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THE PERCEPTIONS OF REMEDIAL MATHEMATICS STUDENTS OF WEB-BASED INSTRUCTION SUPPLEMENTED WITH INSTRUCTOR PRESENTED INSTRUCTION

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THE PERCEPTIONS OF REMEDIAL MATHEMATICS STUDENTS OF WEB-BASED INSTRUCTION SUPPLEMENTED WITH INSTRUCTOR PRESENTED INSTRUCTION

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Abstract

There are a large number of students entering colleges and universities that are in need of remediation before they can begin their college-level classes. Nationwide, it is reported that 36 percent of incoming freshmen take a remedial class (Aud, Hussar, Kena, Bianco, Frohlich, Kemp, & Tahan, 2011). Traditional methods of remediation for these students consisting of lectures and written homework assignments are being replaced with web-based models of instruction. Much of this web-based instruction is based on the theory of mastery learning (Dalton & Hannafin, 1988; Hagerty & Smith, 2005). Mastery learning purports that with enough time any student can master a subject. In order to achieve this, instruction may need to be presented in different ways and using different materials. Along with this, a tutor should be provided for each student, students should be allowed to work at their own pace and choose their own paths through the learning tasks, and regular assessments should be administered to determine if mastery learning has occurred (Bloom, 1968; Carroll, 1963).

For this study, the web-based ALEKS system was used. The ALEKS system uses mastery learning as part of its theoretical design. The majority of instruction for the class was given through the ALEKS system with an instructor present to give help on an individual basis and to present weekly lessons over topics a large number of students were ready to learn.

The purpose of this study was to determine how students' perceptions of their abilities to perform basic algebra tasks in a remedial mathematics class were affected by computer-based instruction and what the students' perceptions were about having received verbal instruction from an instructor along with computer-based instruction.

Answers to these questions were obtained by an analysis of responses given by students to weekly journal questions and an end of semester survey. The study was conducted as a phenomenological study where the purpose was to determine what common experiences the students shared under the method of instruction. The analysis was conducted using the constant comparison method of Glaser and Strauss (Glaser, 1965; Glaser & Strauss, 1967).

As a result of this analysis, five main affects of computer-based instruction surfaced: the students felt they were able to work at their own pace, they were learning on their own, they were motivated by learning on a computer, they felt less self-conscious about their learning, and they were able to learn more and better and retain it longer. The analysis also showed that student perceptions of receiving instruction from a computer and an instructor fell into five general categories: there was no need to receive instruction from an instructor, the instructor should be there to give instruction on an individual basis only, the instructor should give occasional instruction to the entire class on a topic they were ready to learn, the instructor should present instruction to the entire class along with individual help, and the instructor should be presenting all instruction.

Chapter One

Introduction

As I teach classes for students who, from their placement by the university in a remedial class, seemingly do not have the necessary preparation for college mathematics, I find that these students have difficulty learning all they need to from classes in which the primary mode of teaching is lecture. These students enter my classes with varying levels of understanding and knowledge of mathematics. Some students seem to be lost on the first day of class and feel that I am moving through topics too quickly while others are bored and feel that I am going too slowly because they believe they know all the concepts presented early in the class. I believe there is a need for students in these classes to experience and learn mathematics in qualitatively different ways than they have previously. They need to be able to progress through the class at a pace that is appropriate for them. While these students struggle in mathematics, they seem to have good computer skills and do not seem to be apprehensive about using a computer in class or for course assignments.

I have used computers with these classes in the past in a variety of ways and students have had some success. I want to return to some of the methods I have used in the past that I thought were beneficial and determine if student thoughts are the same as mine. In the past, I have used a computer as the predominant means of presenting topics to be learned and used a lecture only to supplement the instruction the students were receiving. At the time, I felt that the students were successfully learning from this type of instruction and now I want to determine if students have the same perceptions. Through this study, I want to find out what students are thinking about using a computer to learn mathematics. I want to know if they think they can learn mathematics this way, if they think they can learn better through a traditional lecture and textbook homework, or if they think that they can learn better with some combination of using a computer and lecture from the instructor.

Chapter One is divided into five sections—Introduction, Background, Need for the Study, Research Question, and a Summary. The Background section will review the need for remediation in education and the use of technology in education as well as its use for remediation. The Need for the Study will show how technology can be used to address the increasing issue of remediation. The Research Question section will present the questions that will be addressed in this study and the methods that will be used to attempt to answer them.

Background

As a mathematics instructor for many years, my concern has continued to grow regarding the needs of students who must take remediation courses before they can proceed with their college-level classes. At a national level the numbers of students requiring remediation courses in mathematics and other content areas is significant. The National Center for Education Statistics reported that nationwide, for the 2007-2008 academic year, 36 percent of incoming freshmen took a remedial class. This number is 39 percent when considering only public non-doctorate institutions (Aud, Hussar, Kena, Bianco, Frohlich, Kemp, & Tahan, 2011). The percentage of students taking remedial classes in the south central portion of the United States varied to some degree from this national average. The Arkansas Higher Education Coordinating Board (2011) reported that of all first-time students entering an Arkansas public institution in the fall of 2010, 53 percent were required to take one or more remedial courses, while the Kansas Board of Regents (2006) reported that in 2005, 26 percent of first-time freshmen took a remedial class. The Oklahoma State Regents for Higher Education (2011) reported that for first-time freshmen in the fall of 2008, 38 percent enrolled in remedial courses sometime during the 2008-09 academic year. Likewise, the Texas Higher Education Coordinating Board (2005a) reported that 41 percent of all new students were under-prepared for college.

Remedial students in college may not have had the necessary preparation while in high school. The High School Survey of Student Engagement (Center for Evaluation and Education Policy, 2005) found that high school students are not doing things that would prepare them for college. This study found that 59 percent of seniors spend three or fewer hours per week preparing for all classes, and still they feel that they are adequately prepared for their classes. Only 49 percent of all high school seniors in a career or vocational track who were planning to go on to college took a mathematics class during their last year. Even for the seniors in a college preparatory track, 18 percent did not take a mathematics class (Center for Evaluation and Education Policy, 2005). Reports have also shown that large percentages of high school students who do not take a recommended curriculum will need to enroll in remedial courses in college (Oklahoma State Regents for Higher Education, 2011; Texas Higher Education Coordinating Board 2005b). Further, students in remedial classes often require several semesters of the same class before they successfully pass. Of the students taking remedial classes, 40 percent or more take more than one semester to complete all their required remedial classes (Kansas Board of Regents, 2006; Wirt, Choy, Rooney, Provasnik, Sen, & Tobin 2004).

In an attempt to help remedial students be more successful, technology is being used in a variety of ways to provide instruction. Technology is pervasive in education today, and its use continues to increase at both the K-12 level and at the post-secondary level. The National Center for Education Statistics in their 2010 Digest of Education Statistics (Snyder & Dillow, 2011) reported that in 2008, the average public school had 189 computers for instructional purposes with 98 percent of these having Internet access. This amounted to 3.1 students per computer having Internet access. Eighty-three percent of elementary and secondary school students reported having used computers at school, with students 10 and older having reported that they are using computers more frequently each academic year. Ninety-one percent of secondary students 15 years and older who used the Internet said they did so for school assignments. Eighty-five percent of college students in 2003 used computers at school and about 80 percent used computers at home for school work. Of the college students who indicated they used the Internet, 93 percent said they did so for school assignments (Snyder & Dillow, 2011).

Not only is technology seemingly pervasive in schools today, its use is also being emphasized by national teacher organizations. The National Council of Teachers of Mathematics (NCTM) supports and encourages the use of technology in *Principles and Standards for School Mathematics* stating that, "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning" (National Council of Teachers of

Mathematics, 2000, p. 24). NCTM views standards such as this as a guide for improving mathematics education. Standards are also seen as a means to ensure quality in the education process, a means to set forth goals for those in the mathematics education field, and a means to bring about change (NCTM, 2000).

More recently, the Common Core State Standards support the use of technology in the preparation of students for college. These Standards emphasize a student's understanding of topics in Mathematics. A student's understanding will allow him/her to go beyond relying on procedures and be able to apply his/her knowledge to other situations, as well as be able to find other procedures and be able to explain the mathematics used. The Standards suggest that technology can be a means for students to gain this kind of understanding. Through the use of technology, a student can vary the parameters of a situation and observe the changes.

> [M]athematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator… When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. (Common Core State Standards Initiative, 2010, p. 7)

All of these activities will aid the student in developing an understanding of the mathematics being studied.

The technology in this study is not being used to the extent that either the Standards of the NCTM or the Common Core State Standards are suggesting. These standards both emphasize an exploratory use of technology to broaden a student's understanding of mathematics. The technology used in this study will only present the mathematics and not allow for a further exploration of it.

The most common way technology is used in education is as a teaching tool to present the topic to be learned. This is happening through the use of a computer and the Internet. A computer connected to the Internet is more frequently used for Internet-based, or what is more commonly called web-based instruction. Research has shown that remedial students using a web-based instruction system reported that they learned as much as or more than they would have in a regular mathematics class and that they would be willing to take another course in this format. Likewise, some felt there was less stress due to the self-paced way the system presented material, and they reported they liked the course better when it was combined with an instructor giving lectures. This research has also shown that the portion of the course completed on the system and the time spent on the system correlated with the final grade for the class (Canfield, 2001; Hardy, 2004; Stillson & Alsup, 2003).

While there are currently many web-based instruction systems in use, one particular implementation of web-based instruction is a system for mathematics instruction called Assessment and LEarning in Knowledge Spaces (ALEKS). ALEKS is an intelligent-tutoring system that provides instruction to students and assesses them on that knowledge. ALEKS is based on theoretical work in the field of Knowledge Space Theory begun by Dr. Jean-Claude Flamagne (ALEKS, 2008a).

Need for the Study

Numerous studies have reported that a large number of students are entering college or their university in need of remedial course work (Aud, et al., 2011;

Arkansas Higher Education Coordinating Board, 2011; Kansas Board of Regents, 2006; Oklahoma State Regents for Higher Education, 2011; Texas Higher Education Coordinating Board, 2005a). One possible way to provide the learning situations needed for successful remediation of these students is through the use of computers. A variety of software programs and web-based instruction packages allow the computer to present instruction for the student to learn and provide immediate feedback related to the answers from the student. Currently, the most common form of computer instruction is via the Internet (Engelbrecht & Harding, 2005).

Internet, or web-based instruction, is a method that is currently used in many remedial mathematics classes in colleges and universities across the United States. Web-based instruction is generally being used either as a standalone source of instruction or as a supplement to a traditional lecture classroom. Research has shown that students are not satisfied with this experience when it is standalone web-based instruction and that the results are not as good as the traditional lecture. Further, web-based instruction used as a supplement is not as effective and students report dissatisfaction with this approach as well (Canfield, 2001; Stillson & Alsup, 2003; Wuensch, Aziz, Ozan, Kishore, & Tabrizi, 2008). There is a third way that has not been addressed in the literature: web-based instruction supplemented with instructor clarification of the material the students are learning on the system.

Research generally compares the results from using web-based instruction with the results from a traditional lecture along with traditional paper-and-pencil homework. There are generally references to pretest and posttest or comparing final grades in a course using web-based instruction with final grades in a course using traditional lecture and homework. This research then provides insight into which method is better (Stillson & Alsup, 2003; Hardy, 2004). Further research should be conducted that allows the students a voice to share what they believe helped them, or could have helped them, instead of using test results to determine which method was best. Students should be invited to share their ideas and perceptions about the process.

Research Questions

The participants in this study were students in four sections of Basic Algebra classes in the spring and fall semesters of 2010 at an Oklahoma regional university. These classes consist of students who made below a 19 on the mathematics section of their ACT or scored below a 75 on the Elementary Algebra portion of the Computerized Placement Test (CPT), which is an exam used to determine a student's placement in mathematics classes at this particular institution. Occasionally, there are students in this class who are there by their own choosing because of their own perceived mathematics deficiency or fear of failure in their general education mathematics classes.

The participants in this study were chosen based on a convenience sampling – they were the students who chose to enroll in the sections of Basic Algebra that I taught. Students who chose to enroll in these sections were unaware at their time of enrollment that they would be asked to participate in a study and would not be told until the first day of class. They were also unaware that the instruction for these sections would be different from the instruction given in the other sections of Basic Algebra.

The instruction for these sections deviated from the traditional lecture format with written homework and the use of an online homework management system that is typically used for this class. For this study the instruction was based on the material presented by the ALEKS system. All student work took place on the ALEKS system. The instructor served as a resource person and was available to answer student questions. Additionally, the instructor presented occasional verbal instruction to the class over topics that most students in the class were currently or soon would be working with on ALEKS. Most of the instruction was presented by the computer only; the instructor did not present each topic students would encounter on ALEKS. Also, due to the self-paced nature of the ALEKS system, students working ahead of the rest of the class would not receive the benefit of the instructor presentations. One problem inherent to planning the teaching topics prior to students working with them on ALEKS is that students receiving computer-based instruction have the ability to move at their own pace. It is possible for all the students in the class to be working at different places within the curriculum.

This provided an ongoing challenge throughout the semester regarding which topics should be presented and when they should be presented to best meet the needs of the majority of the students in the class. This decision was made based on the belief that the students that are furthest along may not require as much help and therefore would not benefit as much from verbal instruction. Going too far forward or too far back would leave a large portion of the class without the benefit of the presentation. Determinations about which topics to teach and when was based throughout the semester on what the majority of students were currently covering or were ready to attempt. The ALEKS system has a feature that lists all the topics students in the class are ready to learn and the number of students ready to learn that topic at any time. Students currently covering a topic are listed as ready to learn the topic until they have mastered it. This information can be used to determine which topics the most number of students are ready to learn. The instructor presentations were taken from these. The top two or three topics were chosen and presented each week.

My position in this study was that of a participant observer. I was the instructor of the course as well as the researcher. Three questions I attempted to answer through this study were:

1. What are the various aspects of a computer-based basic algebra course for remedial students?
2. How are students' perceptions of their abilities to perform basic algebra tasks affected by computer-based instruction?
3. What are students' perceptions about having received verbal instruction from an instructor along with computer-based instruction?

A survey consisting of open-ended questions was given at the beginning of the semester to all students willing to participate. This provided some general initial impressions that students had related to their anticipated experiences in the class. The results of this survey aided in formulating journal questions for the student to respond to during the first several weeks of the semester. Journal questions for subsequent weeks were formulated from an analysis of the previous week's responses and from further journal readings. These questions attempted to draw out the experiences the students were having in this class. A final survey was given that attempted to draw out further explanations and to verify study conclusions.

Collecting data from the students involved in the study allowed me to gain insight into the feelings and perceptions they had about their experience using ALEKS, the amount of achievement they felt that they attained, how their confidence related to mathematics changed as a result of ALEKS, and how their learning was affected because of receiving instruction from a computer only or from a computer along with verbal instruction from an instructor. The students involved in this study were also asked to relate how their experiences with computer-based instruction compare with previous coursework experiences.

Summary

There are a significant, and unfortunately increasing, number of students entering college that do not have the necessary knowledge and skills to be successful in college-level work. Traditional methods of remediation consisting of lectures and written homework assignments are being rapidly replaced with web-based instruction models of instruction that are used either alone or to supplement traditional lecture formats. Students have reported finding this to be an acceptable change (Canfield, 2001; Hardy, 2004; Stillson & Alsup, 2003). Research on web-based instruction has generally focused on determining whether this type of instruction is better than more traditional methods. This study used a slightly different approach, combining web-based instruction supplemented with instruction provided by the instructor. There was no attempt to determine if this is a better approach based on student test scores, but rather this study attempted to capture student's feelings and understandings about using this technology/instruction blend.

Chapter Two

A Review of the Related Literature

This chapter will present a review of the literature, starting with the necessity for students to learn mathematics, and then will proceed to show that many students are not prepared for college and so are not finding success in their learning of mathematics. Some general theories of how people learn will be presented along with a model of teaching that is used in this study. Web-based instruction will be presented as an implementation of this model of teaching with blended learning as a specific way that web-based instruction can be used. A consideration of the appropriateness of web-based instruction for remedial students is given. Finally, the ALEKS system, which is the source of the web-based instruction used in this study, is explained.

The necessity for learning mathematics

It has been a long-held belief that to get a good job and find success, one needs a good education. Thomas Friedman (2005) in his book, *The World is Flat*, echoes that idea, proposing that with the globalization of the American economic system, many high-end jobs are going overseas. He believes that with the opening of trade agreements with other countries, both unskilled workers and skilled workers, in America will find their wages depressed. In order for them to move up or at least stay at the same place economically, they will need to "upgrade their education and upgrade their knowledge skills so that they can occupy one of the new jobs created in the much expanded ... market" (p. 229).

The United States Department of Labor (2011) statistics demonstrate the need for workers to upgrade their education in order to attain new jobs as well as keep their current position. These statistics indicate that the highest unemployment rate is for those who do not have a college education. The 2011 unemployment rate for those who have a bachelor's degree or higher is 4.4 percent; for those who have some college or an associate degree it is 7.4 percent. But high school graduates who have no college have an unemployment rate of 9.5 percent, while those who do not have a high school diploma have a 13.7 percent unemployment rate.

Friedman (2005) further suggested that science, technology, and engineering jobs will go overseas due not only to the fact that workers there are willing to work for lower wages, but also because they have a greater desire and incentives to work than their American counterparts. He argues that in order for the United States to remain a super power economically, the U. S. must continue to produce highly creative and skilled workers in these areas.

Bloom (1968), writing about education almost four decades prior to Friedman (2005), said nearly the same thing. He believed that in order to provide skills necessary for the workforce, education could no longer be thought of as a right of the few. He went on to say that educators must find ways for those seeking an education to successfully complete their education. The problem is determining how the largest proportion of people can learn the knowledge and skills needed to operate in this complex society.

Friedman (2005) interviewed various industry leaders in the process of writing his book; one was Tracy Koon, the director of corporate affairs for Intel. Koon said, "Science and math are the universal language of technology. They drive technology and our standards of living. Unless our kids grow up knowing that universal language, they will not be able to compete" (p. 272).

Various studies have shown that students in the United States do not have as good a grasp of this "language" compared to their counterparts around the world. The Organization for Economic Cooperation and Development (OECD), an intergovernmental organization of 30 member countries, conducted the Program for International Student Assessment, PISA, a system of international assessments that measures the performance in reading literacy, mathematics literacy, and science literacy of 15-year-olds. The average score for 15-year-old students in the United States on the combined science literacy scale was 489, which is lower than the OECD average score of 500. The U.S. students' scores on science literacy were lower than their peers in 16 of the other 29 countries in OECD and 6 of the 27 non-OECD countries. Likewise, the average U.S. score in mathematics literacy was 474, which was lower than the OECD average score of 498. The U.S. students' scores on mathematics literacy were lower than those of 23 OECD countries and eight non-OECD countries (Baldi, Jin, Skemer, Green, & Herget, 2007).

Another study comparing students from the United States with those from around the world was the TIMSS, Trends in International Mathematics and Science Study. In 2007, U.S. eighth-graders' average score in mathematics exceeded the international average, but this was below the average scores of their peers in 10 of the 47 other participating countries. This is actually a slight improvement over the previous study. In science, these eighth-graders exceeded the international average but were below the average scores of nine other countries (Gonzales, Williams, Jocelyn, Roey, Kastberg, & Brenwald, 2009).

