THE EFFECTS OF ARCS-BASED CONFIDENCE STRATEGIES ON LEARNER CONFIDENCE AND PERFORMANCE IN DISTANCE EDUCATION

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The purpose of this research was to manipulate the component of confidence found in Keller's ARCS model to enhance the confidence and performance of undergraduate students enrolled in an online course at a Texas university using SAM 2003 software delivery. This study also tested whether the aforementioned confidence tactics had any unintentional effect on the remaining attention, relevance, and satisfaction subscales of the ARCS model as well as on learners' overall motivation for the class and the instructional materials.

This study was conducted over a 5.5-week period with an initial sample of 81 total students. Two quantitative surveys were used to measure confidence and motivation: (a) the Course Interest Survey (CIS), and (b) the Instructional Materials Motivation Survey (IMMS).

The results indicated that the treatment group showed statistically greater gains than the control group in terms of learner confidence on the CIS but not the IMMS. In terms of performance, the treatment group outperformed the control group on all of the individual posttest measures and on the overall aggregate mean performance score.

The results showed no statistically significant difference on the attention subsection of the ARCS model. However, statistically significant differences were noted for the relevance and satisfaction subscales of the model. There was also a statistically significant difference in overall learner motivation as measured on both surveys.

This research study suggests the feasibility of improving overall learner

motivation and performance through external conditions such as systematically applied confidence tactics. The research further supports claims about the effectiveness of the ARCS model as a viable tool for enhancing online learner motivation and performance. What was unclear in this study was whether individual subsections of the ARCS model, such as confidence, can be independently manipulated.

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Lastly, to J. Alfred Prufock: Are the mermaids singing to you now, J. Al?

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CHAPTER 1

INTRODUCTION

Context of the Problem

The Distance Education and Training Council (DETC) listed distance education as a "mainstream" educational delivery method and predicted more than a 300% increase in terms of students served in the next five years (DETC, 2004). According to a 2004 National Center for Educational Statistics report, "In 2000–01, 56 percent of all postsecondary institutions offered distance education courses, up from 34 percent 3 years earlier" (p. 9). The report went on to state that distance education course enrollments continued to rise with more than 3.1 million students enrolled by 2001—an increase of more than a million and a half students from the 1997-98 school year. The report also indicated that such explosive growth shows no signs of stopping (NCES, 2004). According to Ashby, by 2002, more than 84% of four-year institutions were offering distance education courses (2002). By most accounts, these numbers will continue to rise (DETC, 2004; Huett, Moller, & Young, 2005; NCES, 2004).

With such exponential growth, researchers are examining all aspects of the distance learning environment to determine what approaches, methods, and technologies are most appropriate and effective. However, the quality of many distance education initiatives can be seen as poor, with development "often undertaken with at best only a token consideration of institutional, logistical, and instructional needs" (Prestera & Moller, 2001, p. 4). When considered at all, instructional needs often take a backseat to institutional and logistical needs in distance education. More instructional

studies are needed, and one particular area that must be explored concerns what motivates and inspires the distance learner (Moller et al., 2005; Song, 2000).

Motivation is a critical component to learning (Keller, 1979, 1987a, 1987b, 1987c; Means, Jonassen & Dwyer, 1997; Song & Keller, 2001). Means, Jonassen, and Dwyer (1997) cited studies showing that motivation accounted for 16% to 38% of the variations in overall student achievement. Keller (1999a) noted that self-directed learning environments, like distance education classes, posed greater challenges to learner motivation than their face-to-face counterparts. Song and Keller (2001) advised that continued problems with learner motivation in Web- or site-based computer-assisted instruction (CAI) were often the result of incorrect assumptions on the part of instructional designers that motivation, if taken into account at all, was assumed to be already present in the CAI.

To stimulate and manage student motivation to learn, Keller (1979, 1987a, 1987b) created the ARCS model of motivation. "ARCS" stands for attention, relevance, confidence, and satisfaction and serves as the framework for the confidence-enhancing tactics found in this study. The ARCS model is an attempt to synthesize behavioral, cognitive and affective learning theories and demonstrate that learner motivation can be influenced through external conditions (Moller, 1993). Keller's ARCS model is discussed in detail in the Keller's ARCS Model subsection of Chapter 2.

