend to keep to myself.
O	O	O	O	O	O	45. I express anger toward people who upset me.
O	O	O	O	O	O	46. I miss deadlines.
O	O	O	O	O	O	47. I try to do my best at any task.
O	O	O	O	O	O	48. I cannot think clearly when I'm angry.
O	O	O	O	O	O	49. I tend to trust people.
O	O	O	O	O	O	50. I have developed close friendships wherever I go.
O	O	O	O	O	O	51. I keep my promises.
O	O	O	O	O	O	52. I get easily irritated.
O	O	O	O	O	O	53. I feel nervous when talking with others.
O	O	O	O	O	O	54. I am shy.
O	O	O	O	O	O	55. I consistently do my school work well.
O	O	O	O	O	O	56. Once I set a goal, I do my best to achieve it.
O	O	O	O	O	O	57. I'm satisfied with my academic performance.
O	O	O	O	O	O	58. I'm not smart enough to do well on assignments.
O	O	O	O	O	O	59. I like to help others.
O	O	O	O	O	O	60. I make friends easily.
O	O	O	O	O	O	61. I get along with most people.
O	O	O	O	O	O	62. I brainstorm possible solutions to solve problems.
O	O	O	O	O	O	63. I have a positive view of myself.
O	O	O	O	O	O	64. I try not to hurt others' feelings.
O	O	O	O	O	O	65. I have been involved in extra-curricular activities.
O	O	O	O	O	O	66. When confronted with a problem, I look for patterns that may help me understand it.
O	O	O	O	O	O	67. I am confident of my academic abilities.
O	O	O	O	O	O	68. I summarize important information in diagrams, tables, or lists.
O	O	O	O	O	O	69. It is important for me to finish what I start.
O	O	O	O	O	O	70. When confronted with a problem, I'm willing to do something rather than forget about it.
O	O	O	O	O	O	71. I sympathize when others have troubles.
O	O	O	O	O	O	72. I am serious about fulfilling my obligations.
O	O	O	O	O	O	73. I don't feel comfortable talking to strangers.
O	O	O	O	O	O	74. The social side of college life is a highlight for me.
O	O	O	O	O	O	75. When confronted with a problem, I consider a solution that will not cause problems for other people.
O	O	O	O	O	O	76. When a solution fails, I examine why it didn't work.
O	O	O	O	O	O	77. I bounce back after facing disappointment or failure.
O	O	O	O	O	O	78. After solving a problem, I think about what was right and what was wrong with my approach.
O	O	O	O	O	O	79. I would leave college if I found something more interesting.

Continue on the next page.

Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree	
○	○	○	○	○	○	80. I'm sensitive to others' feelings.
○	○	○	○	○	○	81. When confronted with a problem, I analyze the situation.
○	○	○	○	○	○	82. I share my emotions with others.
○	○	○	○	○	○	83. In reaching an agreement, I consider the needs of others as well as my own needs.
○	○	○	○	○	○	84. I wait until people speak to me before I talk with them.
○	○	○	○	○	○	85. People describe me as a hard worker.
○	○	○	○	○	○	86. I would rather be somewhere else than in college.
○	○	○	○	○	○	87. I'm not sure if my decision to go to college is right.
○	○	○	○	○	○	88. I make an outline before answering essay questions or writing papers.
○	○	○	○	○	○	89. I'm a confident person.
○	○	○	○	○	○	90. I highlight key points when I read assigned materials.
○	○	○	○	○	○	91. If I don't understand classwork, I talk to my instructor.
○	○	○	○	○	○	92. I'm easily annoyed.
○	○	○	○	○	○	93. I work hard to improve on my shortcomings.
○	○	○	○	○	○	94. I'm intelligent.
○	○	○	○	○	○	95. When I make plans, I follow through on them.
○	○	○	○	○	○	96. I don't feel comfortable working with others.
○	○	○	○	○	○	97. I am less talented than other students.
○	○	○	○	○	○	98. I need to work harder than others to get the grades they do.
○	○	○	○	○	○	99. I can follow discussions about abstract academic topics.
○	○	○	○	○	○	100. I have a bad temper.
○	○	○	○	○	○	101. I discuss problems at school with my friends.
○	○	○	○	○	○	102. I have confidence that I can achieve my academic goals.
○	○	○	○	○	○	103. I'm willing to compromise when resolving a conflict.
○	○	○	○	○	○	104. I take good notes in class.
○	○	○	○	○	○	105. I intend to participate in campus social events.
○	○	○	○	○	○	106. I find it hard to pick out main ideas in texts.
○	○	○	○	○	○	107. I strive to achieve the goals I set for myself.
○	○	○	○	○	○	108. I often get into arguments.