Students not prepared for college

The eighth grade is a significant time in determining a student's success in high school and his or her readiness for college. According to ACT (2008) more than 80 percent of eighth-grade students do not have the necessary skills and knowledge to enter high school and succeed there. Also, according to ACT (2008), only the students who have met the College Readiness Benchmarks in the eighth grade will be ready for college and career by the eleventh or twelfth grade. These benchmarks are the minimum achievement level as determined by the EXPLORE test that ACT has shown is necessary for a student to be ready for college and career after high school graduation.

Not only are U. S. students below the international average and that of many of their peers in other nations, there are also a large number of students that are not ready for high school and ultimately not ready for college as measured by the EXPLORE test. This lack of readiness is also evident by the large number of students entering college who are in need of remediation.

Nationwide, 36 percent of incoming college freshmen need to take a remedial class (Snyder & Dillow, 2011). The South Central region of the United States has remediation rates at or above the national percentage. Fifty-three percent of all first time students in the state of Arkansas are in need of some kind of remediation, with 42 percent of these enrolled in remedial mathematics (Arkansas Higher Education Coordinating Board, 2011). In Kansas, 26 percent of first time freshmen take a remedial class (Kansas Board of Regents, 2006). The remediation rate in Oklahoma for first-time freshmen was 38 percent, and 33 percent of all the first-time freshmen took a remedial mathematics class (Oklahoma State Regents for Higher Education, 2011). Likewise in Texas, 41 percent of all first time students need some form of remediation (Texas Higher Education Coordinating Board, 2005a).

For the years 2007-2010, students who took the core requirements or more in high school had composite ACT score that were 2.2 to 3.1 points higher than students who did not take the core. Scores in English, reading, mathematics, and science were all higher for students who took the core requirements. Over this time period, the scores of student who took the core were fairly consistent for all areas, while the scores of students who did not take the core dropped steadily in all areas.

ACT has established benchmarks for determining college readiness. In 2010, 76 percent of students who took the ACT did not meet all four benchmarks in English, reading, mathematics, and science, indicating that they were not ready for college coursework. These benchmarks are set to represent the level of achievement that a student needs to have a 75 percent chance of making a C or higher in a corresponding first-year college course. In mathematics, 57 percent of high school graduates did not meet the mathematics benchmark for college readiness. In Oklahoma and Arkansas, only 30–39 percent of students met three of the four benchmarks. In Kansas, the percentages were 40– 49 percent. There were not enough students in Texas taking the ACT to give significant levels. Students who took more than the core requirements in high school were more likely to have met the benchmarks than those who did not. The greatest difference was in mathematics, where the percent of students who met the mathematics benchmark and who took only the core or less than that were 42 percentage points lower than those who completed more than three years of mathematics.

How People Learn

The issue at hand for those in education is to determine how best to ensure mathematics learning for all students in an effort to address this significant need for remediation and ultimately the need for a more highly educated workforce and citizenry. It is widely believed and understood that people learn from experience and that students arrive at school with a diversity of experiences that shape who they are and how they make sense of the world. Students construct knowledge in their own unique and individual ways, through their own perceptions, cultural beliefs, familial experiences, and understandings.

The fundamental tenet of constructivist theories is that all knowledge is constructed (Boethel & Dimock, 1999; Glasersfeld, 1995; Noddings, 1990; Zahorik, 1995). Constructing knowledge is believed to be the process of taking in new experiences and determining how these experiences fit in with existing knowledge structures. All types of learning, whether discovery or rote, result from the construction of meaning (Noddings, 1990).

Learning, or the process of determining fit, takes place through assimilation and accommodation. Assimilation is the process by which new experiences are placed into existing knowledge structures, while accommodation is the process of reshaping knowledge structures to accept a new experience (Piaget, 1977; Zahorik, 1995). When a new experience fits in with an existing knowledge structure, then assimilation occurs. When the new experience seems to contradict an existing knowledge structure, then accommodation must occur. A contradiction between an existing knowledge structure and a new experience brings about a state of disequilibrium. The desire to achieve equilibrium between existing knowledge structures and new experiences drives the process of accommodation. The resulting knowledge structure is more integrated, allowing it to accept more ideas, and is more differentiated with more substructures (Boethel & Dimock, 1999; Piaget, 1977; Zahorik, 1995). The learning of mathematics offers a slightly different situation. New experiences do not necessarily replace or adapt existing knowledge structures. Existing knowledge structures are adapted only in that they are shown to be insufficient to solve a new problem, not that they are shown to be invalid. Previous structures are assimilated into new ones without accommodation (Piaget, 1977).

Construction takes place, in part, through reflective abstraction. "[I]t is the process of interiorizing our physical operations on objects" (Noddings, 1990, pp. 8&9). This is a purposive activity in which objects or experiences are moved around and rearranged, put together and taken apart, and scrutinized from all possible angles in order to determine the relationships that may exist between them. The outcome of reflective abstraction is to transform existing knowledge structures (Noddings, 1990).

According to constructivist theory, knowledge is a "network of conceptual structures" (Glasersfeld, 1991, p. 32). Thus, it is not something that exists apart from the individual, neither is it something waiting to be discovered. Also, since knowledge is constructed by the individual, knowledge cannot be verbally transmitted to another. (Zahorik, 1995; Glasersfeld, 1991)

Learning, according to constructivist theories, can be characterized as sense-making (Boethel & Dimock, 1999).

> Each of us makes sense of our world by synthesizing new experiences into what we have previously come to understand. Often, we encounter an object, an idea, a relationship, or a phenomenon that doesn't quite make sense to us. When confronted with such initially discrepant data or perceptions, we either interpret what we see to conform to our present set of rules for explaining and ordering our world, or we generate a new set of rules that better accounts for what we perceive to be occurring. Either way, our perceptions and rules are constantly engaged in a grand dance that shapes our understandings. (Brooks & Brooks, 1999, p. 4)

Making sense of something is the process of relating it to the existing structures that one has (Zahorik, 1995). Learning is the process of making sense and therefore, to learn mathematics, a student must be able to make sense of it.

One way of thinking about knowledge is that it is "understandings that can be put to use" (Boethel & Dimock, 1999, p. 4). The National Council of Teachers of Mathematics has addressed the issue of learning and has emphasized that in order for students to learn mathematics effectively they must learn with understanding. In their *Principles and Standards for School Mathematics*, this principle has been stated as, "Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge" (NCTM, 2000, p. 20).

Research by Bransford, Brown, and Cocking (2000) has shown that understanding facts and ideas in a contextual framework, along with a good foundation of factual knowledge and an organization of that knowledge that makes retrieval and application possible, are necessary for students to be competent in an area of study. Students must also have a deep understanding of the subject matter in order to transform their factual knowledge into usable knowledge.

Models of Teaching

Mastery learning is a theory of learning that was developed by Carroll (1963) and Bloom (1968) and has become the model of learning used by most web-based instruction and computer software instruction packages for mathematics in particular. Mastery learning is a method of presenting material to students that proposes that given enough time and opportunity, a student can learn a task to a mastery level. Mastery learning purports to prescribe the conditions that will allow a student to learn. However, mastery learning theory represents a pedagogical approach to learning that does not support an environment conducive to construction of knowledge. It would not be considered a pedagogical approach aligned with constructivist theories of learning. Carroll (1963) has presented a model for learning in which he posits that a learner's success in learning a given task is related to the amount of time that he/she spends devoted to learning the task.

> [T]he model involves five elements—three residing in the individual and two stemming from external conditions. Factors in the individual are (1) aptitude—the amount of time needed to learn the task under optimal instructional conditions, (2) ability to understand instruction,

> and (3) perseverance—the amount of time the learner is willing to engage actively in learning. Factors in external conditions are (4) opportunity—time allowed for learning, and (5) the quality of instruction—a measure of the degree to which instruction is presented so that it will not require additional time for mastery beyond that required in view of aptitude. (p.729)

Bloom (1968) introduced the Learning for Mastery model as a way for nearly all students to succeed at learning. In this model, Bloom expanded on the work and theories of Carroll. Carroll (1963) said that aptitude represented the amount of time a learner needed to learn a task. Bloom took this to imply that with enough time, any student should be able to learn a given task. He said that, under appropriate conditions, 95 percent of students in a class should be able to master a subject, that is, receive an A grade. However, it may take some students more time, effort, and help to achieve mastery than others. Bloom took Carroll's beliefs about instruction to indicate that for different students to all receive quality instruction there may need to be different types of instruction and instructional materials. Bloom believed that a student's ability to understand instruction could be increased by modifying the instruction given in order to meet the needs of individual students. This could be achieved by using cooperative learning groups, one-on-one tutorial help, alternative textbooks, etc. Carroll defined perseverance as the amount of time a student was willing to spend learning a task. Bloom believed that if this amount of time was less than the time needed to learn the task, then the student will not learn it to a level of mastery. Bloom also indicated that successes in attaining mastery can increase a student's perseverance. Also, frequent feedback with help in instruction can reduce the perseverance needed. The amount of time allowed, or opportunity, must be great enough so that all students, no matter what their aptitude, can master the task.

Bloom believed that one strategy for mastery learning to occur would be to provide a tutor for each student. Other strategies might be to allow students to go at their own pace or to allow different groups of students to take different paths through the learning tasks. He suggested using regular assessments and alternative instructional methods and materials for those who have not mastered the task. These assessments assure students who have mastered the tasks that their methods of learning are appropriate. For students who have not mastered the tasks, the assessment can point out the areas where the student still needs to work (Bloom, 1968).

Web-based Instruction

As stated previously (Arkansas Higher Education Coordinating Board, 2011; Kansas Board of Regents, 2006; Oklahoma State Regents for Higher Education, 2011; Snyder & Dillow, 2011; Texas Higher Education Coordinating Board, 2005a), there are a large number of students in need of remedial courses. The purpose of these remedial courses is for students to develop the understanding and skills needed to perform at a level necessary in a college class. In most cases, the student is required to remove the deficiency before taking any other classes in the subject area of the deficiency. One method being more commonly used in universities and colleges across the nation for providing this remediation is that of web-based instruction (Kinney, 2001; Li & Edmonds, 2005; Stillson & Alsup, 2003; Weems, 2002).

Web-based instruction is often built around and used for mastery learning (Dalton & Hannafin, 1988; Hagerty & Smith, 2005). Dalton and Hannafin (1988) report that “[c]omputer mediated instruction may overcome the logistical difficulties of individualizing group-administered mastery instruction while retaining the power of one-to-one tutoring (p. 28).” Mastery learning is characterized by presenting small units of instruction along with frequent testing and requiring a student to master the material before progressing to the next unit. It is thought to be beneficial to remedial students because of the regular reinforcement provided by the testing (Boylan & Saxon, 2005). Boylan and Saxon (2005) also go on to suggest that mastery learning can contribute to successful remediation. The students in remedial courses where mastery learning techniques were used were more likely to receive a higher grade and were more likely to pass the class than students in remedial courses where more traditional techniques were used.

Web-based instruction can present problems in small units for the student to work in order to learn a topic and then assess the student. If the assessment shows that the student has not reached the desired mastery level, the process can be repeated until a certain level of mastery has been achieved. Web-based instruction can also be used to allow students to proceed at their own pace and not that of the rest of the class or the instructors. Students who do not need as much instruction as others to reach a mastery level are allowed the freedom to move faster while students who need more time on a topic will be able to move more slowly through it (Kinney, 2001).

Web-based instruction can also be a means by which students can construct their own knowledge. Many systems provide immediate feedback on practice material and assessments that can act as a guide as the students construct their knowledge. Any misconceptions that a student has can be detected, and feedback can be given immediately on how to correct it (Utts, Sommer, Acredolo, Maher, & Matthews, 2003).

The National Council of Teachers of Mathematics has encouraged the use of technology in the teaching and learning of mathematics by including it as one of their Principles for School Mathematics. This principle is stated in *Principles and Standards for School Mathematics* as, "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning" (NCTM, 2000, p. 24). The Common Core Standards (Common Core State Standards Initiative, 2010,) also emphasize the use of technology. The Common Core Standards, and it can be argued that the NCTM *Principles*, present technology as a dynamic tool for extending and deepening student understanding of mathematics. Web-based instruction based on a mastery learning approach does not use technology for this purpose; therefore it does not fit in with the intent of the NCTM or the Common Core Standards.

Blended Learning

A growing area of instruction that is addressing this issue is the concept of blended learning. The term blended learning is a new term that had very few references before the year 2000, but since then can be found more frequently in the literature (Bliuc, Goodyear, & Elli, 2007). Having such a brief existence, a concise, accepted definition for the term has not been established. Thus, definitions of blended learning are quite broad.

One basic definition of blended learning is "Blended learning systems combine face-to-face instruction with computer-mediated instruction" (Graham, 2006, p. 5). Another similar definition comes from Driscoll (2002) where she defines blended learning as the combination of "any form of instructional technology with face-to-face instructor-led training (p. 1)." Akkoyunlu and Soylu (2006) state that, "blended learning has come to be understood as a combination of conventional classroom instruction and e- learning" (para. 11). Or as Bliuc et al. (2007, p. 234) put it, blended learning is "learning activities that involve a systematic combination of co-present (face-to-face) interactions and technologically-mediated interactions between students, teachers and learning resources." Definitions like these do not say a lot about what is contained in blended learning and how much of each should be included. In response to this, Masie (2006) says, "the amount of traditional classroom, synchronous classroom, and self-directed work is prescribed by the identified learning objectives and resulting design" (p. 33). Osguthorpe and Graham (2003) give a similar response.

> The balance between online and face-to-face components will vary for every course. Some blended courses, because of the nature of their instructional goals, student characteristics, instructor background, and online resources, will include more face-to-face than online strategies. Other courses will tip the balance in favor of online strategies, using face-to-face contact infrequently. Still others will mix the two forms of instruction somewhat equally. … The aim in either case is to find that harmonious balance—the balance of instructional strategies that is tailored specifically to improve student learning. (p. 228)

The Sloan Consortium gives more specifics in their definition of blended learning. A blended learning course is a course in which 30-79 percent of content is delivered online (Allen, Seaman, & Garrett, 2007).

Many authors agree that the non face-to-face component of blended learning should be online, but what is done online varies greatly. The face-to-face component can also vary greatly. The online component for most is some form of commercially available product for instruction. This may range from an applet that demonstrates the topic to an intelligent learning system wherein instruction is presented and assessments are given. Some online components contain the course calendar, class handouts, assignments, additional readings, and class notes. A few have discussion groups online. The face-to-face component is usually a lecture over the material being learned or a question and answer time (Johnson, Dasgupta, Zhang, & Evans, 2009; Utts, et al., 2003; Xu, Meyer, & Morgan, 2009; Ward, 2004).

The results of using blended learning appear to be promising. Means, Toyama, Murphy, Bakia, and Jones, (2009) found that effect sizes were larger for blended learning than for purely online learning when compared to face-to-face learning. Many of the results appear to be contingent on the student's involvement in the learning process. The more time they spend in the learning process, the greater their level of achievement and the more positive their view of blended learning (Akkoyunlu and Soylu, 2006; Means, et al., 2009).

The achievement and participation level of students seems to be tied to their perception of the things needed to succeed in the class. Akkoyunlu and Soylu (2006) found that the views of the lower-achieving students included wishing that the instructor had done more of the presentation; they felt that their lack of success was tied to this. The higher-achieving students felt that the website for the course had the content that they needed to succeed in the class. Some of the students, who had a lower participation rate, as determined by the authors from test results and participation, felt that the class website did not help them with the class, while other low-participating students felt that their lack of success in the class was tied to their lack of participation. High-participation students felt that the class website was very helpful.

Students in a blended learning environment had a more positive attitude toward the instruction given than those in a traditional face-to-face environment. Comments from students in the blended learning environment seemed to indicate that the difference in attitude was a result of their taking more accountability than traditional students for their performance on required components of the course (Ward, 2004).

Studies involving blended learning allow instructors to better define their role in the instructional process. As a result of their study, Utts, et al. (2003) felt that the time their class spent with an instructor should be more interactive. They felt that the role of the instructor should be that of a motivator and explainer with the students providing input as to what would be explained. The instructor should be available to answer questions in a face-to-face setting rather than electronically. The software system that was used seemed to be sufficient in providing the instruction, but an instructor was needed to help students with their understanding of the concepts. The students in this study wanted to interact face-to-face with an instructor who was able to answer their questions. Further, the interaction should involve material the students have already worked on and have questions about rather than provide instruction over material they have not covered yet.

Publishers and software companies are developing many products to meet this growing need and desire for online instruction and claim that their products will greatly increase a student's ability to learn (ALEKS, 2008b; Pearson Education, 2006). With all the computer-based instructional products available and claims about their perceived success, it is important to consider whether or not this method of instruction is best for students. Do students in a developmental/remedial program do as well with a computer-based method of instruction as they would if a traditional lecture were used or even with a combination of computer-based instruction and lecture?

Appropriateness of web-based instruction for remedial students

In an attempt to determine whether or not computer-aided instruction was appropriate for remedial students, Li and Edmonds (2005) studied at-risk adult learners and found that overall, there were no negative effects of the computer-aided instruction on students. There were positive gains on some achievement tests as well as a perceived increase in level of confidence and satisfaction of students in their learning of mathematics. Li and Edmonds suggested that the increased practice afforded by the method of instruction and the scaffolding that could be built into the program were the most important strategies for the building of knowledge. Thomas and Higbee (2000) also found that the amount of time a student spent working on homework alone outside of class and the amount of time the student spent working on computer tutorials was significantly related to the student's homework average. Jung, Choi, Lim, and Leem (2002) found that when instructors provided encouragement to students in a web-based instructional environment, there was an increase in learning achievement. In contrast, Weems (2002) conducted a study focused on a system where there were no instructor presentations. She found there was a decrease in exam scores compared to a traditional classroom wherein the exam scores remained constant. Stillson and Alsup (2003) also found in a study where there were no instructor lectures that the failure rate for students was much higher than it had been in previous semesters when the class had been taught using a traditional lecture method. The results of both the Weems and the Stillson and Alsup studies agree that students in the study felt the need for some type of instructor interaction, with a lecture being the most requested from students. These results seem to indicate that computer-based instruction can be beneficial to students, but there are some factors that improve its effectiveness, in particular, having an instructor presenting the instruction to the class along with the computer-based instruction.

Wuensch, et al. (2008) conducted a nationwide study in which they surveyed students and asked them to rate online classes and face-to face classes. They found that students thought online courses were more convenient and superior in their ability to allow for self-pacing. Further, students in this study consider online classes inferior to face-to-face classes because of the limited communication they could have with the instructor and other students, the difficulty with learning complex material with the aid given, the accuracy of the evaluation of their work, and the overall understanding the students had of the course material.

The ALEKS system

Ideally, any system that is used to present instruction should be able to evaluate a student's knowledge about a certain subject and then adjust what is taught based on the knowledge level that has been determined. This is often referred to as formative assessment: assessment that allows the teacher to determine where the students are in terms of their understanding so as to adjust curriculum and learning experiences to better meet student needs. Computer software systems that do this are called intelligent-tutoring systems. Intelligent-tutoring systems generally have four components: expert knowledge, learner modeling, tutorial planning, and communication.