Keller's ARCS model (1979) lists confidence (expectancy for success), along with attention, relevance, and satisfaction, as one of four general subsections that must be considered to influence student motivation to learn. Within the larger framework of confidence, Keller provides three components that can be manipulated to reduce a

sense of helplessness and increase learner confidence: learning requirements, success opportunities, and personal control.

The purpose of this research was to manipulate the components of confidence found in Keller's ARCS model to enhance student confidence and performance in online learning using SAM 2003 (see Operational Definitions subsection) software delivery for the treatment group. ARCS-based confidence-enhancing email messages (CEE) were also created and distributed thorough the WebCT Campus Edition™ software* (version 3.8). The intent of the CEEs was to communicate and to reiterate the specific confidence tactics (see Table 4) designed to improve learner confidence and performance in the treatment group.

Problem Statement

Distance education environments provide unique challenges for instructors/designers who wish to motivate their students. Song and Keller (2001) noted that with the widespread use of computers in education, one could no longer depend on the "novelty effect" of technology to stimulate learner motivation. Though few would disagree that motivation is an important aspect of learning, there is a noted lack of research concerning the motivational needs of learners (Astleitner & Keller, 1995; Gabrielle, 2003; Means, Jonassen & Dwyer, 1997; Shellnut, Knowlton & Savage, 1999; Visser & Keller, 1990).

Motivation is "the length and direction of effort expended by the learner in pursuit of achievement" (Moller et al., 2005, p. 139). Keller and Burkman (1993) acknowledged that motivation is often thought of as solely a product of learner personality and

* Blackboard, Inc., http://www.blackboard.com

perceptions—much of which is assumed beyond the control of the instructional designer. However, they believe that providing for motivation *is* largely the responsibility of the designer. Additionally, they feel that motivation is a systematic process that must be considered during all stages of design. One cannot rely strictly on the presumed entertainment value of the instructional materials to provide motivation.

Means, Jonassen, and Dwyer (1997) called Keller's ARCS model the "only coherent and comprehensive instructional design model accommodating motivation" (p. 5). If this is the case, it stands to reason that more research needs to be done concerning the ARCS model. Within the ARCS model, confidence (the focus of this study) can be increased according to Keller (1987a, 1987b) by examining learning requirements to give students knowledge of what is expected of them. Confidence can also be increased by providing for success opportunities that are meaningful, are challenging, bolster achievement, and avoid boredom. Lastly, to improve confidence, Keller advocates a sense of personal control where the learner is allowed as much control of the learning experience as possible.

Keller (1987a) defined confidence as "helping the learners believe/feel that they will succeed and control their success" (p. 2). Confidence is the interplay between learners' desire for success and their fear of failure (Keller, 1987a). These opposing forces vie for control of the learning experience. Keller and Suzuki (1988) listed the three most important dimensions to confidence: perceived competence, perceived control, and expectancy for success. This parallels and complements the aforementioned components of confidence: learning requirements, personal control, and success opportunities.

Confidence is about self-perception: perception of one's abilities and perception of one's control within the learning context. In terms of self-perception, if the challenge in the learning environment is too great, anxiety and a sense of helplessness may result, and confidence and effort may wane. If the degree of challenge is too low, boredom may set in and learners will not perform at their highest level. Students with a poor perception of their abilities may become anxious and perform less well than their counterparts with higher confidence in their abilities (Naime-Diefenbach, 1991).

Confidence is also about the perception of control. This relates to locus of control. When learners believe that the effort they expend and the choices they make directly relate to the consequences and outcomes of those efforts and choices, they feel more confident (Bandura, 1977; Keller & Suzuki, 1988). This fosters a higher internal locus of control and a greater sense of self-pride and accomplishment (Moller, 1993). In contrast, learners who believe luck or other uncontrollable outside forces are in charge of their successes or failures tend to feel more helpless, feel less confident, and perform at lower levels: "Features in the instruction that promote feelings of personal control over outcomes will help develop confidence and persistence" (Keller & Suzuki, 1988, p. 405). This concept of control may be particularly relevant to distance learning environments. Roblyer (1999) found that students who chose distance education classes over face-to-face classes often did so out of a greater desire or need for control over their own learning outcomes.