Additional Questions

(If your school supplies you with additional questions, please use the ovals at the right to record your answers.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J

21. SECTION/CLASS NUMBER

If your administrator supplies you with a section/class number, enter that number in the boxes at the right and fill in the appropriate oval below each box.

0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

Thank you for completing this survey.

PLEASE DO NOT WRITE IN THIS AREA.

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APPENDIX B

INTERNAL CONSISTENCY RELIABILITY OF THE SRI SCALES

Internal Consistency Reliability of the SRI Scales (ACT, 2004)

Scale	# of items	Score Range	Alpha
Academic Discipline	10	10-60	0.83
Academic Self-Confidence	12	12-72	0.83
Commitment to College	10	10-60	0.85
Communication Skills	10	10-60	0.82
General Determination	11	11-66	0.87
Goal Striving	10	10-60	0.84
Social Activity	10	10-60	0.84
Social Connection	11	11-66	0.80
Steadiness	12	12-72	0.84
Study Skills	12	12-72	0.86

APPENDIX C

QUANTIFIABLE AFFECTIVE SURVEY PRE AND POSTTEST

Survey Question 1: Do you feel that technologically mediated tools affect your study skill and self-confidence?

Survey Question 2: Do you have any suggestions of how to use technologically mediated tools to improve study skills and/or self-confidence? Please explain.

APPENDIX D

COLLEGE ALGEBRA EXIT INTERVIEW

- Do you think taking a Beginning Algebra course facilitated with technologically mediated tools contributed to your success in College Algebra? Please explain.
- Do you think taking a Beginning Algebra course facilitated with technologically mediated tools helped you to sharpen your study skills? Please explain.
- Do you think taking a Beginning Algebra course facilitated with technologically mediated tools helped you to improve your academic self-confidence? Please explain.

APPENDIX E

CBAM STAGES OF CONCERN QUESTIONNAIRE

SoCQ 075

Stages of Concern Questionnaire

Name (optional): ______________________________

The purpose of this questionnaire is to determine what people who are using or thinking about using various programs are concerned about at various times during the adoption process.

The items were developed from typical responses of school and college teachers who ranged from no knowledge at all about various programs to many years' experience using them. Therefore, **many of the items on this questionnaire may appear to be of little relevance or irrelevant to you at this time.** For the completely irrelevant items, please circle "0" on the scale. Other items will represent those concerns you do have, in varying degrees of intensity, and should be marked higher on the scale.

For example:

This statement is very true of me at this time.	0	1	2	3	4	5	6	7
This statement is somewhat true of me now.	0	1	2	3	4	5	6	7
This statement is not at all true of me at this time.	0	1	2	3	4	5	6	7
This statement seems irrelevant to me.	0	1	2	3	4	5	6	7

Please respond to the items in terms of **your present concerns,** or how you feel about your involvement with **this** innovation. We do not hold to any one definition of the innovation so please think of it in terms of your own perception of what it involves. Phrases such as "this approach" and "the new system" all refer to the same innovation. Remember to respond to each item in terms of your present concerns about your involvement or potential involvement with the innovation.

Thank you for taking time to complete this task.

0	1 2	3 4 5	6 7
Irrelevant	Not true of me now	Somewhat true of me now	Very true of me now

Circle One Number For Each Item

1. I am concerned about students' attitudes toward the innovation.	0 1 2 3 4 5 6 7
2. I now know of some other approaches that might work better.	0 1 2 3 4 5 6 7
3. I am more concerned about another innovation.	0 1 2 3 4 5 6 7
4. I am concerned about not having enough time to organize myself each day.	0 1 2 3 4 5 6 7
5. I would like to help other faculty in their use of the innovation.	0 1 2 3 4 5 6 7
6. I have a very limited knowledge of the innovation.	0 1 2 3 4 5 6 7
7. I would like to know the effect of reorganization on my professional status.	0 1 2 3 4 5 6 7
8. I am concerned about conflict between my interests and my responsibilities.	0 1 2 3 4 5 6 7
9. I am concerned about revising my use of the innovation.	0 1 2 3 4 5 6 7
10. I would like to develop working relationships with both our faculty and outside faculty using this innovation.	0 1 2 3 4 5 6 7
11. I am concerned about how the innovation affects students.	0 1 2 3 4 5 6 7
12. I am not concerned about the innovation at this time.	0 1 2 3 4 5 6 7
13. I would like to know who will make the decisions in the new system.	0 1 2 3 4 5 6 7
14. I would like to discuss the possibility of using the innovation.	0 1 2 3 4 5 6 7
15. I would like to know what resources are available if we decide to adopt the innovation	0 1 2 3 4 5 6 7
16. I am concerned about my inability to manage all that the innovation requires.	0 1 2 3 4 5 6 7
17. I would like to know how my teaching or administration is supposed to change.	0 1 2 3 4 5 6 7
18. I would like to familiarize other departments or persons with the progress of this new approach.	0 1 2 3 4 5 6 7