The expert knowledge component consists of the facts and rules involved in a particular subject area that are known by an expert in that area. Not only does the system need the ability to use the facts and rules, it also needs to be able to explain why these are used when they are used. The learner modeling component consists of the current representation of what the learner knows and can do. This is determined by the system's ability to diagnose the learner's knowledge based on his or her responses to the system as he or she progresses through the instruction. The learner model is constantly changing to reflect the current learner state. The tutorial planning component determines the instructional activities to present next based on the learner model. This may include instructional activities the learner is ready to learn next, explanations of new material, appropriate feedback in the form of encouragement for further success or hints to overcome obstacles, or assessments to confirm and refine the learner model. The communication component provides a means for interaction between the system and learner. This is achieved through the use of text and graphic interfaces (Canfield, 2001; Mandl & Lesgold, 1988).

One web-based system for mathematics instruction is Assessment and LEarning in Knowledge Spaces (ALEKS). ALEKS is an intelligent-tutoring system that provides instruction to students and assesses them on that knowledge. ALEKS is based on theoretical work in the field of Knowledge Space Theory begun by Dr. Jean-Claude Flamagne. Flamagne is the founder of ALEKS Corporation and is a mathematician and professor of Cognitive Sciences at the University of California, Irvine (ALEKS, 2008a). Knowledge Space Theory is not a theory of how one learns, rather it is a theory of the order in which different concepts can be learned and how everything that a person knows about a subject can be deduced from determining whether a person knows or does not know a few topics. Two concepts key to Knowledge Space Theory are the knowledge state, which is some set of problems that a student can solve correctly, and the knowledge structure, which is a set of all possible knowledge states. A knowledge state is based on a precedence relation in which some pieces of knowledge must precede other pieces. All possible topics in a subject are arranged by some precedence relation. This precedence relation may be based on the need for one skill in order to obtain another skill, or it may be based on one topic being more difficult than another. This relation is determined by those who are experts in the field. A student's knowledge state consists of all skills that the student has along with all the prerequisite skills. Thus, if a student can solve a particular problem, then that problem and all those that contain skills necessary to solve this particular problem are in the student's knowledge state. Likewise, if a student can solve a particular problem, then it can be surmised that the student can also solve all those that involve the skills necessary for this particular problem. In the process of reaching a given knowledge state, the student may be able to get there by many possible paths. For a particular knowledge state, there are those problems that are considered to be on the outer fringe and the inner fringe. The outer fringe includes problems that the student has the necessary prerequisite knowledge to solve, and the inner fringe includes those problems that were the most recent to be added. The outer fringe is where learning takes place; these are the problems that the student is ready to learn. The inner fringe is where reassessment and review take place (ALEKS Corporation, 2008a; Flamagne, Cosyn, Doignon, & Thiery, 2006; Lukas & Albert, 1999; Flamagne, Koppen, Villano, Doignon, & Johannesen, 1990).

The first time a student uses ALEKS, he or she is assessed to determine his or her current knowledge of mathematics. The student's knowledge is assessed using a small number of questions, approximately 30, that are chosen based on the answers to previous questions. After the assessment, ALEKS presents the student with a list of topics that he or she is ready to learn. The student can then select a problem from this list, and ALEKS presents practice problems to teach the topic. ALEKS has an explanation available for the topic if the student is having difficulty with it. Once the student has consistently answered the problems correctly for the topic, ALEKS considers that the student has learned the topic, and the list of topics that the student knows or is ready to know is updated. The student can then select another topic that he or she is ready to learn. The student is periodically reassessed by ALEKS to determine if the student has actually mastered the topics covered. The student's knowledge of the course is readjusted based on this assessment. It is possible for the student to be required to repeat some topics as well as it is possible for the student to advance beyond some topics as a result of this assessment (ALEKS, 2008a).

There have been several studies conducted in order to evaluate the implementation and success of the ALEKS system (Canfield, 2001; Hagerty & Smith, 2005; Hardy, 2004; Stillson & Alsup, 2003). These research studies generally fall into one of two categories. Either ALEKS is used as a standalone program where the instructor is simply a resource person who is able to answer student questions, or ALEKS is used to supplement a traditional lecture and is used in place of written homework.

Hagerty and Smith (2005) used ALEKS in college algebra classes. In this study, students in sections that were taught with a traditional lecture and textbook assignments were compared with students in sections that ALEKS was used as a supplement to the regular lecture. The students in this study who used ALEKS outperformed the students who did not as measured by gains between a pre-test and post-test. When surveyed, the students using ALEKS were satisfied with their experience, though concern was expressed that many topics introduced in ALEKS were never considered as possible test questions. The skill retention rate of a group of students was also studied three semesters after completing these courses. The students who had been in the ALEKS sections scored significantly better on a test of algebra skills than those who had not been in ALEKS sections.

Hardy's (2004) study of ALEKS was also a comparison of the course grade and several criteria. In this study, students were enrolled in either a course in Basic

Algebra or a course in Intermediate Algebra. Some students were in classes in which ALEKS was used to supplement a lecture, while some were in classes in which it was used as a stand-alone. Hardy found that the amount of time a student spent on the system was positively correlated with their progress through the course content, although there were a few students for whom this was not the case. He also found that the correlation between the final assessment on the system and the paper-and-pencil final was highly significant.

Stillson and Alsup (2003) performed a study using ALEKS as a supplement to traditional class lecture and textbook usage for developmental mathematics classes. Their study was different from those previously mentioned in that it was a student survey rather than a comparison of an ALEKS group and a traditional lecture group. Their findings indicated that a majority of the students believed they had learned more than they had in traditional classes; most said they would take another class using this system, but they did not want the system to replace the human contact that the instructor provided. The portion of the course completed on the system and the time spent on the system correlated with the final grade for the class. There were a higher number of students not passing the course and a higher number of students dropping out of the course than there had been in previous semesters. In this study, ALEKS was used as a supplement to a textbook and class lectures, therefore, some students felt that the tutoring system did not help on tests because the tests came from the textbook and lectures, which covered different material than the tutoring system.

Canfield (2001) reported on using ALEKS in developmental mathematics classes as a supplement to traditional classroom lectures. Though this study involved only a questionnaire at the beginning and end of a term, it looked at students' attitudes toward this type of learning. Students reported they had learned as much as or more than they would have in a regular mathematics class, and they would be willing to take another course in this format; several felt there was less stress due to the self-paced way the system presented material, and they liked the course better when it was combined with an instructor giving lectures. Canfield (2001) concluded that when ALEKS is used with an entire class, it should be used as a supplement to traditional class lectures and ALEKS should be used as a stand-alone only with self-motivated students who need only to review the material. He also concluded that written exams should be given along the way as another form of assessment.

Summary

The old adage that to get a good job, one needs a good education is as true today as it ever has been. The problem is that many students are not ready to get a good education. Reports show that there are a large number of students who do not have the necessary preparation to perform successfully in a post-secondary setting. Attempts are being made to provide these students with the skills needed to succeed. One method growing in popularity for providing the skills is web-based instruction and blended learning. In these settings, the student is provided instruction that is broken down into small pieces by way of a computer and the Internet. In most cases, mastery learning theory (Bloom, 1968) guides the instructional process with new material presented only when the student has mastered a current topic. Ultimately, learning is taking place by constructing knowledge.

Studies have shown that students in need of remediation can benefit from web-based instruction (Jung, Choi, Lim, & Leem, 2002; Li & Edmonds, 2005; Stillson & Alsup, 2003; Thomas & Higbee, 2000; Weems, 2002; Wuensch, et al., 2008). Several things affect the amount of success a student attains. One is the amount of time the student spends learning, and another is whether or not an instructor is presenting instruction and interacting with students.

One system for presenting web-based instruction is the ALEKS system. ALEKS is an intelligent-tutoring system in that it can present instruction and give appropriate feedback to the user. The topics and instruction presented are based on the user's responses to previous questions. Studies have shown that remedial students using ALEKS learned as much as they would have in a traditional class and their attitudes toward learning in this manner are positive (Hagerty and Smith, 2005; Hardy, 2004; Stillson and Alsup, 2003; Canfield, 2001).

Studies do not reveal, though, students' perceptions about receiving verbal instruction that supplements the instruction they are receiving from the ALEKS system or any other online learning system. Therefore, this research study focuses on contributing to that body of knowledge by attempting to show how students' perceptions of their abilities to perform basic algebra tasks is affected by computer-based instruction and what students' perceptions are about having received verbal instruction from an instructor along with computer-based instruction. In Chapter Three, the methodology for this study is presented.

Chapter Three

Research Design and Methodology

The purpose of this study was to determine those aspects of the instruction in a university remedial algebra class conducted using web-based instruction and supplemented with instructor-provided lectures that students felt helped them the most in learning and making sense of the mathematics presented. The grades for the class are not of interest in this study because the goal was not to compare students or methods, nor to say which was better. The goal was to allow students the opportunity to share their perspectives about the learning process and the aspects of the course they thought helped them make sense of the learning tasks provided. Qualitative data were collected and analyzed to gain insight about the thinking of the students taking a remedial mathematics class and the aspects they felt helped them succeed or hindered their success. The appropriateness of using qualitative methodology for this study was addressed in this chapter along with the method for collecting data and the procedures for analyzing this data.

The research questions that guided this study were:

1. What are the various aspects of a computer-based basic algebra course for remedial students?
2. How are students' perceptions of their abilities to perform basic algebra tasks affected by computer-based instruction?
3. What are students' perceptions about having received verbal instruction from an instructor along with computer-based instruction?

In order to address these questions, this chapter begins with a presentation of the research design and rationale for the design, followed by a list of the key terms that are pertinent to this study along with working definitions for those terms. The chapter then continues by describing the participants in this study along with the university setting in which the study took place. My role as a participant researcher and instructor along with my previous experience teaching classes similar to those in the study is provided. The method of instruction that was used in this study is presented. Finally, the data collection procedures are presented.

Research Design

The study was conducted as a phenomenological study. As such, the purpose was to determine what common experiences the students in these classes shared under the method of instruction. Dermot (1999) defines phenomenology by saying "Phenomenology emphasizes the attempt to get to the truth of matters, to describe *phenomena*, in the broadest sense as whatever appears in the manner in which it appears, that is as it manifests itself to consciousness, to the experiencer" (p. 4). Merleau-Ponty (1956) defines phenomenology as "the study of essences and accordingly its treatment of every problem is an attempt to define an essence, the essence of perception, or the essence of consciousness, for example" (p. 59). According to Creswell, Hanson, Plano Clark, and Morales (2007), phenomenological studies attempt to describe the common experiences the participants in a study have as they experience the phenomenon. And as Merleau-Ponty (1956) suggests, it is an attempt to describe these experiences as lived experiences.

A phenomenological study is performed by first identifying a phenomenon (Creswell, et al., 2007), which in this study was web-based instruction supplemented with verbal instruction provided by myself. Data are then collected from the persons experiencing the phenomenon (Creswell, et al., 2007). In phenomenological studies, a detailed description of the person's experiences and actions is sought that is as accurate as possible to what the person experienced (Giorgi, 1997). For this study, the data were collected through the use of surveys and journal entries and involved the perceptions the students had with this phenomenon. The goal of a phenomenological study is to reduce the experiences of all persons in order to develop a composite description of the essence of these experiences. The purpose of phenomenological studies is not to develop theory, but to take the specific statements participants give about a phenomenon along with their experiences with the phenomenon to describe the essence of that phenomenon (Creswell, et al., 2007).

In the process of conducting a phenomenological study, it is necessary to bracket out one's own views as to what is thought about the phenomenon. The purpose of this is to be able to more objectively describe the experiences of others (Creswell, et al., 2007) and to keep from imposing explanations of the phenomenon before it can be understood for what it is (Moran, 1999): it may also include explanations that may be imposed by various theories of learning (Giorgi, 1997). My views on this phenomenon, based on expectations and previous experience, are that students who have some knowledge of basic algebra and wish to proceed at a faster pace will be able to do so and will therefore have a better perception of this method of instruction. They will have neutral feelings about the instruction given by the instructor because they did not benefit from it. These students may have negative feelings toward it in that when they were in need of additional instruction, the instruction given to the class as a whole was over topics they had already covered. Their perception toward one-on-one instruction from the instructor should be better, though. I believe that students who feel that they learn best from verbal instruction in the form of a lecture will have positive feelings toward a verbal presentation and may express the wish that all topics had been presented in this manner. These students may express ill feelings toward having instruction presented solely via web-based instruction. Further, students who are not accustomed to having to complete a large amount of work to master a task before they can move on may express negative perceptions because of this. My view is that there will be students who express an appreciation for the ability to repeatedly work problems so that they can learn how to do them. I also believe that there will be some students who have the poorest background in mathematics who will express a high level of frustration with this method of instruction because they will never be able to progress past the early material.

The analysis of a phenomenological study begins with a reading of all of the data to obtain a global sense of the data. Through subsequent readings, the data can be organized into units that come from the data and are not imposed from the outside (Giorgi, 1997). Through this process, significant statements made by the participants can be identified that provide an understanding of the overall experience (Creswell, et al., 2007). The actual analysis of the data was conducted using the constant comparison method of analysis of Glaser and Strauss. The constant comparison method consists of four stages: “(1) comparing incidents applicable to each category, (2) integrating categories and their properties, (3) delimiting the theory, and (4) writing the theory” (Glaser, 1965, p. 439). Through the process of the constant comparison method, each stage will grow into the next, but at the same time previous stages remain in effect. In stage one; each incident in the data is coded in as many categories as possible. Glaser (1965) gives the following defining rule for the constant comparative method: “while coding an incident for a category, compare it with the previous incidents coded in the same category” (p. 439). As each incident is constantly compared to other incidents in the same category, theoretical properties of the category soon begin to surface, which should be recorded as soon as possible. Stage two consists of comparing properties of the categories. This causes the categories to be integrated with other categories, and relationships are discovered between the categories. At the same time, new incidents are compared with the emerging properties rather than with other incidents. Theory is developed as the categories are integrated and relationships are discovered as a result of this constant comparison (Glaser, 1965; Glaser & Strauss, 1967). The theory is delimited in stage three when comparisons with new categories do not bring any major modifications to the theory. These only bring about clarification or the removal of non-relevant properties. Delimiting also takes place as categories become saturated and there is no need to compare new incidents with this category (Glaser, 1965; Glaser & Strauss, 1965; Glaser & Strauss, 1967). The final stage is to write the theory in which the final properties can now be combined (Glaser, 1965; Glaser & Strauss, 1967). It was not the purpose of this study to develop theory. The purpose of this study was to present the perspectives of the participants in their own words. The analysis in this study will stop with the second stage, where the major themes from the participants will have emerged, and not continue to theory building. These themes will be presented using the words that the participants used.

The process of constant comparison was done throughout the study and was used to guide the development of the journal questions and the final survey. The responses to an initial survey were analyzed and the results were used to develop some of the journal questions used in the first few weeks. The responses from the journal entries were compared with those on the survey. Glaser and Strauss (1965) suggest that making comparisons between different groups, such as the journal entries and survey responses, can provide new data about the categories, suggest new hypotheses, and verify initial hypotheses. The results of this comparison aided in the development of journal questions used in subsequent weeks. All responses were then analyzed to determine the questions on the final survey. After the completion of the final survey, all data were analyzed again.

Definitions

Remedial Student – A student who has been deemed by specific criteria to have insufficient preparation or to be lacking in certain basic skills needed for the work required in a college-level class. A student may be deemed deficient in one or more subject areas but not all (i.e., a student may need remediation in mathematics but in no other subject area). This student may be able to perform the work for other subject areas while being deficient in one or more identified subjects. The student's deficiencies are often determined by such criteria as the student's ACT score; for example, a score of below 19 in any subject area would identify the student as deficient in that particular subject area or using a standardized placement test such as the Course Placement Test, a score below 75 in a subject area would indicate that the student is deficient in that particular subject area. The actual exams and cutoff points for these criteria are established by individual institution. Another term that is used sometimes instead of remedial is developmental.

Remedial/Developmental Course – A course where the goal is to provide the skills needed to perform at a level necessary in a college class to a student who does not have these basic skills. Typically, the completion of a remedial/developmental course does not result in credit toward graduation. A student that is required to take a remedial/developmental course must successfully complete the class before being allowed to take any other classes in that subject area.

Remediation – The process of removing deficiencies a student may have in knowledge and skill in particular subject areas. Usually this involves the student successfully completing a remedial-level class.

Technology – Anything that can be used to perform a task. Instructional technology is anything that can be used to present or aid in the presentation of instruction.

Web-based Instruction – Instruction on a topic that a student can receive by using a computer to access a website on the Internet that contains the instructional material. Once the student has accessed the website, he or she must typically provide information such as a username and password to verify that the student has enrolled in the class and to provide security to prevent others from accessing the student's account. Instruction can be presented in forms such as text or graphics for the student to read or a video clip the student can watch. After receiving the instruction, the student may need to interact in some way with the instruction that has been presented. It may be that the student is asked to answer a series of questions about the instruction received. These questions may be set up to provide immediate feedback to the correctness of the answers and may provide hints or suggestions if the answer is incorrect.

Web-based Instruction System – A website that can provide instruction on a variety of topics along with administrative tools that can be used to determine progress. Such a website contains all the software needed to provide the instruction so it can be accessed from any computer that has access to the site on the Internet. The amount of content and the interactivity of the sites may vary. Along with the all the software needed to provide instruction, the site also contains administrative tools such as a calendar for determining when and what content and activities are presented, content pages that present the instruction, a test/survey capability, a tool for communication between students and between student and teacher, a tool for reporting grades, and a tracking system that reports student access and progress which can be accessed by the student or the instructor of the course.

Participants in this study

The participants for this study were the students in the four sections of Basic Algebra taught by myself in the spring and fall semesters of 2010 at an Oklahoma regional university. The regional university system is made up of universities that do not have research as a primary focus. These universities are public universities and grant few, if any, doctoral degrees. The Basic Algebra classes the participants are a part of are designed for students who have been deemed deficient in their mathematics skills and are not prepared to successfully complete their general education mathematics classes. Most students are in this class because they have an ACT mathematics score of 19 or below or have a score below 75 on the basic algebra portion of the Course Placement Test given by the university. The state board of regents and the university have set these numbers as cutoffs for enrollment in general education mathematics classes. Therefore, students scoring below those cutoffs have not met the criteria to enroll in a general education mathematics class. A few students are in this class because they feel they are not ready to go into a general education college-level mathematics class and would like to take a course that will refresh and reinforce their mathematics skills.

The selection of students for this study was not done randomly. Students were allowed to enroll in any section of Basic Algebra and those that chose these sections did so out of convenience to their own schedules. Thus, the participants in this study were chosen based on a convenience sampling. The students enrolling in these sections had no knowledge that these sections would be used as part of a research study nor did they know that the classes would be conducted in a way that was different from the other sections of Basic Algebra. All students enrolled in these sections were invited to participate in this study, but only those who agreed to participate were included in this study. I was an active participant observer during the research in that I was the instructor of the course and I presented the lectures during the class.

During the first semester of this study, 56 students were enrolled in the two sections that were used. The following table presents the demographic breakdown of the students.