Expectancy for success is also a key component of confidence. To be motivated, learners need a reasonable assumption of success (Naime-Diefenbach, 1991). This is related to the concept of the self-fulfilling prophecy (Jones, 1977; Keller & Suzuki, 1988;

Naime-Diefenbach, 1991). In education, a learner may have particular expectations or beliefs that actually influence outcomes. For example, if the learner believes she will be successful at a given task, such belief may result in greater effort expended; this, in turn, improves success. In general, Keller (1987a, 1987b) calls for increasing confidence by providing for success opportunities that are meaningful, provide adequate challenge, bolster achievement, and avoid boredom.

There is a need for more research regarding improving learner confidence in face-to-face and online environments (Moller, 1993; Moller & Russell, 1994; Visser, 1998). There is support in the research for the need of this experiment as well as the methods being used. Moller and Russell (1994) used the confidence strategies of Keller's ARCS model to develop confidence tactics for 66 graduate and undergraduate students using printed, self-instruction materials. They found that the strategies produced no evidence of an increase in learner confidence. However, because of the unknown nature of ARCS confidence-building strategies, they deemed further research into the matter "imperative" (p. 67). In an article concerning motivational issues in Web-based instruction (WBI), Song (2000) found "there is a need to explore motivational issues and suggest critical areas of research on motivation in WBI" (p. 225). Chacon-Duque (1987) cited online learners' lack of confidence as a clear reason why learners drop out of distance education classes. Similarly, in a case study at the Department of Instructional & Performance Technology at Boise State University, Chyung (2001) used Keller's ARCS model to address online learners' dropout rates and found that student dissatisfaction with online learning was directly tied to low confidence levels regarding learning at a distance. Shellnut, Knowlton, and Savage (1999) also detailed how Wayne

State University applied Keller's ARCS model to increase learner confidence in computer-based instruction modules for a college engineering course in economics.

In a review of the existing literature concerning learner motivation and E-learning design, Keller and Suzuki (2004) claimed to have established "the validity of this model [ARCS] for the systematic design of motivationally enhanced instruction in E-learning settings with regard to lowering drop-out rates and other positive motivational outcomes" (p. 229). For clarity, Keller and Suzuki used e-learning "to refer to almost any learning environment in which electronic media, such as computers, are used as a component of an instructional delivery system" (p. 230).

However, with new, improved, and extensively used CAI delivery systems, such as SAM 2003, comes the need to explore just how the ARCS principles can be systematically applied to improve learner confidence and overall performance.

This study also sought to increase learner confidence and performance through communication with the learner by way of ARCS-based confidence-enhancing emails. These emails were used to help facilitate communication of the confidence tactics (see Table 4). There is support for the efficacy of such messages in the literature as well. In a study of adult students in Mozambique, Visser and Keller (1990) delivered ARCS-based motivational messages to students and showed improvement in motivation. Keller and Suzuki (2004) cited a 1998 report by Visser outlining a 70-80% improvement in retention rates of distance learners when motivational messages based on the ARCS model were used. Visser, Plomp, and Kuiper (1999) used the ARCS model as a guide for developing motivational communications with distance education students. They found that such motivational support "considerably increased the completion rates of

students" (p. 410). They also found no statistically significant difference between the use of mass messages versus personalized messages and recommended using mass messages to increase "the chance of successful implementation" (p. 410). Gabrielle (2003) used Keller's ARCS model and Visser's motivational message support system (MMSS) as the basis for interventions and mass messages designed to improve learner motivation and performance in a study of undergraduate students in a public military school. She found statistically significant differences between the groups regarding motivation, academic performance, and self-directed learning and added that strategies based on Keller's ARCS model were worthy instructional design considerations.

Specifically, the research questions that were explored:

1. Will incorporating ARCS-based confidence tactics into WebCT and the SAM 2003 software improve learner confidence in the treatment group?
2. Will incorporating ARCS-based confidence tactics into WebCT and the SAM 2003 software improve learner performance in the treatment group?
3. Since no intentional effort was made to enhance the attention, relevance and satisfaction components of the ARCS, will the confidence tactics used in this study produce any unintentional statistically significant differences in the scores of the remaining ARCS subsections of attention, relevance, and satisfaction?
4. Will the confidence tactics used in this study produce statistically significant differences between the control group and the treatment group in terms of overall learner motivation as measured by the ARCS total score on the Course Interest Survey (CIS) and Instructional Materials Motivation Survey (IMMS)?