0	1 2	3 4 5	6 7
Irrelevant	Not true of me now	Somewhat true of me now	Very true of me now

Circle One Number For Each Item

19. I am concerned about evaluating my impact on students.	0 1 2 3 4 5 6 7
20. I would like to revise the innovation's approach.	0 1 2 3 4 5 6 7
21. I am preoccupied with things other than the innovation.	0 1 2 3 4 5 6 7
22. I would like to modify our use of the innovation based on the experiences of our students.	0 1 2 3 4 5 6 7
23. I spend little time thinking about the innovation.	0 1 2 3 4 5 6 7
24. I would like to excite my students about their part in this approach.	0 1 2 3 4 5 6 7
25. I am concerned about time spent working with nonacademic problems related to the innovation.	0 1 2 3 4 5 6 7
26. I would like to know what the use of the innovation will require in the immediate future.	0 1 2 3 4 5 6 7
27. I would like to coordinate my efforts with others to maximize the innovation's effects.	0 1 2 3 4 5 6 7
28. I would like to have more information on time and energy commitments required by the innovation.	0 1 2 3 4 5 6 7
29. I would like to know what other faculty are doing in this area.	0 1 2 3 4 5 6 7
30. Currently, other priorities prevent me from focusing my attention on the innovation.	0 1 2 3 4 5 6 7
31. I would like to determine how to supplement, enhance, or replace the innovation.	0 1 2 3 4 5 6 7
32. I would like to use feedback from students to change the program.	0 1 2 3 4 5 6 7
33. I would like to know how my role will change when I am using the innovation.	0 1 2 3 4 5 6 7
34. Coordination of tasks and people is taking too much of my time.	0 1 2 3 4 5 6 7
35. I would like to know how the innovation is better than what we have now.	0 1 2 3 4 5 6 7

APPENDIX F

BEGINNING ALGEBRA DAY 1 AGENDA

1. Take attendance
2. Instructor introduction
3. Students share:
    a. Name
    b. Major
4. Introduce the Tablet PC
    a. HP Tablet PCs and Success at Clemson University http://www.youtube.com/watch?v=qF_x1dkMtzc
    b. Hp Tablet PCs used in Higher Education http://www.youtube.com/watch?v=opdZX6NxOrU&feature=related
    c. How to Organize Stuff in OneNote http://www.youtube.com/watch?v=PYQS-b-xFFU&feature=related
5. Open the course notebook to check out sections
    a. Select SYLLABUS
    b. Select BA ASSIGNMENTS
    c. Select Day 1 Assign Docs
        i. Information Sheet
        ii. Contact Teacher Exercise
    d. Select BA Templates and see how this set of partial notes will work.
6. Become familiar with OneNote
    a. Pull down Quick Access Toolbar and select options.
    b. File Tab – Check out SaveAs
    c. Home Tab – Similar to Word
    d. Insert Tab – Practice inserting space
    e. Share Tab – Advanced
    f. Draw Tab – Write, highlight, Ink to Math, Lasso Select, Erase, and Insert Space again
    g. Review Tab – Spell check
    h. View Tab – Normal, Full Page, Page Color, Rule Lines, Graph Paper
7. Fill out **Information Sheet** – Submit (5 pts)
    a. Create a Desktop Folder called **Assignment pdfs.**
8. Wireless internet on campus
    a. Students with issued computers **may** use wireless internet on campus
        i. Wireless icon select UIUwireless
        ii. Pword: students07
        iii. Fill out information

iv. Good for one term

b. You may backup your notebook and save under a different name.

9. Complete ACT ENGAGE Assessment
10. Assign **Contact Your Teacher Exercise** (15 pts). **Due: January 25, 2013.**
11. Assign: Read 5.1
12. Visit from Developmental Mathematics Coordinator in Academic Support Center.
13. Take **Pretest**.