Table 1. Demographic Breakdown of Students

Total students	Male	Female	White	Hispanic	American Indian	Black or African American
56	27	29	33	9	6	8

Not all students in these classes chose to participate in this study. Signed consent forms were returned by 19 students. The demographic breakdown of these students is presented in the following table.

Table 2. Demographic Breakdown of Students in Study

Total students	Male	Female	White	Hispanic	American Indian	Black or African American
19	7	12	15	2	2	0

The second semester of the study was conducted in two sections of 29 students each. The table below presents the demographic breakdown of the students.

Table 3. Demographic Breakdown of Students

Total students	Male	Female	White	Hispanic	American Indian	Black or African American
58	22	36	42	11	4	1

The students during this semester demonstrated their agreement to participate in the study by returning an anonymous survey; therefore it was impossible to determine the demographics of those participating. Completed surveys were returned by 30 students. During both semesters of this study, a total of 49 students participated.

At the beginning of this study I had been teaching for 24 years, 16 of which had been on the university level where a large portion of my course load was teaching remedial mathematics classes; the last 12 were at the university where this study was conducted. I have also had several semesters' experience with computer-based instruction. Several years prior to the semesters this study was conducted, I used ALEKS for a fall, spring, and summer semester. The first two semesters, ALEKS was used as a standalone source of instruction; I was present only to answer questions. No instruction was given to the entire class. During the summer semester, I gave instruction to the entire class once a week over a topic I felt a large number of students would benefit from. The semester prior to the semester this study took place, I supplemented ALEKS instruction with instruction to the entire class over topics a large number of students were ready to learn as well. I was also available during class time to answer student questions. I am knowledgeable of the mathematics content in ALEKS as well as the implementation of the system.

Class Instruction

On a typical day, students in these classes worked on the ALEKS system the entire hour. The system presented them with a list of approximately 20 topics for which they have the prerequisite knowledge needed to learn through a circle graph called "My Pie".

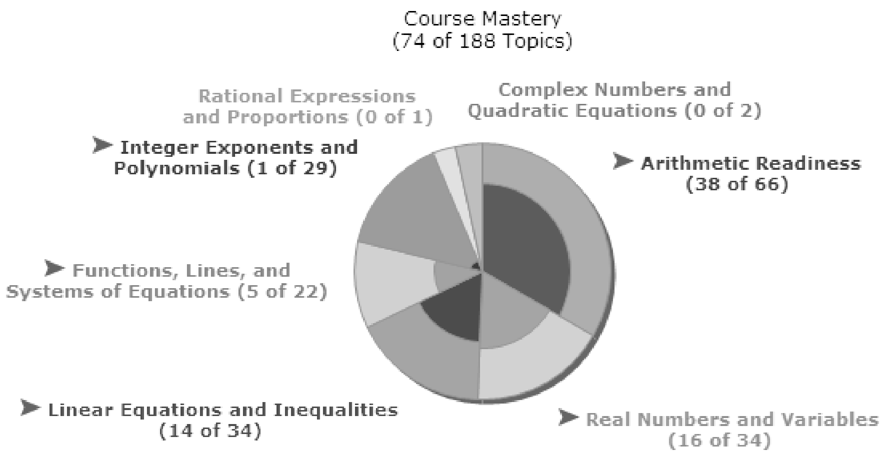

Figure 1. Typical My Pie

The topics that ALEKS has available are grouped in general headings in the pieces of the pie much like chapters in a book. The available topics may be in several pieces of the pie and the student is able to choose any topic from this list. I suggested several strategies for choosing topics. One strategy I suggested was to choose anything that looked interesting. A second, preferable, strategy is to finish all the available topics in one piece of the pie before attempting those in another piece. This second strategy gives the students a little more continuity in that the topics will be similar and will involve similar methods in working the problems.

Once a topic is chosen, the ALEKS system presents a question for the student to answer. If the student already knows how to answer the question, or thinks he or she knows how to answer it, the answer can be given. The ALEKS system has an advanced answer entry ability that allows any symbol or format needed for a mathematical expression to be input. The answers can be entered in the same format that they would be written. The system then tells them if their answer is correct or not. If the student does not know how to answer the question or would like a little help, an explanation is available from the system on how to solve the particular problem. Also available are explanations and examples of the terminology used. The system will give the student a series of similar questions until it is determined that the student probably has mastered the topic. This number depends on the number of times the student has answered the question incorrectly and the amount of explanation that has been needed. Once this has happened, the topic is added to the list of topics the student knows how to do.

Figure 2. Typical Question in ALEKS

I was available during all class times to answer student questions. Usually I would walk around the classroom to interact with students and to answer questions. Occasionally I would notice that a student was answering a question incorrectly several times or that the student seemed to have a confused facial expression, I would stop then and ask the student if he or she had a question or needed help. If the student wanted help, I was there to give it. After helping the student, I would stay nearby to give assistance on the next question, if it was needed. I would come back a little later to check on the student's progress.

Students would occasionally ask their classmates for help with a question. This was encouraged so that the student asking could get a different perspective on the question than I might give. It also allowed more people to be actively involved in the learning process.

ALEKS is a web-based system and can be accessed by a student anywhere there is Internet access. This made it possible for students to work on it outside of class time. One requirement for the class was that students have at least five hours of time spent working in the ALEKS system each week. Class time provided an opportunity to get over three hours of the required time; the remaining time could be put in at home or a computer lab on campus.

After a certain number of topics have been learned and the student has been using the system a certain number of hours, an assessment is automatically given. The assessment presents questions that the student has been learning since the last assessment. The questions are presented in the same way that they were while learning them, except that the explanation option is not available. The assessment will determine if the student has mastered these topics. If a question is answered correctly, it is assumed to be mastered. If the question is answered incorrectly, a second chance at answering this question is given later in the assessment. If it is answered incorrectly a second time, it is assumed that the topic has not been mastered. If the student has not mastered a topic, it is removed from the list of mastered topics along with any other topics that have this as prerequisite knowledge. Throughout the semester, there were four assessments that I scheduled. These were the same as the automatic assessments except that the questions could come from anything that was on their list of mastered topics.

One day a week I gave a lesson on several topics that a large number of students were ready to learn. Instructors in ALEKS have access to a list of all topics that students in the class are ready to learn along with the number of students ready to learn each topic. I took two or three topics from this list that the most number of students were ready to learn. Students in the later semester of the class who were ready to learn the topic were sent a message through the ALEKS system stating that a lesson would be given over the topic. The instruction I gave was usually similar to that given by the ALEKS explanation. Sometimes, I gave an explanation that was slightly different when my past experiences provided explanations that I thought were better. Usually I presented two problems of each type along with a verbal explanation of how to arrive at the answer for the question. Students who did not have the topic in their "ready to learn" list were not required to listen to the explanations as well as any student who chose not to listen. Instruction time usually lasted around fifteen minutes. Students used the remaining time in the class working in the ALEKS system.

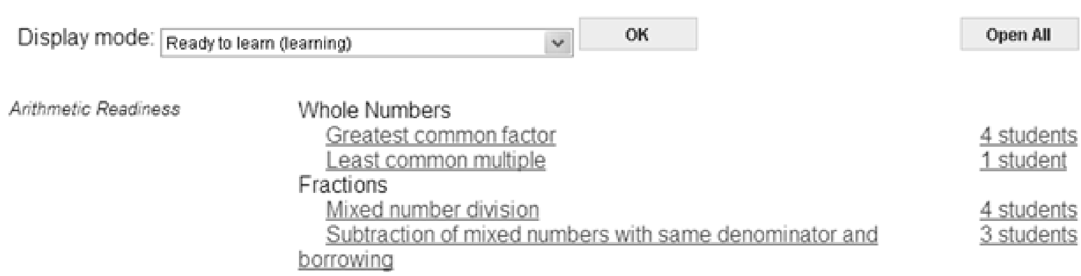

Figure 3. Typical List of Topics Students Are Ready to Learn

Data collection

Data were collected through surveys and weekly journal entries over two semesters. The first semester of the study an initial survey, journal entries, and a final survey were given. The second semester only a final survey was given. The initial survey, given at the beginning of the semester, was given to attain student's initial feelings and perceptions about this type of instruction along with demographic data of those involved in the study. This survey was also used to determine topics that the students would write about in their journals. This survey was conducted only during the first semester because only general information was being gathered at this time and the general information that was gathered could be assumed to be true for the second group of students as well, given that they were in back-to-back semesters and were in the class for the same reasons as the first group. Weekly topics were given to all students in the class to respond to in their journals. The topics were chosen so that the students could expand on their initial comments and to gain further insight into their feelings on the type of instruction they were receiving. A final survey was given to all participants during the last week of the semester. The purpose of this was to verify that the conclusions arrived at from the initial survey and journal responses were valid and to draw out further perceptions of the experiences the students were having.

The initial survey is included in Appendix B. It was developed for this study to determine the students' abilities and comfort levels using a computer and to determine their initial thoughts about using a computer for instruction in Basic Algebra. The questions were formulated based on responses I thought would answer the research questions and questions that came out through reading the literature.

The weekly journal questions are included in Appendix C. The questions for the first several weeks were developed to get further information about responses on the initial survey. Later questions were developed as I read through the journal responses. As I read through the responses, I used the constant comparison method of

Glaser and Strauss to analyze the data (Glaser, 1965; Glaser & Strauss, 1967). If I noted themes in the responses or there were items of interest, questions were developed that would probe deeper into these responses in subsequent journal entries and attempt to determine if these were widely held beliefs or if they were isolated instances. In this way, coding for themes allowed the study to evolve in ways to better understand the phenomenon being studied. One example of this was to ask about things that were perceived as a motivating factor. Several students had mentioned the idea of motivation, so I chose to pursue this with the entire class. Journal questions were also developed based on issues that came up through reading the literature. I was interested in determining if the participants in this study were having similar experiences as those noted in earlier studies.

A final survey was given at the end of the semester and was designed to draw out further information from the comments given on the weekly journal responses as well as to attempt to summarize and verify conclusions made from the journal responses. The final survey is included in Appendix D. The survey given at the end of the second semester classes was a refinement of the surveys given to the first semester classes and was designed to further expand on the information gained during the first semester and to validate the findings from the first semester. This survey is included in Appendix E.

Table 4. Data Collection Time Line

Semester of Study	Date of Collection	Data Collected
First semester		
	First day of class	Basic Algebra Student Survey – Appendix B
	Week 1	Journal Question 1 – Appendix C
	Week 2	Journal Question 2 – Appendix C
	Week 3	Journal Question 3 – Appendix C
	Week 4	Journal Question 4 – Appendix C
	Week 5	Journal Question 5 – Appendix C
	Week 6	Journal Question 6 – Appendix C
	Week 7	Journal Question 7 – Appendix C
	Week 8	Journal Question 8 – Appendix C
	Week 9	Journal Question 9 – Appendix C
	Week 10	Journal Question 10 – Appendix C
	Week 11	Journal Question 11 – Appendix C
	Week 12	Journal Question 12 – Appendix C
	Week 13	Journal Question 13 – Appendix C
	Week 14	Journal Question 14 – Appendix C
	Week 15	Final Survey Questions – Appendix D
Second Semester		
	Week 15	Basic Algebra Student Survey – Appendix E

Summary

The purpose of this study was to determine those aspects of the instruction in a university remedial algebra class conducted using web-based instruction and supplemented with instructor-provided lectures that students felt helped them the most in learning and making sense of the mathematics presented. Details of the participants in this study were provided along with the institutional settings and the method of instruction. The particular research questions to which I sought answers can be reiterated as follows:

1. What are the various aspects of a computer-based basic algebra course for remedial students?
2. How are students' perceptions of their abilities to perform basic algebra tasks affected by computer-based instruction?

3. What are students' perceptions about having received verbal instruction from an instructor along with computer-based instruction?

Qualitative data were collected to answer the research questions through the use of surveys and journal entries soliciting student feelings and perceptions of this type of instruction and through classroom observations. The study was conducted as a phenomenological study. As such, the purpose was to determine what common experiences the students in these classes shared under the method of instruction. The analysis of the data was conducted using the constant comparison method of analysis of Glaser and Strauss. In the next chapter, I analyze the findings in response to the research questions of my study.

Chapter Four

Results and Analysis of Findings

This study is based on qualitative data gathered from students in sections of a remedial Basic Algebra class and is designed to investigate their feelings and perceptions about receiving instruction on the computer from a web-based system along with face-to-face instruction from an instructor. In this chapter, research data will be presented that was collected through surveys, class journals, and classroom observations. The research questions that guided the study were:

1. What are the various aspects of a computer-based basic algebra course for remedial students?
2. How are students' perceptions of their abilities to perform basic algebra tasks affected by computer-based instruction?
3. What are students' perceptions about having received verbal instruction from an instructor along with computer-based instruction?

In this chapter, four major sections will be presented. The first will be a description of the aspects of a computer-based basic algebra course for remedial students. The second will give selected characteristics of students in the study. The third will present qualitative data to describe how computer-based instruction affects students' perceptions of their abilities to perform basic algebra tasks. Finally, the fourth will present qualitative data to describe students' perceptions about having received verbal instruction from an instructor along with computer-based instruction.

Aspects of a Computer-Based Basic Algebra Course for Remedial Students

The ALEKS system. The instruction for this course was presented primarily on the ALEKS system. A student accesses the ALEKS system by logging on to the website aleks.com. This site requires an initial access code that must be purchased to register with the system. Students use a login name and password on subsequent visits.

After a student registers with the ALEKS system an assessment is given to the student. This assessment is used by the system to determine the student's current knowledge and understanding of particular mathematics concepts and skills. If a student correctly answers a question about a certain topic, the system assumes the student knows how to answer that type of question along with all topics that are considered prerequisite knowledge for that topic. The student will not need to spend time learning topics the system has determined are already in the student's current knowledge state. Based on the student's current knowledge state, a list of approximately 20 topics is determined for which the student has all the prerequisite knowledge. The topics on this list are the topics the student is ready to learn.

The topics that are available in ALEKS for the student to learn come from the categories Arithmetic Readiness; Real Numbers and Variables; Linear Equations and Inequalities; Functions, Lines, and Systems of Equations; Integer Exponents and Polynomials; Rational Expressions and Proportions; and Complex Numbers and Quadratic Equations. These are topics generally covered in a traditional basic algebra class. The categories are arranged in a circle graph called My Pie. The individual topics that the student is ready to learn are displayed next to the piece of the pie representing the category they come from.

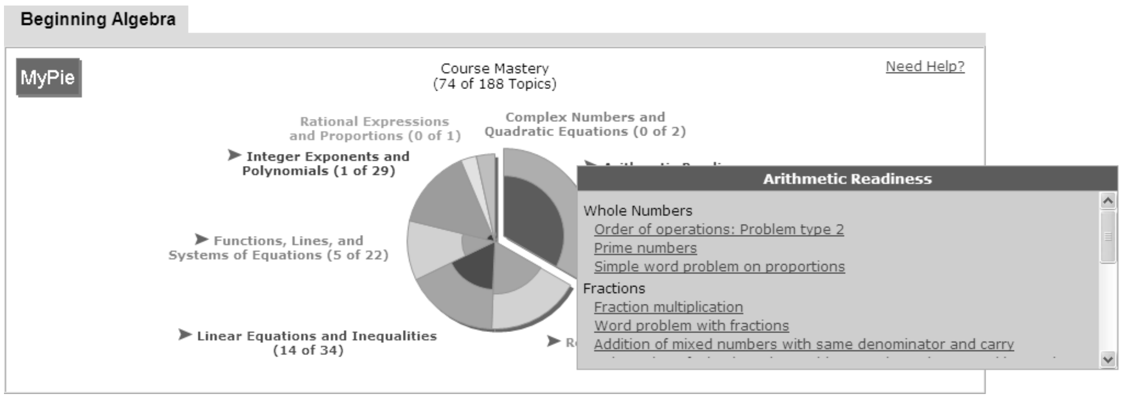

Figure 4. Typical My Pie with topics ready to learn

Learning with the ALEKS system. A student can select any topic to learn from the list of topics the ALEKS system has determined the student is ready to learn. When a topic is selected, the ALEKS system presents a question to the student. The student has two options at this time. One is to attempt to answer the question, and the other is to get an explanation that will show the student how to answer the question. The explanations show how the current question is worked out, giving the steps that are needed in the calculation. These explanations are essentially the same as would be given in a verbal lecture in a traditional class, except that they are presented in printed form. The explanations that are given for the topics a student chooses are the primary means of instruction.

When the student submits an answer, a response is given stating whether the answer is correct or not. When an incorrect response is given, the student may answer the question again or go to the explanation. Correct answers will give another question of the same type. After the student has correctly answered the question a certain number of times, the topic is added to the list of topics the student has learned, and the student can move on to a new topic. The number of times the student must answer correctly is affected by the number of times the student has answered incorrectly. After a student has learned a topic it is added to the student's current knowledge state and the list of ready-to-learn topics is updated.

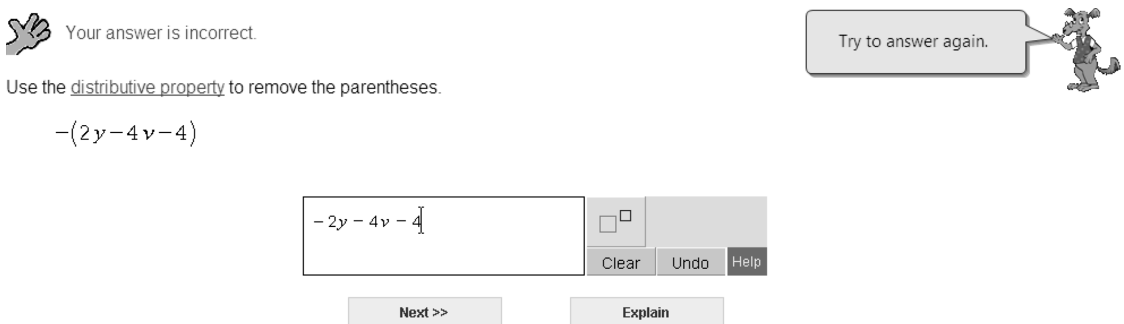

Figure 5. Response to Incorrect Answer

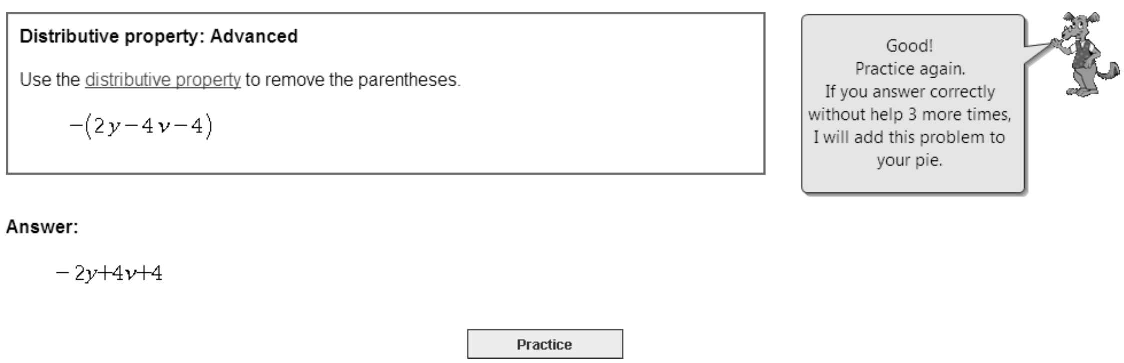

Figure 6. Response to Correct Answer

Assessments are given to a student automatically after they have learned at least 20 topics and have spent at least five hours on the system since their last assessment. The purpose of an assessment is to determine if the student has mastered the topics learned. Mastery of a topic is assumed when the student has correctly answered a question covering that topic on an assessment. If a student incorrectly answers a question, a similar question will be given later. If it is answered incorrectly a second time, the system assumes that the student has not mastered the topic and it, and all topics for which it is a prerequisite, are removed from the student's current knowledge state.