Purpose of the Study

The purposes of this research were to: (a) determine if there were statistically significant differences in confidence levels of online learners using systematically designed confidence tactics based on Keller's ARCS model; (b) determine if said tactics

also produced a statistically significant difference in academic performance; (c) determine if said tactics also produced a statistically significant difference in the remaining ARCS subsections of attention, relevance, and satisfaction; and (d) determine if said tactics also produced a statistically significant difference in overall learner motivation as measured by the total ARCS score.

Two surveys were used in the study to collect and to analyze quantitative data on confidence and motivation: (a) the CIS, which was designed by Keller to gauge student motivation related to the course being taught; and (b) the IMMS, also developed by Keller and based on the ARCS model. The IMMS gauges the motivational effect of instructional materials. Performance was measured based on posttest scores automatically generated in SAM 2003. A detailed discussion of the instruments used in this study can be found in the Instruments subsection of Chapter 3.

In summary, the intent of this study was to increase online student confidence and performance through the careful and systematic application of ARCS-based confidence-enhancing tactics.

Research Hypotheses

H_o1 There will be no statistically significant differences between the control group and the treatment group in terms of learner confidence.

H_o2 There will be no statistically significant differences between the control group and the treatment group in terms of learner performance as based on posttest scores automatically generated in SAM 2003.

H_o3 There will be no statistically significant differences between the control group and the treatment group in terms of the remaining ARCS subsections of attention, relevance, and satisfaction.

H_o4 There will be no statistically significant differences between the control group and the treatment group in terms of overall motivation as measured by the total ARCS score.

Limitations of the Study

1. According to Gall, Gall, and Borg (2003), the posttest-only design used in this experiment carries with it three caveats: (a) random assignment may not be completely successful in eliminating all differences among the treatment and control groups; (b) individual differences at different levels of the variables cannot be measured; and (c) if attrition is a factor in the study, differences on the posttest may be attributable to characteristics of the dropouts and not the experimental treatment. Attrition was not a significant factor in this study.

2. Multiple tactics were applied in the study in the form of confidence enhancements. With the design of this study, it is not possible to ascertain, with certainty, if one tactic was more effective than another.

3. Students entered the course with differing levels of experience or expertise with Microsoft® Office 2003 software[*] (and with technology in general), and this might have had an effect on confidence and performance. However, random sampling of the subjects helped to control for this variable. Also, SAM 2003 simulation of Microsoft Access was used for the duration of this experiment, since three past surveys of students and a survey of the current participants indicated that Access was the program with which they were the least familiar.

4. This experiment was conducted in the context of a for-credit course, and students were given class credit for completing assignments used in this experiment. Since this was a required course, it is unknown what, if any, motivating effects the pursuit of grades had on this study.

5. There was the potential for contamination of the control and experimental groups. Since this experiment was delivered at a distance via the Web, there was no way to predict the relationships among the participants, and there was no guarantee that the populations did not come into contact with each other in social or academic situations. However, there was no reason to suspect that they did.

6. Additionally, with Web-based delivery there was no guarantee that students were completing the work on their own; however, this has not been a noted issue for this course over the past two years. SAM 2003 does require individual login names and passwords as well specific software that must be installed on the individual user's machine. Students were informed of the school's academic

[*] Microsoft, Corporation, www.microsoft.com

dishonesty policy, and, for the purposes of this study, academic honesty was assumed.

7. There are studies that suggest that increasing student confidence, motivation, and performance may require more time to show statistically significant results than was provided in this study.

Significance of the Study

Motivation is a highly important yet under-researched aspect of learning. An extensive review of the literature leads one to concur that there is a noted lack of research concerning the motivational needs of learners (Astleitner & Keller, 1995; Gabrielle, 2003; Means, Jonassen & Dwyer, 1997; Shellnut, Knowlton & Savage, 1999; Visser & Keller, 1990). This is particularly true in terms of computer and Web-based instruction. In an in-depth study of the proceedings of the World Conferences of the International Council for Distance Education from 1988 to 1995, Visser, Plomp, Amirault, and Kuiper (2002) found that only six of 801 studies addressed motivational concerns of online learners. They also noted that a disturbing "trend in the lack of attention paid to motivation in distance education is present in some of the recently published specialized handbooks in the field of distance education" (p. 95).

Traditional distance learning models stress learner independence (Downs & Moller, 1999; Moore, 1989) and increased privatization of the learning environment (Keegan, 1986; Moller et al., 2005). Such student-centered, independent learning requires a strong sense of motivation and confidence. The literature has not adequately explored how to motivate these learners. With the rapid expansion of online learning and the ever-increasing use of simulated learning environments like SAM 2003, it behooves the instructional designer to cultivate distance learner motivation.

This study addresses many of the same issues found in Moller and Russell's (1994) use of ARCS-inspired confidence-building strategies as well as motivational message issues found in works such as Gabrielle (2003) and Visser, Plomp, Amirault, and Kuiper (2002). This work seeks to advance the knowledge in the literature by showing how a systematic approach to increasing learner confidence can help *online* students perform at higher levels.

This research study is one of the first to use new technologies like the SAM 2003 simulation environment. This software is widely distributed to universities across the country and claims to have served hundreds of thousands of students and educators since its inception in 1998. According to an interview with Chriss Cazayoux (personal communication, June 25, 2005), a regional director for course technology, as of June, 2005:

1. A new student joins SAM every 30 seconds;
2. Number of SAM schools: 1,941;
3. Number of SAM student users: 526,253;
4. Number of SAM exams given: 15,205,351;
5. There is a SAM account in each of the 50 states. There are SAM accounts in each of these countries: Australia, British Virgin Islands, Canada, China, England, Hong Kong, Japan, New Zealand, Singapore, Northern Ireland, and South Africa.

Research regarding such a ubiquitous learning application is important. This research should benefit the numerous students, instructors and instructional designers who employ this software.

Lastly, the potential for increases in confidence and performance in online learners has benefit not only to the student but also the instructor and the university.

Such changes should lead to better classes and to the continued advancement of distance education programs at the university level.

Operational Definitions

- *CAI* (Computer-assisted instruction): There are certainly differences in site-based CAI versus CAI delivered at a distance. For the purposes of this study, CAI refers to computer-assisted instruction delivered at a *distance,* unless otherwise noted.
- *Confidence:* Keller (1987a) defined confidence as "helping the learners believe/feel that they will succeed and control their success" (p. 2). He lists three components to Confidence: (a) learning requirements, (b) opportunities for success, and (c) learner personal control. In this study, confidence was measured using the Confidence subsection of Keller's CIS, which gauges motivation for the course, and the Confidence subsection of the IMMS, which gauges motivational interest in the instructional materials.
- *Distance learning/learner*: The class section used for the study was designated as a "Web-based only" offering. Therefore, learners in this section were classified, for the purposes of this study, as distance learners. No attempt was made to determine the learners' actual distance from the campus. Rather, anyone enrolled in the section under study was considered to be participating "at a distance" for the purposes of this research.
- *Motivation:* Motivation is "the length and direction of effort expended by the learners in pursuit of achievement" (Moller et al., 2005, p. 139). It was measured in this study using the CIS and IMMS.

- *Performance:* In the case of this study, academic performance was measured through comparison of automatically generated posttest scores between the treatment and control group in SAM 2003.
- *SAM 2003:* SAM (Skill Assessment Manager) provides training scenarios for Microsoft Office in a lifelike, simulated environment designed to replicate Microsoft Office 2003. “SAM 2003 has helped hundreds of thousands of educators and students assess and improve their skills in the Microsoft Office 2003 suite and essential computer concepts” (Course Technology Website, 2005). The version used for this study was version 2.5.

CHAPTER 2

REVIEW OF RELATED LITERATURE

This chapter will begin with a review of the literature surrounding learner motivation and motivation in distance instruction. The analysis of the literature will continue with a review of Keller's ARCS model of motivation, learner confidence, and motivational messages. This review will conclude with a summary and implications for the current study.