Face-to-face assistance from the instructor. There was also a face-to-face aspect of this class. As the instructor for this class, I was available during all class periods to answer any questions the students may have. I attempted to remain visible to all students by walking around the classroom. The hope was that if I was near, a student may be more likely to ask a question. While walking around, I attempted to be aware of student body language to detect if there was confusion or questions about an explanation or be aware if a student had been on the same question for a long time. In either case, I would ask if there was a question that I could help with. After answering a question, I generally stayed with the student to see if there were still questions on the next problem. I would also return later to check with the student.

Face-to-face instruction from the instructor. Another face-to-face aspect of the class consisted of the weekly lectures I gave to the entire class over a topic a large number of students were ready to learn based on their knowledge states. The ALEKS system provides instructors a list of topics students in the class are ready to learn and how many students are ready to learn each topic. I chose three topics that the most number of students were ready to learn for a presentation to the class. The presentation was a traditional lecture to the entire class. Usually two examples were provided for each topic. The explanations provided were similar to the explanations given in the ALEKS system. At times, though, from my previous experience, I felt that another explanation would be more helpful. Students that chose not to listen were not required to do so. Students could continue working in the ALEKS system if the lesson was not focused on something they were ready to learn.

Selected Characteristics of Students in the Study

Student comfort level with using a computer. One of the purposes of giving the initial survey to students in the study during the first semester was to determine information about who the students were in the study and some of their initial feelings about using a computer to learn Basic Algebra. The students in this study seemed to be comfortable with using a computer. Eighty-three percent responded that they were comfortable, very comfortable, or extremely comfortable using a computer. Sixty-three percent of the respondents said they used a computer more than three hours a week. For the students who reported that they were only somewhat comfortable using a computer, most said that they used a computer less than one hour per week or less than three hours per week.

Student perceptions of a computer giving instruction. Eighty-one percent of the students who responded to the initial survey said they thought that a computer could present material in a clear way. Two of the three students who disagreed that a computer can present material in a clear way also reported that they were only somewhat comfortable using a computer.

Seventy-five percent of those surveyed thought that a computer could accurately determine when they were having trouble with their work, while 81 percent thought that an instructor could accurately determine when they were having trouble with their work. There was no overlap of students thinking that neither could determine when they were having trouble. Of the three students who disagreed with the statement “An instructor can accurately determine when I am having trouble with my work,” all agreed to the previous statements about a computer, “A computer can present material in a clear way” and “A computer can accurately determine when I am having trouble with my work.” Only one of these disagreed with the last statement about computers, “A computer can give the individual help I need.”

Only 56 percent agreed that a computer could give them the individual help they needed. The two that strongly agreed with this statement agreed with all the other statements about a computer or instructor.

Student use of computers. Three survey questions asked about the activities for which the students were using a computer. Sixty-three percent of the students used a computer for playing games and were comfortable doing it, while 25 percent reported not playing games on a computer. Fifty-six percent of the students who responded indicated that they were comfortable using social networking and only 19 percent said he or she did not use it much or not at all. Only one person indicated that they never use the Internet for finding information, while the remainder were comfortable doing so. Most students are comfortable using productivity tools. Some indicated that they had used them in their other classes. One student reported having grown up using this software.

One student responded negatively to all questions having to do with the student’s comfort using a computer. This person reported that he or she never plays games on a computer, never uses social networking, never uses the Internet to find information, and is not comfortable using productivity tools. Overall, the student is somewhat comfortable using a computer, though. This student also reported using a computer less than one hour per week.

Students' perceptions of using a computer summary. In summary, the majority of students in this study were comfortable using a computer and used one more than three hours per week. Most said they thought that both a computer and an instructor could present material in a clear way. All thought that an instructor could give the individual help they needed, but only just over half thought the same of a computer. Additionally, most thought that both a computer and an instructor could accurately determine when they were having difficulty with their work.

Students' previous experience of computer instruction. Sixty-nine percent of the respondents said that they had had a previous experience in which a computer was used to present instruction. There seemed to be some confusion, though, on the part of the students, as to what constitutes instruction from a computer. Several referenced having previously used MathXL or MyMathLab. These are two versions of an online homework system offered through Pearson Education that are used in the traditional sections of Basic Algebra at this university. These are available at http://mathxl.com and http://www.coursecompass.com. If a student has attempted Basic Algebra at this university in the past six years, they would have used one of these. The homework system does not present nor give explanation about new material, and there is limited explanation about how to work problems.

Most students who had previous experience with a computer presenting instruction had a positive experience with it. Many of them said that they liked their previous experiences, and several reported that they liked being able to work at their own pace. There were comments such as “I felt I learned a lot,” “I felt that it helped greatly,” and it “explained things well.”

Of those that did not have a positive experience, one attributed the difficulty with it to the instructor not explaining the material very well. This person reported being extremely comfortable using a computer. This person also agreed to the statements “A computer can present material in a clear way” and “A computer can accurately determine when I am having trouble with my work” but disagreed with the statement “A computer can give the individual help I need.” This person reported having used MathXL, which would not present the instruction the student felt he/she had not received from the instructor.

Another student reported that the experience with a computer presenting instruction had left him/her confused. This person was comfortable using a computer, agreed to the statement “A computer can present material in a clear way,” but disagreed with the statements “A computer can accurately determine when I am having trouble with my work” and “A computer can give the individual help I need.”

Another student who was comfortable using a computer thought that instruction from a computer was clear, but did not like that there was not a person to go to when there was a problem. This person disagreed with the statements “A computer can present material in a clear way,” “A computer can accurately determine when I am having trouble with my work,” and “A computer can give the individual help I need.” This person did not specifically mention how a computer had been used, but mentioned being in a particular class in which MathXL was being used.

There were two students who reported never having had an experience in which a computer was used to present instruction. Both disagreed with the statements "A computer can present material in a clear way" and "A computer can give the individual help I need." Both expressed being only "Somewhat comfortable" using a computer and indicated using a computer less than three hours a week. One of these students never uses a computer to play games, for social networking, to find information on the Internet, or for productivity tools.

Student reaction to computer-based instruction. A majority of the class, 63 percent, were positive about receiving instruction from a computer program. They made comments such as, "I'm open to it," "willing to learn," "I like it because I am learning at my speed," "A little nervous, but I think it will go well," and "I would rather work on the computer than book work." On the other hand, over a third of the class had initial thoughts about receiving instruction from a computer that were not totally positive. Most of these mentioned that they would like to have an instructor teaching the class or at least present to answer questions. Some of the comments made were "very open as long as there is a instructor to help if I need," "don't mind at all as long as an instructor is there for questions," "not having a teacher to explain things and to practice with scares me," "I feel that I may be able to learn Algebra better if I was taught by a teacher." One student mentioned preferring to have a book to go along with the class and extra problems to practice.

Over half of the students agreed with the statement, "Computers and web-based instruction are an effective way to present instruction in Basic Algebra." One student agreed because of previous experience, another because it allowed the user to work at his/her own pace, several agreed because it would immediately tell them if their answer was correct, still others said that it would take them step-by-step through an explanation and show different ways. Nearly a third disagreed with the statement. One reason for their disagreement was "a computer cannot help you like a human"; a similar comment was "I don't think computers should replace things such as books or teachers"; another reason was "Sometimes I need to ask specific questions and I'm not sure how that will work."

Affect of Computer-Based Instruction on Students' Perceptions of Their Abilities to Perform Basic Algebra Tasks

The journal questions were the main way that the last two research questions were answered. The surveys at the end of both semesters also aimed at answering these questions. The journal questions and surveys attempted to gain insight into the students' thinking as they proceeded through the semester. The question addressed here is, "How are students' perceptions of their abilities to perform basic algebra tasks affected by computer-based instruction?" Several main themes were evidenced in the data and will be presented in response to this question. Student responses generally fell into six categories: learning better because working at their own pace, learning better because learning on their own, learning because computer is more motivational, learning better because not as self conscious, learning more on the computer and retaining it better, and learning better is not true for all. The analysis of the data to determine these main themes included coding the data into categories that addressed the affect of computer-based instruction. There were a total of 207 comments in these categories.

Learning better because working at their own pace. The most common response from the students relating to the affect of computer-based instruction on students' perceptions of their abilities to perform basic algebra tasks was that they liked the ability to work at their own pace. There were 78 comments, or 38 percent of the comments, that were coded into this category. But what did they mean by that? Occasionally, the responses provided insight into what was meant by working at their own pace. Several different aspects of a definition of this statement came out in their responses.

The facet of working at their own pace that came up the most often was the ability to take as much time as was needed.

- On a computer I can take as much time as I need.
- I feel like I am learning more better because I can focus on that specific topic as long as I need.
- I was allowed to spend as much time on a type of problem as I needed to understand the operation.

The ALEKS system was designed so that a student could take all the time that he or she (and not someone else) thought was needed to learn and understand the topic. The ability to take all the time needed to learn a topic had another benefit to the student: they didn't feel rushed. This was another aspect of taking as much time as was needed that came up.

- …I'd rather learn at my own pace and not feel rushed to move on to something else when I'm not ready.

- Being able to work at my own pace has helped. I don't have to be rushed.

Another aspect of taking as much time as was needed was that it was also on their time.

- Just by being able to do it on my own and on my own time, at my pace.

The next facet of working at their own pace that was revealed in the data was the idea that the student felt that he or she would not get left behind. Several students commented to me in class that in previous mathematics classes they felt that they had gotten left behind because they could not keep up with the pace of the class. Now, since they were working at their own pace, they felt that they would not get left behind.

- I felt more motivated by working at my own pace and not have the worry of being left behind.
- It allows me to work at my own pace and not get left behind which tells me that I can do this and there is no chance you will be left behind.

A third facet of working at their own pace that arose is very similar to the idea of not getting left behind. This is the idea of not having to go at the pace of the class. This idea would encompass not being left behind, but appears much broader than that. Going at a different pace than the class could be needing to go slower than everyone else, which might include the fear of being left behind, but that idea was not specifically mentioned; also, going at a different speed than the rest of the class could reflect a desire to go faster than everyone else. Some felt that the extra time they took allowed them to learn more.

- I felt that I was actually learning something and I liked being able to work at my own pace and not trying to keep up with the others in the class.
- I felt stress free by moving at my own pace and not having to work at the pace with the rest of the class. I think it really helped me understand better and be more calm (less stressed about the class in general).

Some felt that they could move through the material faster than the rest of the class, therefore they were learning more.

- I have learned more in this class than the traditional classes I have previously taken because I get bored with having to slow down on topics that others don't understand.
- I found I did really well, I learned things faster than others, so for once I could keep going.

Some students expressed this idea as not having to wait on the rest of the class or have the rest of the class wait on them.

- I like being able to move at my own pace without waiting on the class or them wait on me.

A fourth facet of the theme of working at their own pace that was apparent was the student did not have to move on until ready. All the students in a class do not learn at the same rate, so working at their own pace allows them to spend as much time working on a topic as they need. Additionally they can also practice as many problems as they want.

- I think I probably learned more because I refused to move on until I had done some problems over and over. I would not move on until I was confident I was ready. Whereas in a regular classroom the instructor moves on quicker than I would probably be ready.
- I like it because you can work at your own pace and do more if you want to.

Not having to keep up with the rest of the class and not moving on until ready result in a fifth facet of working at their own pace. Students indicated that they felt less stress when they were able to work at their own pace.

- I felt stress free by moving at my own pace and not having to work at the pace with the rest of the class. I think it really helped me understand better and be more calm (less stressed about the class in general).
- It's a work at your own pace which makes learning less stressful.

A sixth facet of working at their own pace is the student is able to work at his or her knowledge level or ability. Students are coming into the class with different levels of knowledge of Basic Algebra. The ability to work at their own pace afforded the opportunity to learn concepts for which they have the prerequisite knowledge.

- I think learning with ALEKS is probably faster because everyone is at a different level and with ALEKS you will be working at your level and not waiting for other people or them waiting for you.

- … everyone understands differently and ALEKS allows us to work and learn at/to our abilities.

There were three lesser facets of learning at their own pace that were apparent in the data. One student wrote on several occasions in journal entries that working at their own pace allowed him or her to understand better. Two of the comments were,

- … I can learn at my own pace and be able to understand it and try not [to] get behind.
- Because we can work at our own pace and be able to understand better.

Another of the lesser facets was that a student does not need to go over things he or she already knows.

- Because the computer teaches you the topics that you do not know on a basis of what you know – you work at your own pace – you do not have to try to go over things you already know.
- I know that with ALEKS when you learn something new it sends you on pretty quickly to the next topic. So you don't waste a lot of time on something that is easy to do and you already know it.

A final lesser facet was that a student can move between topics. If the student does not understand a topic, he or she has the flexibility to move on to something different and come back to it when he or she feels ready to learn it.

- I really enjoy going at my own pace and if I get stuck can move on to another one and go back when ready. I enjoy this class.

- I think a computer might be better because if you get tied up on one type problem you can put it off for a while and move on to another topic.

Students feel that computer-based instruction has positively affected their abilities to perform basic algebra tasks through their ability to work at their own pace. Students have commented that they are able to learn the topics presented better because of being able to work at their own pace.

- I feel like I am learning more better because I can focus on that specific topic as long as I need.
- I felt that I was actually learning something and I liked being able to work at my own pace and not trying to keep up with the others in the class.
- I have learned more in this class than the traditional classes I have previously taken because I get bored with having to slow down on topics that others don't understand.
- I found I did really well, I learned things faster than others, so for once I could keep going.
- I think I probably learned more because I refused to move on until I had done some problems over and over. I would not move on until I was confident I was ready. Whereas in a regular classroom the instructor moves on quicker than I would probably be ready.

Students also feel that their abilities to perform basic algebra tasks have improved because they understand the concepts better. This, too, is because they were able to work at their own pace.

- I was allowed to spend as much time on a type of problem as I needed to understand the operation.
- I think it really helped me understand better and be more calm (less stressed about the class in general).
- … I can learn at my own pace and be able to understand it and try not [to] get behind.
- Because we can work at our own pace and be able to understand better.

When students are allowed to work at their own pace they believe that they can take as much time as is needed to learn a concept and because of this they do not feel rushed. When they work at their own pace, they believe that they will not get left behind. This is because they do not have to go at the pace of the rest of the class, they do not need to move on until they are ready, and they can spend as much time working on a topic as they need, and because of this, they feel less stress. They can also move faster than the rest of the class. When they work at their own pace, they believe that they are able to work at their knowledge level or ability level. When they work at their own pace they believe that they are able to learn and understand better.

Learning better because learning on their own. Another major theme revealed in the data related to the affect of computer-based instruction on students' perceptions of their abilities to perform basic algebra tasks was that the students enjoyed being able to learn on their own. There were 42 comments, or 20 percent of the comments, that were coded into this category. Several different facets of this also came out of the student responses.

Many of the students in their responses to various questions wrote that they were learning better because they were doing the work. They were not just passively sitting and listening, but they were active in the learning process. When they were active in the learning process, they believed they were learning more and remembering it longer.

- [Learning from a computer is a] lot better then just sitting there listening to someone talk all hour. I like the more doing than more just sitting there doing nothing but being bored.
- I do think I am learning more from doing it myself because the repetition drills it into my brain.
- … [W]hen you do things on your [own], just like many things in life you remember it!
- [I learned more] because I have had to do it by myself.

One student mentioned another benefit of working by himself or herself.

- Sometimes I day dream and I think having to do it myself really helped.

A second facet of learning on their own was the students' belief that, in general, they are learning more.

- I do better when I learn it and not having someone tell me how to do it.

- [N]ow that I have done it on my own, it gives me a better understanding of what I'm doing.
- I liked it I feel that you learn more when you take the bull by the horns.
- I learn more this way because I actually learn it. I'm just better at doing my own thing.

A third facet that students reported was that learning on their own has helped them develop some responsibility for learning. They can no longer rely on the instructor to present everything. They have realized that it is their responsibility to work to understand the concepts presented.

- [I]t taught me not to rely on a teacher, and depend on myself to get the job done.
- I have found it's showed me that I can truly figure things out on my own.
- The self discipline because it's up to you to get things done.
- [Y]ou have to want to learn and teach yourself.

It would be interesting to know if this realization carries over into their other classes.

Even though ALEKS is inherently not aligned to constructivism in terms of its teaching philosophy, students are still constructing knowledge when they use it to learn basic algebra. This is a fourth facet of learning on their own that was apparent in the student responses. Students are constructing knowledge by discovering for themselves ways to solve the problems presented to them. For example,

- I think this was a good thing because I've figured out ways to understand the problems and didn't have to struggle doing it the way a person would want done.
- Yes I do learn better and remember because I come up with my own way to solve a problem instead of someone else's.

One student commented that through learning on his or her own, he or she can recognize how to do similar problems. This person has come to the point where he or she can apply learning from one situation to another.

- Good because, I learned it better. Because now when I see a problem like it I recognize and know how to do it.

When students learn on their own, they believe that they are learning better because they are doing the work and they believe that they are learning more. They feel a strong sense of pride. Learning on their own has helped them develop some responsibility for learning and has also allowed the students to construct knowledge by discovering for themselves ways to solve the problems.

Learning because computer is more motivational. Many students in the study felt that learning from a computer positively affected their ability to perform basic algebra tasks because it was more motivating than other approaches. There were 17 comments, or 8 percent of the comments, were coded as a computer is more motivating. Using a computer to learn basic algebra was motivating in several different ways. Some of the students were motivated by learning on the computer because of the self-paced nature of ALEKS. One way this motivated students was the ability to complete the course requirements early.

- More motivated because I[']m moving at my own pace and can do it at my own rate. Wanting to finish early and pass affects my motivation.

The course was set up so that a student could finish the class early and not have to attend the remaining class sessions when all topics on the pie had been mastered.

For other students, learning on a computer was motivating because they could see how far they had come.

- I think seeing how many out of 187 you have finished makes you want to keep working once you've started.

Students were able to watch their progress as the number of topics on their pie increased toward the goal of having finished all the topics.

Students also indicated they were motivated by working at their own pace because they could not get left behind.

- I think that I am more motivated because of using a computer. I can't get left behind like I did in past classroom settings. If I'm having trouble with one problem I have however much time I need to figure it out.
- I felt more motivated by working at my own pace and not have the worry of being left behind.

Another reason students indicated for being motivated by working at their own pace was that they felt motivated by the challenge it presented.

- I felt that it was a self based class I think its better because you have to challenge yourself to do better.