Motivation

There is considerable research regarding the importance of motivation in learning contexts. Motivation has been defined on one extreme as the product of environmental conditioning—of deprivation and reinforcement schedules (Skinner, 1953). On the other extreme, individuals like Carl Rogers (1951) and Abraham Maslow (1954) adopt a humanistic approach where motivation is almost entirely a byproduct of free will and an internal drive for self-actualization.

Though theorists continue to debate whether motivation belongs in the cognitive or affective domain, Song (1998) finds this argument useless. If motivation can be seen as an internal force, then it "can come from all the human psychological constructs, either in the affective or cognitive domains that influence the direction and intensity of behavior" (p. 30).

Bandura's (1969) *Social Learning Theory* argued that learning and motivation were a result not just of the environment or the individual's free will but a combination of the two. Gagné (1985) advised that both internal and external conditions existed that

influenced learning and motivation. Internal conditions consist of skills (a developed capacity or state) already mastered by the learner that are independent of the instruction being offered. External conditions are the instructional materials or other things to which the learner is exposed to achieve a desired outcome. Motivation can be seen as a product of an individual's engagement with his environment and "is in part a function of the characteristic choices a person will make for one type of goal over others" (Keller, 1979, p. 28).

For the purposes of this study, motivation is defined as "the length and direction of effort expended by the learner in pursuit of achievement" (Moller et al., 2005, p. 139). According to Keller (1983), motivation can be further defined as "the choices people make as to what experiences or goals they will approach or avoid and the degree of effort they will exert in that respect" (p. 389). In other words, motivation provides the impetus to learn and to achieve one's goals.

Motivation is a critical component to learning (Keller, 1979, 1987a, 1987b; Means, Jonassen & Dwyer, 1997; Moller, 1993; Song & Keller, 2001). Means, Jonassen, and Dwyer (1997) cite studies that show that motivation accounts for 16% to 38% of the variations in overall student achievement. Keller and Burkman (1993) acknowledge that motivation is often thought of as solely a product of learner personality and perceptions—much of which is assumed beyond the control of the instructional designer. However, they believe that providing for motivation is largely the responsibility of the designer. Additionally, they feel that motivation is a systematic process that must be considered during all stages of design. Keller (1999b) finds stable elements of motivation that can be successfully manipulated and "even some of the

unstable elements are predictable" (p. 47). He further elaborates that instructors can manage the learning environment to create and to maintain motivation and, even if they cannot control an individual's internal motivational condition, "it is abundantly clear that the environment can have a strong impact on both the direction and intensity of a person's motivation" (p. 47).

Gabrielle (2003) feels that the literature supports three contentions about motivation and self-directed learning (SDL). Both motivation and SDL "(1) can be influenced by external factors, (2) are situational in that learners can have different levels at different times, and (3) can affect performance" (p. 21). In short, external conditions can have a positive (or negative) influence on motivation and performance, even if learners are not particularly internally motivated. If one agrees that external conditions can influence learner motives and motivation, then it follows that for lessons to be effective, they need to be appealing to learners.

Motivational Design Efforts in Distance Education and Other CAI

With the explosive growth of distance education initiatives, computers are becoming a mainstream educational delivery method (DETC, 2004). With such ubiquitous use, one can no longer simply count on the "novelty effect" of technology to engage students. If the designer is left without novelty, the question then arises: How do instructional designers initiate and maintain learner motivation and confidence in technology-based instruction (Song & Keller, 1999)? This concept of designing appealing instruction that allows for manipulations of learner motivation and confidence is at the heart of distance learning.

Even today, many learners initially find Web-based environments like distance education and other CAI programs novel or fun. This often translates into a temporary increase in learner motivation. Unfortunately, if the CAI is poorly designed or lacks continuing motivational appeal beyond that of an initial novelty level, learners will eventually lose interest, and motivation and confidence will wane (Keller & Suzuki, 1988). It becomes the responsibility of the instructional designer to incorporate strategies that maintain this initial level of motivation through effectively designed distance courses. Based on the ARCS model, Song (2000) lists three types of motivation that must be taken into consideration when designing distant or Web-based instruction: (a) motivation to initiate, (b) motivation to persist, and (c) motivation to continue. Song's research into these three types of motivation directly influences the confidence-enhancing tactics and emails detailed in Chapter 3.