- I believe it challenges you and helps better in the long run, it is a GREAT way to learn math, and it allows people to learn at the pace they are at.

This challenge, to some, was the same as the challenge of a game.

- To me math is a puzzle and I like puzzles. … At times it feels like I am playing. I look at the program as a game to conquer.
- I have found myself to take into a challenge. Which, in a way, feels like a game I like to play.

Students also indicated they were more motivated to work with technology because it was something they are accustomed to using.

- I am more motivated to do it on the computer because it is habit for me to be on the computer.

Many students believe that their ability to perform basic algebra tasks were positively affected because learning on a computer was more motivating to them. They were motivated because they could complete the required tasks ahead of time and they could see how far they had progressed toward the goal of being finished. They were also motivated because they could work at their own pace. The motivation for some came because while working at their own pace they felt that they could not be left behind, while others felt motivated because working at their own pace was a challenge to them. Some equated this challenge as the same as the challenge of winning a game.

Learning because not as self-conscious. Many students feel self-conscious in a basic algebra class and do not want to appear that they are having trouble with the subject. Students feel that learning on a computer will positively affect their abilities to perform basic algebra tasks because they will not feel as self-conscious. There were 17 comments, or 8 percent of the comments, that addressed the feeling of self-consciousness.

One way that using a computer to learn helps them to be less self-conscious is through not having to ask questions in front of everyone in class.

- Don't like asking questions in class, because all the attention is on the student and teacher, where as if it's computer even if a questioned is asked everyone is paying attention to their own computer.
- Some students might not like asking questions.
- Less … embarrassing rather than asking the teacher constantly.

Some students feel that asking questions in front of the class shows the rest of the class how little they know.

- I do think there is a difference because I know I'm not good at math. I'm sure I'm not the only one either but the whole class doesn't have to know that either. ALEKS helps people like me who's a little self conscious how smart I am when it comes to numbers.

Another way that using a computer helps them feel less self-conscious is that they do not feel judged when they do not know the answer.

- I feel like I am not being judged if I don't know an answer like I would if a person was helping me.

When students do not feel judged, they do not feel stupid. One student repeated this throughout the semester.

- I don’t think most instructors know how to break problems down enough for comprehension without making the students feel dumb.
- I don’t feel stupid on the computer because you’re right or wrong.
- The computer doesn’t make you feel stupid.

Students may be coming into Basic Algebra self-conscious about their abilities to perform basic algebra tasks. Using a computer helps them feel less self-conscious because they do not need to ask questions in front of the class. They do not even need to ask a person questions if they do not want to. Using a computer also helps them feel less self-conscious because it is not judgmental of them and they believe that it does not make them feel stupid.

Learning more on the computer and retaining it better. Many students in the study felt that learning on a computer was having a positive effect on their abilities to perform basic algebra tasks because they were learning more and retaining it better. There were 17 comments, or 8 percent of the comments, that were coded into this category. This was happening in one way because the students must be actively involved in the learning process and learn it for themselves.

- I understand the material so much better working by myself.
- Like I said seeing and actually getting to be hands on doing the math, you learn it better and it catches on.
- I am a visual learning so therefore I learn more and faster by looking and doing it myself.

They are learning more because they are learning it themselves and not having someone else tell them how to do it.

- I feel like I actually “learned” it – not just see how someone else is doing it.
- I think its been good its helped me to fully understand what I’m doing not just being shown how to do the math.

They feel they are learning more than they would have in a face-to-face classroom.

- I think that I have learned a lot more, more thoroughly than I would if by an instructor.
- Yes because I have learned more through ALEKS than in a face-to-face class.
- Good because I happened to learn more and understand things better than with an instructor.

Many students also feel that learning on a computer is helping them retain their knowledge.

- I am retaining the material much better using ALEKS.

But just working on a computer is not enough to retain their knowledge. There are some things that facilitate this.

- I think I have had to commit myself in a way that forces you to remember.
- No I feel that ALEKS has taught the material to me. I believe it is a good thing. I feel that way because with ALEKS you have to

understand the problems you are working on and so I think it made it stick in my head better.

When students learn basic algebra tasks on a computer, they feel they learn more and better and they feel that they can retain it longer. They feel they are learning more and better because they are the ones doing the work to learn rather than someone else telling them how to do it. In fact, they believe they are learning more on their own than from another person. They also feel that they have a better retention of what they have learned. The reason for this may be tied to learning it on their own. They need to be committed to the learning process and want to understand.

Learning better is not true for all. Not all students feel that their abilities to perform basic algebra tasks have been affected positively. There are some students who do not feel the previously listed effects are positive. There were 36 comments, or 17 percent of the comments, that were in this category. Some students do not like working at their own pace. They seem to prefer having a schedule to stay on. One student responded this way to two different questions, stating that an instructor could provide this schedule whereas the computer would not.

- I would also know the pace I need to stay at.
- I would know how much work I needed to get done at a time.

Another student did not think working at their own pace was best. They may be moving faster, but they were not learning.

- Not sure that the understanding is better. I think that people move along faster.

A third student thought that working at their own pace was not good because he or she would jump around to different topics when frustrated.

- I think it helps, but then if I don't get it, I get frustrated and just do another subject.

Other students feel that they are not able to learn from a computer because the computer cannot give as many examples or as many ways to do a problem as a person.

- ALEKS to me doesn't show every example needed to solve a problem. That's why I enjoyed the time when the instructor worked on topics.
- A person can show you more than one way of viewing or doing a problem. Whereas computer programs (like ALEKS) can only present the problem in one way. And often hearing step-by-step instructions is easier.

There are students who feel that they have not been able to learn as much because they were not taught in a manner that goes along with their preferred learning style.

- I can't retain the knowledge from a computer like I can from an instructor.
- I'm not being shown in the way my mind comprehends it the best.

There are several students that felt that they could have done better if they would have had an instructor, rather than the computer give the instruction. One student, when responding to a question about having to teach yourself everything, wrote,

- Yes I do because the computer is confusing. It's a bad thing cause it makes you feel stupid.

Another student thought that he or she could have learned the first time from an instructor.

- I think that [an instructor giving daily presentations to the entire class] would help because it will teach the students the proper way to do the problems instead of us having to keep doing the same problem over and over until we get it right.

Some students are scared by the thought of receiving instruction from a computer.

- Well right now I'm scared I won't learn and get stuck. How well can a computer program teach?
- It was scary at first because I wasn't sure how the instructions would be. I was scared I would not understand them and then it would make the class a lot harder.

Not all students felt that their abilities to perform basic algebra tasks were affected positively. There were some in the class that did not agree with the previously listed positive effects. There were students who do not think working at their own pace was positive. Some of them seemed to prefer having a schedule provided by an instructor to stay on. Some felt that they may have moved faster, but they were not learning as well. And others felt that working at their own pace was not good because it provided a way for them to jump around between topics when frustrated. There were students that felt that a computer could not give as many examples or as many ways to do a problem as a person could. There were students who felt that they were not taught in a manner that goes along with their preferred learning style. There were students who felt that they could have done better if they would have had an instructor, rather than the computer give the instruction. And there were students who were scared by the thought of receiving instruction from a computer.

Summary of affect. This section has attempted to answer the question, "How are students' perceptions of their abilities to perform basic algebra tasks affected by computer-based instruction?" The responses given by the students in their weekly journal entries and end of semester surveys were analyzed using the constant comparison method of analysis of Glaser and Strauss. As a result of this analysis, five main affects of computer-based instruction surfaced. Not all students agreed that they had been affected in a positive way. Their disagreement has also been noted.

Students believe that their abilities to perform basic algebra tasks were affected by computer-based instruction. A major way computer-based instruction affected the students was by allowing them to work at their own pace. Many students believed that they could take as much time as was needed to learn a concept, which had the effect that they did not feel rushed. They believed that they would not get left behind because they did not need to go at the pace of the rest of the class–they could move as fast or as slow as they wanted and because of this, they felt less stress. They believed that they were able to work at their knowledge level or ability and were able to learn and understand the topics presented better because they were able to work at their own pace.

A second way computer-based instruction affected the students was through learning on their own. They believed that they were learning better because they were doing the work and so they were learning more. They believed that learning on their own helped them develop some responsibility for learning and allowed them to construct knowledge by discovering for themselves ways to solve the problems.

A third way computer-based instruction affected the students was through increased motivation due to learning on a computer. They were motivated because they could complete the required tasks ahead of time. They were motivated because they could see how far they had progressed toward the goal of being finished. They were motivated because they could work at their own pace. They were motivated because they felt that they could not be left behind. And they were motivated because working at their own pace was a challenge to them.

A fourth way computer-based instruction affected the students was through providing a means for students to feel less self-conscious. They felt less self-conscious because they did not need to ask questions in front of the class and because the computer was not judgmental of them and did not make them feel stupid.

A fifth way computer-based instruction affected the students was by enabling them to learn more and better and to retain it longer. The students were doing the work necessary to learn the topics and because of this, they felt they were learning more and better. They believed they were learning more on their own than they could from an instructor and believed that they had a better retention of what they learned because they learned it on their own. They also believed that they must be committed to the learning process and must want to understand.

Not all students felt that computer-based instruction affected them positively. There were students who did not think working at their own pace was positive. Some seemed to prefer following a schedule provided by an instructor. Some felt that through working at their own pace they may have moved faster, but they were not learning as well. And some felt that working at their own pace was not good because, when they were frustrated, it allowed them to jump around between topics. There were students who felt that they were not learning as much as they could have because they felt a computer could not give as many examples or as many ways to do a problem as a person could. There were students who felt they were not learning as much as they could because they were not taught using their preferred learning style. There were students that felt that they could have learned more if they would have had an instructor giving the instruction. And there were students that were scared by the thought of receiving instruction from a computer.

No analysis was done to determine which of these affects of computer-based instruction a majority of students had experienced. The purpose of this study was only to enumerate and describe the affects as they surfaced in the data.

Students' Perceptions about Having Received Verbal Instruction from an Instructor along with Computer-Based Instruction

The question addressed here is, "What are students' perceptions about having received verbal instruction from an instructor along with computer-based instruction?" Answers for this question were obtained from student responses to journal questions and surveys at the end of both semesters. Several main themes emerged from the data and will be presented in response to this question. Student responses to journal questions and surveys generally fell in five categories: instruction from an instructor is not necessary; instruction from an instructor on an individual basis only; instruction from an instructor to the entire class on an occasional basis; instruction from an instructor to the entire class on an occasional basis along with individual instruction; and instruction from an instructor on everything. When the data were coded into categories to determine the students' perceptions about the type of instruction received, 147 responses fell into the five categories.

Instruction from an instructor is not necessary. One group of students in the classes felt that there was no need to receive instruction from an instructor. There were 26 responses from the students, or 18 percent of the responses, that were coded in this category. They felt that the ALEKS system was sufficient to provide all the instruction they needed. There were those who commented that they thought it was better to receive instruction from a computer than from an instructor.

- I happened to learn more and understand things better than with an instructor.
- I do better when I learn it and not having someone tell me how to do it. I think that I have learned a lot more, more thoroughly than I would if by an instructor.
- Well have taken this being my second time I have learned twice as much by being on the computer than by an instructor so my ability to solve the problems I think has improved.

There were several aspects of computer-based instruction that some of the students gave as being better than instruction from an instructor. Two of these aspects were an affect of computer-based instruction on their perceptions of their abilities to perform basic algebra tasks. One aspect was the ability to work at their own pace.

- Computer might be better because you [are] more on your own and you can keep going back looking at examples.
- I'm farther in this class than any other because it is at my own pace. I think with a[n] instructor I would not be this far in my learning.
- My ability has increased by doing computer-based instruction. It would be a lot different if an instructor was presenting the topics because I could not work at my own pace.

A second aspect was the student was the one doing the work.

- I think it works out better for me; I have had regular instructors and I would very easily forget how to do the problem because I need to be the one to do the work.
- I learn a lot better on the computer, because when the teacher talks my mind wanders away but when I am reading it myself I pay attention.
- Sometimes reading it is better than listening.

A third aspect of receiving instruction from a computer that was perceived to be better than from an instructor was that a computer may be able to do things more quickly and accurately.

- The computer tells you immediately … if you're doing it right or wrong.
- A computer does not mess up on a[n] equation and a person can.

- A computer is better to present instruction than a person because sometimes people better said instructors are sloppy with their writing or go too fast.

There was one student in this group who responded on two different occasions to journal questions that an instructor talked too much and was boring when he or she did so.

- An instructor to me talks to[o] much. I don't know about most people but for me, sitting there listening to someone talking is so boring. I get distracted easy so when someone gets up and talks the whole hour is pointless. ALEKS to me is good because we can go at our pace and not have to just set there and do non-stop listening.
- I just think it is easier to comprehend the information better from the computer. A lot better then just sitting there listening to someone talk all hour. I like the more doing than more just sitting there doing nothing but being bored.

There were also students in the group that believed that they didn't need an instructor because an instructor could not give everyone the help they needed whereas a computer could.

- The computer gives many examples anytime a student needs help. A teacher doesn't really have that much time to help every single student.
- A teacher can't spend too much time on one topic because of all the students.

- I really don't think [a person is better than a computer to give instruction] because the instructor is usually rushing and can't really help with everyone. Not enough time.

A final comment made by students in this group was that receiving instruction from a computer was closer to their preferred learning style.

- ALEKS teaches the way I like to learn and so I learn easier and quicker.
- I'm a visual learner so I learn better and faster seeing it in front of me on a screen than listening to an instructor teaching. It just comes easier to me learning from the computer.
- I am a visual learning so therefore I learn more and faster by looking and doing it myself.

There were students in the classes who felt that there was no need to receive instruction from an instructor. Four different aspects of this surfaced in the data. One was that some of these students thought it was better to receive instruction from a computer than from an instructor. The students felt this because they were able to able to work at their own pace, they were able to learn by doing the work themselves, and the computer could more quickly respond and give accurate instruction. A second aspect was that some students felt that an instructor talks too much and is boring when he or she talks. A third aspect from the data was that an instructor cannot give everyone the help needed whereas a computer can. And a fourth aspect was that receiving instruction from a computer was closer to the students' preferred learning style.

Instruction from an instructor on an individual basis only. Another group of students felt that the instructor should be there to give instruction on an individual basis only. This category had 37 responses, or 25 percent of the responses given. The ALEKS system was sufficient to give the instruction, so the instructor was only needed to answer specific questions the students may have.

- With the ALEKS program the best thing that the instructor can be there to just answer questions.
- I think they should be there to answer questions on an individual basis or not at all.
- I think the instructor helping on an individual basis is the best.

Several different reasons surfaced for having an instructor give instruction on an individual basis only. One of them was that the ALEKS system was capable of giving good instruction.

- I think the instructor helping on an individual basis is the best. Because we have a program that will show us how to work the problem.
- ALEKS gives good thorough explanations and an instructor is only helpful when we really get stuck.

Another reason was that students were working at their own pace and all the students may be working on different topics, so instruction to the entire class would not be effective.

- With ALEKS program the best thing that the instructor can be there to just answer questions. Kids are learning the ALEKS program at their own pace, so there is no point in teaching one subject.
- Because people are learning at their own pace, some will be done with that subject, others won't be close to it. And that topic may be easy to some of the students. So its easier to just answer questions when asked.
- I think they should be there to answer questions on an individual basis or not at all. I feel this way because we all work at our own pace and its better that way.
- A person explaining topics to individuals. Because why waste the whole class time and students time when only a few people may not know to do it. If a person has a question if not then they must know how to do it.

There were some of the students who liked the idea of learning on their own and trying to understand the instruction first. Then, if there were any questions, they would ask the instructor.

- I would like to see if I could understand from the computer first and if not then ask.
- I believe 50% [of the instruction should be presented by a computer], you need to learn on your own and be hands on with the work. The other 50% can be used to get help from the professor

when you really can't find the answer, or you need a better explanation than what the computer can provide.

- I like that [the instructor] walks around and helps us when we need it. It helps me understand more because he lets us do what we can do then helps us when we need it.

Some of the students in the classes were not ready to have instruction from the computer only. They liked the idea that they were not alone with the computer; there was someone there if they needed help understanding a topic or if they had a question.

- I like knowing someone is there to ask for help if needed, but love learning on my own.
- I know I had help if I needed it.
- I think it is always good to have someone there just in case someone has a question.
- I think an instructor that can be there to answer your questions on an individual basis would be best. Individualized help is best.

There were students in the classes who felt that the instructor should be there to only give instruction on an individual basis. They believed this was the case because they felt that the ALEKS system was capable of giving good instruction. They also believed this was the case because they felt that students were working at their own pace and instruction to the entire class would not be effective since all the students may be working on different topics. There were some students who felt that the instructor should only give instruction on an individual basis because they liked the idea of learning on their own and trying to understand the instruction by themselves. They would ask the instructor for help only if there were any questions. There were also some students who were not ready to receive their instruction from the computer only. They liked knowing that they were not alone with the computer and that there was someone available to ask for help if they needed it to understand a topic.

Instruction from an instructor to the entire class on an occasional basis. A third group of students in the classes felt the instructor should give instruction to the entire class on an occasional basis. There were 25 responses, or 17 percent of the responses, given by these students that were coded into this category. They were not quite ready to give up instruction to the entire class.

- I would like the professor to explain how to do problems [in] class every now and then.
- The only thing I would add would be maybe just a little more explanation. Like today was good it really helped me out to understand things better.
- [The instruction was v]ery helpful and wish it would have happened more.

These students commented that they would like to have something besides the explanation that was given on the computer through ALEKS. They were looking for a different explanation to help them understand the topics they were working on.

- ALEKS explains a lot but it’s still good to have the professor’s point of view.

- It has been very helpful for the instructor to present an explanation to the entire class because it shows me how to properly do a problem that I am stuck on.
- Because it might be something I don't understand and he could [help] me and maybe a lot of other people in the class.

Even though the self-paced nature of ALEKS made it so that all of the students in the class were not at the same point at the same time, some of the students realized that they could listen when a topic was being presented that they needed help with or continue to work if it was not.

- For students who need help they [can] listen and those who aren't on that topic can move on to their work on their own.
- Because if the topic doesn't pertain to us we can keep working but if its something we are ready to learn then we can take notes.

There were students in the classes who felt the instructor should occasionally give instruction to the entire class on a topic they were ready to learn. They wanted something different or more than what was being presented on the computer through ALEKS to help them understand the topics they were working on. They also realized that if they were not currently working on the topic being presented, they did not need to listen and could continue working where they were. If they were working on that topic, they had the opportunity to listen to the explanation.

Instruction from an instructor to the entire class on an occasional basis along with individual instruction. A fourth group of students in the classes felt the instructor should give instruction to the entire class on an occasional basis along with individual instruction. Students in this group gave 25 responses, or 17 percent of the responses. The people in this group wanted to have the instructor giving occasional explanations of topics to the entire class, but they also wanted the instructor to be available to answer individual questions.

- From time to time [the instructor] can figure out what the majority of the class needs help on and he can have a class teaching over that topic. He must also make time to answer individual questions throughout the class time.
- I would have to say [an instructor answering individual questions and an instructor occasionally giving presentations to the entire class] combined. Individual help and presentations to the entire class. … There were times that [the instructor's] instruction to the whole class helped me to understand when I was unsure of ALEKS's explanation.
- A combo [of an instructor answering individual questions and an instructor occasionally giving presentations to the entire class] because answering individual questions is good but as a group a lot of people can get it done.