Song and Keller (1999) cite three typical approaches to designing and developing motivational CAI: (a) the computer feature approach wherein the features of the program and any novelty effects associated with it are assumed to increase motivation; (b) the principle seeking approach, found in educational games, wherein "prescriptive motivational design principles and tactics for CAI are identified for the development of motivating CAI" (p. 513); and (c) the model establishing approach wherein practical models are created for the development and design of motivational CAI such as screen design guidelines and frameworks for incorporating motivation into multimedia productions.

In this study, aspects of all three approaches can be found. For instance, computer features are enhanced following ARCS principles. Also, specific principles

such as learner control and content sequencing are designed to improve learner confidence. Lastly, the ARCS model serves as a practical model for identifying and sequencing motivational and confidence-enhancing strategies. However, the literature addresses a common shortcoming of each of these approaches: they are more or less static, and they do little to address the continuously changing motivational nature of learners over time. In addition, Keller (1999b) notes that an excessive number of motivational tactics in CAI might prove distracting to already motivated students. He recommends designing interactive CAI that can adjust to the changing motivational needs of learners.

While research is beginning to explore the concept of designing motivationally adaptive CAI, SAM 2003 is a self-contained simulation program that does not allow for adjustments in multimedia presentation, screen layout and design, adaptive interaction design, or communication. Though these are all legitimate concerns for instructional designers who wish to design their own motivating distance course or CAI, exploring these topics is beyond the scope of this study. It was my hope that efforts to design and to deploy confidence-enhancing tactics, such as multiple entry points and multiple attempts at assignments, allow for the learner to work at an appropriate and individualized motivational level. Regardless, Keller (1999b) and Song (1998) believe the research supports the contention that both adaptive and full-featured (saturated) motivational treatments are superior to minimalist treatments. In other words, it appears that one is better served erring on the side of incorporating too many motivational enhancements than too few.

Even though literature supporting the need for enhancing learner motivation can be found frequently, the study of motivation in distance education, Web-based environments, and other forms of distant CAI is sorely lacking (Lee & Boling, 1996; Rezabeck, 1994). For example, in an in-depth study of the proceedings of the World Conferences of the International Council for Distance Education from 1988 to 1995, Visser, Plomp, Amirault, and Kuiper (2002) found that only six of 801 studies addressed motivational concerns of online learners. They also noted that a disturbing "trend in the lack of attention paid to motivation in distance education is present in some of the recently published specialized handbooks in the field of distance education" (p. 95).

Keller and others have recently begun examining how the ARCS model can be applied to computer-based instruction and distance education (Keller, 1999b). This is important as Means, Jonassen, and Dwyer (1997) call Keller's ARCS model the "only coherent and comprehensive instructional design model accommodating motivation" (p. 5). Keller's ARCS model is explored in greater detail in the next section.

Keller's ARCS Model

To stimulate and manage student motivation to learn, Keller (1987a, 1987b, 1987c) created the ARCS model of motivation. ARCS stands for attention, relevance, confidence and satisfaction and serves as the framework for the motivational and confidence-enhancing tactics found in this study.

The ARCS model was initially predicated on the *expectancy value theory* based on the work of Tolman (1932) and Lewin (1938). The expectancy value theory essentially states that learners pursue activities they value and in which they expect to

succeed (Keller, 1987c). The ARCS model is an attempt to synthesize behavioral, cognitive, and affective learning theories and demonstrate that learner motivation can be influenced through external conditions such as instructional materials (Moller, 1993).

Keller's ARCS model enjoys wide support in the literature, and many researchers attest to its reliability and validity in many different learning and design environments. For example, ARCS research can be found concerning the traditional classroom (Bickford, 1989; Klein & Freitag, 1992; Means, Jonassen, & Dwyer, 1997; Moller, 1993; Naime-Diefenbach, 1991; Small & Gluck, 1994; Visser & Keller, 1990), computer-assisted instruction (Asteitner & Keller, 1995; Bohlin & Milheim, 1994; ChanLin, 1994; Lee & Boling, 1996; Shelnut, Knowlton & Savage, 1999; Song, 1998; Song & Keller, 1999; Suzuki & Keller, 1996), blended learning environments (Gabrielle, 2003) and online, distant, and web-based classrooms (Chyung, 2001; Song, 2000; Visser, 1998).