The beliefs of this group are a combination of the beliefs of the previous two groups. They want the instructor presenting explanations to the entire class as well as being available to answer questions on an individual basis.

There were those in this group who felt that instruction to the entire class was helpful, but they realized that this method wasn't always the best. They may have wanted to have instruction presented to the entire class, but they realized that individual help would work better.

- I think someone that is there to answer individual questions. It does help me sometimes when you talk to the class as a whole. But it seems like only a few people are paying attention. And there are times you are talking about things, problems I have not yet gotten to. I like it when I can ask for help and you can put the problem in words and explanations I can understand.
- Probably individual help. I like the instruction on the board too but not everyone is on the same level so a lot of time teaching I think is pointless.

The students in this group felt that it was best to have an instructor presenting instruction to the entire class along with individual help from the instructor. Their beliefs encompassed the beliefs of the previous two groups. There were some in this group, though, that realized that instruction to the entire class did not fit in with the self-paced nature of ALEKS.

Instruction from an instructor on everything. A fifth group of students in the classes felt that all instruction in the class should come from the instructor. There were 34 responses, or 23 percent of the responses, given by students in this group. Many of these made comments about not wanting to have a computer presenting instruction.

- [Y]ou kind of need a teacher to be teaching all the time so you can better understand it.

- I would much rather have a teacher teach me than a computer.
- Basic Algebra is great presented by a good instructor person in class.

Several reasons surfaced as to why the students felt this way. One of these was that the students wanted to be taught the correct way to work a problem before they attempted it.

- I think that [an instructor giving daily presentations to the entire class] would help because it will teach the students the proper way to do the problems instead of us having to keep doing the same problem over and over until we get it right.
- I am one that likes to be taught the information before I do it.

A second reason the students gave was they believed that they needed to be shown an idea in order to learn it.

- The instructor, because I would see them do it step by step and explain it, plus I would know how much work I needed to get done at a time.
- because most people learn from being showed.

A third reason was they believed that they needed to hear it to learn.

- I like how it works on the computer but I'm one that has to hear it and be shown the steps very well.
- Because for some it is better to listen than read.
- Yes we need an instructor. We would have to listen to pass.

A fourth reason the students gave for wanting all instruction from an instructor was they believed that instruction from an instructor was closer to their preferred learning style.

- No [I'm not learning more], because I'm not being shown in the way my mind comprehends it the best.
- You get to hear them tell you and show you at the same time. They can find a way that best fits you.
- Because they can help you and show you how to do the problem the way you understand it.

The students in this group believed that all instruction should be coming from the instructor. They felt this because, first, the students believed that an instructor could have taught them the correct way to work a problem before they attempted it. Second, the students believed that they needed to be shown how to do something to learn it. Third, the students believed that they needed to hear the instruction to learn it. And fourth, the students believed that the instruction an instructor would give would be closer to their preferred learning style.

Summary of perceptions. This section has attempted to answer the question, "What were students' perceptions about having received verbal instruction from an instructor along with computer-based instruction?" The responses given by the students in their weekly journal entries and end-of-semester surveys were analyzed using the constant comparison method of analysis of Glaser and Strauss. As a result of this analysis, it was determined that students' perceptions fell into five general categories: instruction from an instructor is not necessary; instruction should come from an instructor on an individual basis only; instruction should come from an instructor to the entire class on an occasional basis; instruction should come from an instructor to the entire class on an occasional basis along with individual instruction; and instruction should come from an instructor on everything.

The first category consisted of students who felt that there was no need to receive instruction from an instructor. These students thought it was better to receive instruction from a computer than from an instructor because they were able to able to work at their own pace, they were able to learn because they were doing the work themselves, and the computer was able to respond more quickly and give more accurate instruction. They felt that an instructor talks more than is necessary and can be boring when he or she talks. They felt that an instructor is not able to give everyone the help needed whereas a computer can. And they felt that a computer can present instruction in a way that was closer to the students' preferred learning style.

The second category consisted of students who felt that the instructor should be there to give instruction on an individual basis only. These students felt that the ALEKS system was capable of giving adequate instruction. They felt that students in the classes were working at their own pace and not all students would be working on the same topics, therefore, instruction to the entire class would not be effective. They felt that the instructor should give instruction only on an individual basis because they liked learning on their own and would ask the instructor for help only when needed. They also liked knowing that they were not alone with the computer because there was someone available to ask for help in understanding a topic.

The third category consisted of students who felt that the instructor should give occasional instruction to the entire class on a topic they were ready to learn. These students wanted instruction that was different from or more than what ALEKS presented; they felt this would help them better understand the topics they were working on. They realized that they had the choice whether or not to listen to the instructor. If they were not currently working on the topic being presented, they did not need to listen and could continue working, but if they were working on that topic they had the opportunity to listen to the explanation.

The fourth category consisted of students who felt that it was best to have an instructor presenting instruction to the entire class along with individual help from the instructor. These students wanted the same benefits of having an instructor as the previous two groups. There were some students in this group that were aware that the self-paced nature of ALEKS was not conducive to instruction to the entire class.

The fifth category consisted of students who felt that all instruction should be coming from the instructor. These students believed that an instructor could have taught them the correct way to work a problem before they attempted it and believed that they needed to be shown how to do something in order to learn it. They believed that they needed to have instruction they could hear and believed their preferred learning style to be receiving instruction from an instructor.

No analysis was done to determine which of these categories a majority of students had as their preferred method of instruction. The purpose of this study was only to enumerate and describe the categories as they surfaced in the data.

Summary

This study has attempted to answer the guiding research questions:

1. What are the various aspects of a computer-based basic algebra course for remedial students?
2. How are students' perceptions of their abilities to perform basic algebra tasks affected by computer-based instruction?
3. What are students' perceptions about having received verbal instruction from an instructor along with computer-based instruction?

Four major sections were presented in this chapter. The first section described the aspects of a computer-based basic algebra course for remedial students. The second gave selected characteristics of students in the study. The third presented qualitative data to describe how computer-based instruction affects students' perceptions of their abilities to perform basic algebra tasks. Finally, the fourth presented qualitative data to describe students' perceptions about having received verbal instruction from an instructor along with computer-based instruction.

The computer-based basic algebra course that was the basis of this study was built around the web-based system ALEKS, which presented most of the instruction for this course. The topics that were presented in ALEKS are topics generally covered in a traditional basic algebra class. A student can select any topic-to-learn from the list of ready to learn topics presented by the ALEKS system. Questions are presented to the student, who may answer them or receive an explanation of the steps to the answer. Periodic assessments are given to the student to determine mastery of the previously learned topics. An instructor was available during all class periods to answer questions and give further explanation to help students understand the topics they were working on. The instructor also provided weekly lessons to the entire class over a topic a large number of students were ready to learn.

All work in this class was completed on a computer through the ALEKS system; therefore, an initial survey was given to determine characteristics of the students in this study that pertained to using and learning on a computer. The majority of students responded that they were at least comfortable using a computer and did so three or more hours a week. A majority thought that a computer could present material in a clear way and could accurately determine when they were having trouble with their work. Just over half agreed that a computer could give them the individual help they needed. Most of the students felt comfortable using a computer for games, social networking, and productivity tools. Over two-thirds of the students had a previous experience in which a computer was used to present instruction; most of these thought it was a positive experience. Nearly two-thirds of the students were positive about receiving instruction from a computer program, though there were comments wishing to have an instructor present.

Five main effects of computer-based instruction surfaced in response to the question, "How are students' perceptions of their abilities to perform basic algebra tasks affected by computer-based instruction?" Students believed they were affected because they were able to work at their own pace. They believed that that they could take as much time as was needed to learn a concept; thus they did not feel rushed and felt they would not get left behind. Because of this they felt less stress, were able to work at their knowledge level or ability, and were better able to learn and understand the topics presented. A second way the students were being affected was through learning on their own. They believed that doing the work helped them learn better and more, develop some responsibility for learning, and construct knowledge by discovering solutions for themselves. A third way the students were being affected was through being motivated by learning on a computer. They were motivated by the ability to complete required tasks ahead of time, the ability to see the progress they had made, the ability to work at their own pace, the feeling that they could not be left behind, and by the challenge of working at their own pace. A fourth way the students were being affected was through feeling less self-conscious. They felt less self-conscious because they did not need to ask questions in front of the class, and the computer was not judgmental of them and did not make them feel stupid. A fifth way the students were being affected was by learning more and better and retaining longer. The students felt they were learning more and better because they were doing the work necessary to learn the topics, were learning more on their own than they could from an instructor, had a better retention of what they learned because they learned it on their own, and must be committed to the learning process and want to understand.

Some students felt that computer-based instruction had not affected them positively. They did not think working at their own pace was positive and seemed to prefer having a schedule provided by an instructor. They felt that even though they may have moved faster, they were not learning as well and found themselves jumping around between topics when they were frustrated. There were students who felt that they were not learning as much because they felt a computer could not give as many explanations as a person could and were not being taught using their preferred learning style. An instructor was not giving the instruction, and they were scared by the thought of receiving instruction from a computer.

Chapter Five

Conclusions and Implications

Introduction

Society in the United States has long held the belief that to get a good job and be successful, one needs a good education. The current situation has gone beyond that to where workers need to upgrade their education in order to compete in a global market place, as was suggested by Friedman (2005). Statistics from the United States Department of Labor (2011) demonstrated that workers need to upgrade their education to get one of the new jobs in the global market place as well as remain in their current one. For many, to get a good education means first completing remedial coursework at the college level. Nationwide, 36 percent of incoming college freshmen need to take remedial coursework (Snyder & Dillow, 2011). This current study took place in two classes that were part of the remedial coursework many of these students were required to take.

The mastery learning theory of Carroll (1963) and Bloom (1968) is the model of learning used by the web-based instructional system ALEKS, which was used to present a majority of the instruction in these classes. One aspect of this theory was that with enough time, any student should be able to learn a given task. ALEKS is a self-paced system; therefore, students can take whatever time is needed to master the task. A second aspect of mastery learning theory is that for different students to all receive quality instruction there may need to be different types of instruction and instructional materials. In these classes, instruction was presented predominantly by the ALEKS system. Given that ALEKS can provide only one type of instruction, additional instruction was presented to the entire class once a week over topics a large number of students were ready to learn. Instruction was also presented on an individual basis whenever a student would ask for help.

This individual instruction aligns with a third aspect of the mastery learning theory, which states that a student's ability to understand instruction could be increased by modifying the instruction given in order to meet the needs of individual students. Mastery learning theory defines perseverance as the amount of time a student is willing to spend learning a task. The self-paced nature of ALEKS allows for students to spend as much time as they want to learn a concept. And for some, the option of finishing early motivated them to spend more time learning the concepts and completing tasks. According to the theory, as a student succeeds in attaining mastery the student's perseverance will increase. The display of topics learned in ALEKS allowed a student to observe the success that he or she had. Some students had reported this as being motivational as well. As a student worked through the topics in ALEKS, he or she was given immediate feedback pertaining to his or her answers to questions along with any needed explanations. According to mastery learning theory, this can reduce the perseverance needed.

Another aspect of mastery learning claims that for mastery learning to occur, a tutor should be provided for each student; ALEKS and the instructor were this tutor. Students were allowed to go at their own pace and were allowed to take different paths through the learning tasks as the theory suggests. They were allowed to select any topic to learn for which they had the prerequisite knowledge. Regular assessments are also a part of mastery learning; these were given to the students when they had completed a certain number of topics in a certain amount of time. These assessments assured the students who had mastered the tasks that their methods of learning were appropriate. For students who had not yet mastered the tasks, the assessments pointed out the areas where they still needed to work; these topics were removed from the list of topics they had learned and were placed on the list of topics that they still needed to learn. The ALEKS system follows all the aspects of mastery learning theory, therefore, if mastery learning is desired, ALEKS is a good candidate.

This study, which collected data from a variety of qualitative sources, focused on answering the following questions:

1. What are the various aspects of a computer-based basic algebra course for remedial students?
2. How are students' perceptions of their abilities to perform basic algebra tasks affected by computer-based instruction?
3. What are students' perceptions about having received verbal instruction from an instructor along with computer-based instruction?

In this chapter, I will show how this study is connected with the existing literature by presenting the outcomes that follow and the outcomes that differ from previous research in the area of computer-based instruction. The significance of the study and the particular issues that the study aimed to address in the instruction of remedial mathematics students are presented. I offer a discussion of my findings and describe their implications for instructing students in remedial mathematics. Some recommendations for future study that have surfaced as a result of this study will also be presented.

Connection of This Study with the Literature

The literature was a guide for the formulation of the various questions students responded to in this study. Therefore, the results of this study are highly connected to the studies cited. Questions were formulated in an attempt to achieve the same results as these studies; other questions were formulated in an attempt to show there is a difference between the present study and those cited.

One study cited investigated the effects of regular assessments in mastery learning. Boylan and Saxon (2005) found that mastery learning through web-based instruction was beneficial to remedial students because of the regular reinforcement provided by the testing. The ALEKS system gave assessments to students at regular intervals. Any topic that they had learned recently had the possibility of being assessed. There were also four comprehensive assessments given to the students during the semester that could contain questions over any topics they had previously mastered. These assessments provided beneficial reinforcement. If a student did not demonstrate mastery of a topic, it was removed from the student's list of mastered topics.

Another study revealed more connections between web-based instruction and mastery learning. The ALEKS system is one such system designed to accomplish the combination of web-based instruction with mastery learning. Kinney (2001) stated that web-based instructional systems like ALEKS could present problems in small units for the student to work in order to learn a topic. The ALEKS system has each concept divided into all the prerequisite steps needed and presents them to the student one step at a time. Kinney stated that if an assessment showed that a student has not reached the desired mastery level, the process can be repeated until a certain level of mastery has been achieved. ALEKS does this via the removal of topics that the student did not answer correctly from the list of topics the student had previously learned. Kinney also stated that web-based instruction could be used to allow students to proceed at their own pace and not that of the rest of the class or the instructors. Students who did not need as much instruction as others to reach a mastery level would be allowed the freedom to move more quickly while students who needed more time on a topic would be able to move more slowly through the material. Using ALEKS, students could do just that.

Utts, et al. (2003) stated that through web-based instruction immediate feedback on practice material and assessments could be given which could act as a guide for the students as they constructed their knowledge. The system could detect any misconceptions or miscalculations that a student had, and feedback could be given immediately on how to correct them. The ALEKS system did this by indicating to a student when he or she had answered a question incorrectly; the student could then get an explanation of the correct way to answer it.

The classes in this study were presented in the manner that is now being called “blended learning”. In blended learning there is an online component of instruction and a face-to-face component. The online component was the instruction that was presented through the ALEKS system; the face-to-face component was the instruction presented to the entire class over topics a large number of students were ready to learn as well as individual instruction given to students when they had a question.

Though nothing was done to determine the achievement and participation level of the students in this study, they appear to be similar to those in the study done by Akkoyunlu and Soylu (2006). There they observed that the views of the lower-achieving students reflected a desire for the instructor to do more of the presentation; they felt that their lack of success was tied to this. Students in the present study were not asked about their feeling of success, but many commented that they wished that there had been an instructor presenting more of the instruction. Akkoyunlu and Soylu further observed that the higher-achieving students felt that the website for the course had the content that they needed to succeed in the class. Similarly, there were students in the present study that felt that there was no need for the instructor to be presenting instruction, because they felt that the ALEKS system provided all the instruction they needed.

Burley, Butner, Anderson, and Siwatu (2009) found a similar characteristic when they examined the National Educational Longitudinal Study: 88/2000 dataset that was released by the National Center for Education Statistics in 2001. They found that “developmental math students tended to have a more external locus of control, making them more apt to attribute life’s successes and failures to concepts like luck” (p. 36). This may be a reason that the students in the present study preferred having an instructor present the material in a mathematics class. With an external locus of control, they may see their learning tied to an instructor giving a lecture and not to their own effort to understand. With an internal locus of control, they would have taken the responsibility, as many in the class did, to learn the material for themselves without needing the instructor to present all the information. The students who wanted an instructor for answering questions were still exercising internal locus of control.

As a result of their study, Utts, et al. (2003) felt that the role of the instructor should be that of a motivator and explainer; the instructor should be available to answer questions in a face-to-face setting, and the instructor's interaction with the students should involve material the students have already worked on and have questions about rather than provide instruction over material they have not covered yet. Many students in the present study agreed with this, but there were some students who felt that this was not needed, while there were others who wanted the instructor answering questions and presenting material that had not yet been covered. The Utts study involved interaction between student and instructor that was not face-to-face. There were no times during the class period in the present study when the instructor was not available. The only non face-to-face correspondence in the current study occurred when a student would send a message to the instructor at a time other than class time. Most of the correspondences of this type involved questions or comments about attendance rather than requesting help understanding a topic.

There have been studies that attempted to find a connection between having an instructor and not having one. Weems (2002) and Stillson and Alsup (2003) conducted studies comparing web-based instruction, where there were no lectures given by an instructor, to a traditional classroom. Both studies found that the passing rates of students in the web-based classes were lower than the traditional classroom. The present study made no comparison of pass rates between the semesters of the study and previous semesters. But based on my experiences as the instructor of the classes and one who has been teaching classes of this type for several years using a traditional lecture format, the pass rate was not any lower than it has been in previous semesters when the traditional format was used. In the Weems (2002) and Stillson and Alsup (2003) studies, students felt the need for some type of instructor interaction, with a lecture being the most requested from students. The present study found that a large number of students wanted the same thing. Some wanted the instructor to present a lecture, but most of these at least wanted the instructor to be there to answer individual questions.

The study conducted by Wuensch, et al. (2008) found that some students felt that online classes were superior to face-to face classes because of their self-paced nature. In the present study, the number one reason students gave for their belief that they were learning more with web-based instruction was the self-paced nature of the ALEKS system. Other students in the Wuensch study felt that online classes were inferior to face-to-face classes because of the limited amount of interaction they could have with the instructor and other students. In the present study, interaction between students and between students and instructor was not studied, but students repeatedly stated that they thought the ability to interact with the instructor, whether through listening to a lecture given by the instructor or through individualized assistance from the instructor when they had a question, was very important. Online classes and face-to-face classes were never compared in the present study, but some students stated that the self-paced nature of ALEKS was superior to their previous classes and that they also appreciated the individualized help they received that they may not have gotten in a traditional class.

There have been different implementation models using the ALEKS system. One of the things the present study aimed to determine was the instructor's role in a class that uses ALEKS. Hagerty and Smith (2005) and Stillson and Alsup (2003) used the ALEKS system to supplement regular lectures. Their results showed that, though the students may have done just as well using this approach, they did not feel that the things they were learning in the lectures and on ALEKS were the same. Tests for the course were given over material covered in the lecture, which was based on the textbook used for the class and not on the material presented in ALEKS. Even though many instructors try to use ALEKS along with a lecture from a textbook, this may not be the best use of it. Students expressed that they liked the self-paced nature of ALEKS; therefore it should not be tied down to a textbook for use in a class. The best use of ALEKS is with an instructor available to answer questions that arise from students' interaction with the content presented in ALEKS and possibly to present occasional lectures over topics presented in ALEKS.

Conclusions

The students in this study fell into three general categories: students who did not require or want any instruction from an instructor, students who wanted the instructor to give instruction on every topic, and students who wanted the instructor to give some instruction whenever they felt they needed it on an individual basis only. Their perceptions presented in this study were influenced greatly by these categories.

Answers to research questions. One of the questions addressed in this study was, "How are students' perceptions of their abilities to perform basic algebra tasks affected by computer-based instruction?" Based on this study, students' perceptions of their abilities to perform basic algebra tasks are, for the most part, affected positively by computer-based instruction. Their abilities are increased because they are working at their own pace, because they are learning on their own and developing ways of learning for themselves, because they are more motivated by it, because they are not as self-conscious about asking questions, and because they are learning more and retaining it longer since they are more active in the learning process. These attitudes tended to go with the category of students wanting limited instruction from an instructor. Students preferring a high amount of instruction presented by the instructor do not have these positive perceptions of effects on their abilities. These students feel that they could have learned more if an instructor had been in charge of the class giving instruction and guidance.

A second question addressed in this study was, "What are students' perceptions about having received verbal instruction from an instructor along with computer-based instruction?" The data used to answer this question in particular revealed the three categories of students mentioned above. The students who believe they do not want and do not need an instructor want to take advantage of the self-paced nature of computer-based instruction: therefore their perceptions of receiving instruction from an instructor along with computer-based instruction may be slightly negative. In their view, this instruction was a waste of time. In contrast, the students who expressed that they wanted the instructor to give instruction on every topic do not believe that they received enough instruction. They perceive that they learn better when the instructor presents instruction to the entire class. They would have preferred not having the computer-based instruction at all; therefore, their perceptions were also negative. Students in the third group expressed a desire to receive instruction from both the computer and the instructor. These students expressed varying degrees of positive perceptions about having received verbal instruction from an instructor along with computer-based instruction. Some of them liked having an occasional lecture to the entire class, while all of them were positive about having the instructor present to answer questions on an individual basis.

It was my observation that although a majority of the students in these classes indicated that the instructor's lectures were helpful, most of them were not listening when one was given. Rather, they were busy working on their computers. The students were not required to pay attention to the lectures and stop working on the computer, so it was optional and intended for those who wanted help on a topic they were ready to learn. At times it seemed as though no one was listening, so the lecture was cut short for that day with no one requesting further explanation of the topic. It was also my observation that after I had talked about a topic that a large number of students in the class were ready to learn, very few of them actually worked on that topic. Even though I might have sent them a message indicating I would be talking about a topic they were ready to learn, many chose not to listen and chose to work on topics they wanted and not on the topics I had explained in class. Even among those who chose to listen to the discussion I gave, many did not work on the topic in the time following the instruction. Thus students may say they want the lectures, but they do not seem to be interested in taking the time to listen and work through the topics presented in the lecture.

Recommendations for best uses. Based on the findings of this study, the best use of the ALEKS system is in a class where the instructor is present to answer individual questions. This way, students who want to work at their own pace may do so. Students who want to move more quickly through the content can go at the pace they want, and students who want to spend more time on a particular topic can take as much time as they need. Presenting topics to the entire class may not be the best approach because students may not be ready to learn the same topics and may choose to do different topics than what is presented by the instructor. Also, the best way to use the ALEKS system is in a class where all the students are able and willing to learn on their own. Where this is not the case, the instructor can present occasional topics to the entire class that will assist those who want the instructor lectures.

The result of this study that applies specifically to a remedial mathematics class using the ALEKS system is that a class of this type is best if the students in it are able to learn on their own and do not feel the need to have an instructor presenting instruction to the entire class. These students only need a refresher of the things they have previously learned. In this setting, the students will be able to move at a pace they choose. As a motivation to work quickly, there should be some incentive for finishing early. The instructor would be present in the class to answer individual questions and give encouragement to the students.

The results of this study have implications for online learning in general. There are some students who do not need an instructor to provide instruction or to answer questions. For these, online learning may be a very useful option. For the remaining students, however, the need to have access to someone who is available to answer questions and give further instruction as needed is important. And as the Wuensch, et al. (2008) study pointed out, this person needs to have face-to-face contact with the students, not simply contact via email.

Limitations of This Study

There were limitations in this study based on the number of participants that chose to be included in the study. The sections of Basic Algebra that were used in the first semester of this study started with 56 students with only 19 choosing to participate. Thus there were only a small number of participants upon which the conclusions were based. Significant statements were made throughout the semester by students that were not participating that could not be included in this study. The number of participants decreased as the semester progressed due to students withdrawing or being withdrawn. Of the 19 students choosing to participate, four did not finish the class. The second semester of the study consisted of a final survey only. Thus there was no attrition of participants. But the sections started with 58 students and by the time the survey was given, 10 students had withdrawn or were withdrawn and 15 students had finished early. This reduced the pool of potential participants to 33, of which 30 chose to participate. The students who did not finish the class in both semesters and those who finished early would have had a unique perspective on the method of instruction used in this study and their responses could have possibly added new dimensions to the results. The method of instruction may have influenced their choice to withdraw from the class or provided a means to finish the class early. An email message was sent to the students who had finished early during the second semester asking them to take the survey, but none responded.

Recommendations for Future Study

Many students in this study believed that they learned not only more but also better because they were learning for themselves. Have these students developed habits or strategies for learning that have aided them in learning what they did in this class? And if they have developed habits or strategies, will these carry over into future coursework? Will these habits and strategies provide them capacity for success in classes where there is a traditional lecture with written homework, or do these only help in self-paced online classes? All of these students will be required to take a general education mathematics class after they have completed this class. Do the students who used ALEKS for their remediation perform better in their future classes than students who took a traditional class for remediation?

There are some students who excel using ALEKS and quickly move through the topics presented to them without any help from an instructor. Many of the students are able to complete the required material ahead of the rest of the class. There are also students who do not do very well using ALEKS because of the lack of instruction and guidance provided by an instructor. These students struggle when required to learn the topics by simply reading an explanation. What are the factors that differentiate these two groups? Are there factors that will allow a student to be placed in a class where he or she will perform the best?

In a web-based setting such as ALEKS, instruction is usually presented in a print format only requiring the student to read everything. Many students, who need remediation, do so in more than one discipline and perhaps even struggle in reading. Do students who need remediation in reading as well as mathematics perform worse than students who do not need remediation in reading in computer-based or web-based learning environments? Do students who need remediation in both these areas perform better in a traditional classroom where instruction is given orally?

It was interesting to note that the majority of responses stating that instruction should come from an instructor only came from the surveys given in the classes during the second semester of the study, which was the fall semester. Are the students in the fall and spring semesters similar with respect to their ideas of the role of an instructor, as was assumed? Do students who have recently come from a high school setting have different attitudes toward the role of an instructor than do students that have been in a university setting for at least one semester?

Summary

The instruction presented in the classes used for this study came from the web-based ALEKS system and me, as the instructor of the class. This method of instruction was shown to follow the theory of mastery learning. This conclusion followed the results given in various studies cited. It was noted that there were students in this study that demonstrated the same feelings as those presented in other studies when they tied their success, or lack of success, to an instructor's presentations to the entire class. Several of the studies cited indicated that students wanted an instructor present. The present study came to the same conclusion, with the difference being that some of these students wanted instruction before they attempted a topic.

Several conclusions were drawn from this study. One was that students' perception of their abilities to perform basic algebra tasks are affected positively by computer-based instruction if they are able to learn on their own without an instructor providing all the instruction. Another conclusion was that students' perceptions about having received verbal instruction from an instructor along with computer-based instruction are also tied to their ability to learn on their own. Those that can learn on their own and those who want a significant portion of the instruction from an instructor do not think that both should be given, while students who want the instructor to answer questions and give some instruction like receiving both. A third conclusion was that even though many students asked for instruction to the entire class, very few took advantage, therefore it is not best to do so. The overall conclusion of this study was that web-based or online classes should have an instructor available to answer questions and give further instruction as needed. Having the instructor present with the students is the best approach. Also, this type of instruction in remedial classes should be used only with students who are able to learn on their own without an instructor giving a majority of the instruction.

Some recommendations for future study were also given. One would be a follow-up study to determine lasting effects of this type of instruction. Another would seek methods to determine a student's success with this type of instruction.

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Appendices

Appendix A

Course Information

IMPORTANT CLASS INFORMATION – SPRING 2010

Course: MATH 0124 Basic Algebra

Text: ALEKS

Instructor: Ron Koehn
Office: 324C CAM
Phone: 774-7119
Email: ron.koehn@swosu.edu

Office Hours: M-F 10:00-11:00, 2:00-3:00
(Or by appointment)

Attendance:

Class attendance is very important for the completion of this class. If you have more than 5 absences, you may be administratively dropped from this class and receive a W on your transcript. Attendance will be taken at the first of each class period. If you are not in class when attendance is taken, you will be counted absent. There are no "excused" absences.

Grading Procedures:

All work and assessments for this class will be completed on ALEKS

Your grade for the class will be based on the number of topics completed in ALEKS.

There will be 4 scheduled in class progress assessments on ALEKS. The dates for these assessments are:

- January 29
- February 19
- March 12
- April 9

Other assessments may also occur. These may occur after 20 new items have been learned (but no sooner than 5 ALEKS hours after the last assessment) or after 10 hours have been spent in Learning Mode since the last assessment.

A final assessment for this class will be a comprehensive assessment and will occur on April 30.

The following is a suggested learning rate giving the minimum number of topics that should be learned in order to pass the class.

February 5 – at least 56 topics
March 4 – at least 94 topics
April 8 – at least 112 topics
April 30 – at least 131 topics

A minimum of 5 hours per week on ALEKS is required. Your final number of topics completed will be reduced by the number of weeks that you have not met the 5 hour requirement.

A journal with weekly entries about your experiences involving ALEKS and the class presentation will also be required. These will be collected on the following dates.

February 5
March 5
April 9
April 27

Your total number of topics will be increased by one on each of these dates if you have the required weekly entries.

Grading scale:

Only grades of Satisfactory or Unsatisfactory will be given. To receive a grade of Satisfactory, you must complete 70% (131) or more of the topics.

Early completion:

Anyone who completes all the topics for the class and retains at least 90% (168) of the topics after an in class comprehensive assessment has completed all the requirements for passing the class and will no longer be required to attend.

April 2 is the last day to drop the class with an automatic W on your transcript. If you drop the class after that date, you will receive either a withdrawal satisfactory (W/S) or a withdrawal unsatisfactory (W/U) depending on your grade at that time.

If any member of the class feels that s\he has a disability and is in need of special academic accommodations, the instructor will work with you and Student Services in order to provide reasonable accommodations. This will help ensure that you have an equal opportunity to perform in this class. Please advise the instructor of such disability at some point before, during, or immediately after the first scheduled class period.

Appendix B

Basic Algebra Student Survey

1. Which of the following best describes your overall comfort using a computer? Check one.
   ___ Not comfortable at all
   ___ Somewhat comfortable
   ___ Comfortable
   ___ Very comfortable
   ___ Extremely comfortable

2 How much time do you spend using a computer during an average week? Check one.
   ___ Never
   ___ Less than 1 hour
   ___ 1 – 3 hours
   ___ 3 – 5 hours
   ___ More than 5 hours

Please indicate the degree to which you agree or disagree with each statement below by circling the appropriate letters to the right of each statement.

(SA=Strongly Agree, A=Agree, D=Disagree, SD=Strongly Disagree)

3	A computer can present material in a clear way.	SA	A	D	SD
4	An instructor can give the individual help I need.	SA	A	D	SD
5	A computer can accurately determine when I am having trouble with my work.	SA	A	D	SD
6	An instructor can present material in a clear way.	SA	A	D	SD
7	An instructor can accurately determine when I am having trouble with my work.	SA	A	D	SD
8	A computer can give the individual help I need.	SA	A	D	SD

Describe your level of comfort in using a computer for the following:

9. Playing games

10. Social networking

11. Finding information of the internet

12. Using productivity tools (word processor, spread sheet, etc.)

Please answer the following with as much detail as possible. If you need more space, please continue on back.

13. Have you had any previous experience where a computer was used to present instruction?

14. If you have had previous experience, describe how this was conducted and what you felt about this form of instruction.

15. What are your initial thoughts about receiving instruction from a computer to learn Basic Algebra?

16. Why do you agree or disagree with the following statement: "Computers and web-based instruction are an effective way to present instruction in Basic Algebra."

17. What would your initial reaction be if you were to learn that the majority of the instruction for this Basic Algebra class would come from a computer?

18. Describe why you think a computer might be better to present instruction in Basic Algebra than a person.

19. Describe why you think a person as an instructor might be better to present instruction in Basic Algebra than a computer.

20. If part of the instruction in Basic Algebra was presented by a person and part was presented by a computer, what percent should be presented by each and why do you think it should be this way?

21. How do you think your abilities to perform basic algebra tasks would be affected if you received instruction from a computer?

22. How do you think your abilities to perform basic algebra tasks would be affected if you received instruction from an instructor as well as from a computer?

Appendix C

Weekly Journal Questions

Week 1
What are your initial impressions of this class?
How do you think ALEKS will affect the way you learn Basic Algebra?
What suggestions would you have for improving this class, based on what you know right now?

Week 2
How does learning from ALEKS compare with learning from an instructor?
How does the amount you have learned already using ALEKS compare with the amount you would have learned in the same amount of time in a regular class that had an instructor presenting the material?
If there is a difference, why do you think there is one?

Week 3
Describe a resent experience you have had using ALEKS and the things that helped you learn a topic, such as the explanation given on ALEKS, help given by another student/friend, individual help given by Mr. Koehn, instruction given to the entire class by Mr. Koehn, or anything else that helped you. You may give as many experiences as you wish.

Week 4
Describe why you think a computer might be better to present instruction in Basic Algebra than a person.
Describe why you think a person as an instructor might be better to present instruction in Basic Algebra than a computer.
How have your ideas on this changed because you were in this class?

Week 5
What should the instructor's role be in a class using ALEKS – someone who gives instruction to the entire class, someone who is there to answer questions on an individual basis, or someone who does not need to be there? Why do you think that? How can the instructor carry out this role?

Week 6
Tell me how you learn mathematics on the computer. Can you read an explanation once and know how to do it? Do you need to read it several times? Do you stop and think about what you have read before you understand it? Do you have to work several problems before the explanation begins to make sense? Do you need to have someone tell you how to do it in order for it to make sense? What other things are involved?

Week 7
Which might be more helpful with ALEKS, a person explaining various topics to the entire class or a person explaining topics to individuals when they have questions? Why do you think that?
Week 8
How do you think your ability to solve problems in Basic Algebra is being affected by computer-based instruction?

Week 9
How do the explanations that ALEKS gives compare with the explanations a person might give over the same topics? Give some examples if possible.

Week 10
Do you think you are more or less motivated to learn Basic Algebra because you are using a computer? What things are affecting your motivation?

Week 11
Do you think that reading an explanation is enough to learn a topic or does there need to be something else? If there needs to be something else, what is that? Do you find that you need to reread explanations? If so, how does rereading the explanation help you understand? Give some examples for any or all of these questions, if possible.

Week 12
Do you think that reading an explanation is enough to learn a topic or does there need to be something else? If there needs to be something else, what is that? If you have to read an explanation more than once, how does rereading the explanation help you understand? What things do you look for as you read the explanation?

Week 13
Do you think you can get more customized instruction from a computer or a person? How important is that to you? Do you think you get more different explanations from a computer or a person? How important is that to you?

Week 14
Your next math class will most likely not be on a computer like this class was. How do you think the method this class was presented will help you or hurt you then? How do you think the amount you learned in this class with the method the topics were presented would compare with a class where the teacher lectured all hour and you had written homework and tests?

Appendix D

Final Survey Questions

1. Do you feel that your understanding is better when using ALEKS and the computer than in a face-to-face class?

2. What aspects of this class have helped you understand Basic Algebra? How do these help you understand?

3. What are your ideas now about receiving instruction from a computer? How have these changed from the beginning?

4. Do you feel that since you have been using ALEKS you have had to teach yourself everything in this class? Is that a good or bad thing? Why do you feel that way?

5. How do the following affect your motivation in learning Basic Algebra on a computer: It is a new way to learn math, it makes learning more challenging, it allows me to work at my own pace and not get left behind?

6. Which of these methods of conducting this class would help you the most to learn Basic Algebra?
    1. An instructor giving daily presentations to the entire class and ALEKS used only as homework.
    2. All instruction coming from ALEKS and an instructor only answering individual questions.
    3. An instructor occasionally giving presentations to the entire class over a topic a large number of students are working on in ALEKS with the majority of instruction coming from ALEKS.

    Why do you think this would help the most?

7. Do you think having to learn on your own has been a good thing or a bad thing? Why do you think that?

8. How do you think your ability to solve problems in Basic Algebra is being affected by computer-based instruction? Do you think it would be different if an instructor was presenting the topics? If so, how would it be different?

9. How helpful has it been to have an instructor presenting an explanation of a topic to the entire class?

10. Do you think you are learning more and remembering it better because you have to learn it by yourself? Why or why not?

11. Do you think you have learned more or less in this class than you would have in a traditional class? What things caused that to happen?

Appendix E

Basic Algebra Student Survey

1. Describe why you think a computer might be better to present instruction in Basic Algebra than a person.

2. Describe why you think a person as an instructor might be better to present instruction in Basic Algebra than a computer.

3. If part of the instruction in Basic Algebra was presented by a person and part was presented by a computer, what percent should be presented by each and why do you think it should be this way?

4. Do you feel that your understanding is better when using ALEKS and the computer than in a face-to-face class?

5. What aspects of this class have helped you understand Basic Algebra? How do these help you understand?

6. What are your ideas now about receiving instruction from a computer? How have these changed from the beginning?

7. Do you feel that since you have been using ALEKS you have had to teach yourself everything in this class? Is that a good or bad thing? Why do you feel that way?

8. How do the following affect your motivation in learning Basic Algebra on a computer: It is a new way to learn math, it makes learning more challenging, it allows me to work at my own pace and not get left behind?

9. Which of these methods of conducting this class would help you the most to learn Basic Algebra?
    1. An instructor giving daily presentations to the entire class and ALEKS used only as homework.
    2. An instructor occasionally giving presentations to the entire class over a topic a large number of students are working on in ALEKS with the majority of instruction coming from ALEKS.
    3. All instruction coming from ALEKS and an instructor only answering individual questions.

    Why do you think this would help the most?

10. How do you think your ability to solve problems in Basic Algebra is being affected by computer-based instruction? Do you think it would be different if an instructor was presenting the topics? If so, how would it be different?

11. How helpful has it been to you to have an instructor presenting an explanation of a topic to the entire class?

12. Do you think you are learning more and remembering it better because you have to learn it by yourself? Why or why not?

13. Would you rather ask a question about something that you don't understand after you have been working on it or have the instructor give a lecture on how to do it before you try it? Why?

14. Do you think you have learned more or less in this class than you would have in a traditional class? What things caused that to happen?

15. Do you think that Basic Algebra could be successfully taken as a class that was totally independent and never meeting as a class? If it was offered as an independent class, what things would you think would be necessary for you to pass it?