The present study is the first known research of the extensively-used Microsoft® Office software* simulation SAM 2003 and offers a unique incorporation of many of the aspects found in the research concerning ARCS-based CAI and distant, Web-based instruction.

Before a discussion can begin about the variable of confidence specifically addressed in this study, it is important to examine, in greater detail, the four major categories of ARCS: attention, relevance, confidence and satisfaction.

Attention

According to Keller and Kopp (1987), attention is the act of getting and sustaining learner curiosity and interest. It is relatively easy to gain a learner's attention, but very

* Microsoft Corporation, www.microsoft.com

difficult to maintain it (Keller, 1983). Keller's model of attention differs from the concept of attention in information processing models. In information processing, attention serves to help focus the learner on specific learning tasks or performance goals rather than on motivation (Bickford, 1989).

Keller (1987b) lists three subcategories for attention: perceptual arousal, inquiry arousal, and variability. Perceptual arousal relates to capturing learner interest. Inquiry arousal focuses on stimulating learner curiosity. Variability in instruction reinforces perceptual and inquiry arousal by maintaining attention, stimulating inquiry, piquing curiosity, providing new arousal, and alleviating boredom (Keller & Suzuki, 2004).

Relevance

Keller (1987a) defines relevance as "those things which we perceive as instrumental in meeting the needs and satisfying the personal desires, including the accomplishment of personal goals" (p. 3). Relevance addresses the connection between the subject matter to be taught and the learner's need to find that material personally meaningful. Keller (1987a) lists three subcategories of tactics for relevance: goal orientation, motive matching, and familiarity.

Goal orientation refers to relating instruction to the learner's present or future goals. Motive matching is a style of instruction where strategies are matched to varying motivational needs, interests, and learning styles of students (Gabrielle, 2003). Familiarity refers to generating relevance in the lesson by relating it to the learner's beliefs, experiences, and interests. This is often done by getting learners personally involved in the subject matter (Keller, 1987a). Research has shown that relevance-

enhancing strategies may be the most effective at improving learner performance and motivation (Means, Jonassen, & Dwyer, 1997).

Confidence

Keller (1987a) defines confidence as “Helping the learners believe/feel that they will succeed and control their success” (p. 2). He lists three subcategories for confidence: learning requirements, success opportunities, and personal control. With learning requirements, Keller encourages designers to examine ways to improve learner confidence by letting students know what is expected of them. This helps students build a positive expectation for success by clearly explaining what is required of students and how they will be evaluated.

Keller (1987a, 1987b) also calls for increasing confidence by providing for success opportunities that are meaningful, provide adequate challenge, bolster achievement, and avoid boredom. This requires providing varied learning experiences for student success.

Lastly, he advocates a sense of personal control to increase confidence where the learner is allowed as much control of the learning experience as possible, and where feedback is provided that reinforces personal effort.

Confidence, the main focus of this study, will be explored in greater detail in the next section.

Satisfaction

Satisfaction, the final component of the ARCS model, serves to increase learner

motivation by creating learning experiences about which the learner can feel positive and “includes affirmation to learners that the instructional content was relevant and that they had the ability to learn the material” (Gabrielle, 2003, p. 29). Keller (1987a) lists three subcategories for satisfaction: natural consequences, positive consequences, and equity.

Natural consequences allow for the learner to use newly acquired skills in an authentic learning environment, thereby boosting the learner’s intrinsic motivation. According to Bruner (1960), "The best way to create interest in a subject is to render it worth knowing, which means to make the knowledge gained usable in one's thinking beyond the situation in which learning has occurred” (p. 31). Keller (1987a) lists case studies, simulations, and experiential learning activities as examples.

Positive consequences involve rewards and other forms of extrinsic positive reinforcement to “stimulate, shape and maintain behavior . . . when the learner is not intrinsically motivated, and when the learning task is inherently monotonous” (Keller, 1987a, p. 6). Some examples are verbal praise, the use of certificates or awards, and any other actual or symbolic incentives that the learner may value.

Equity involves maintaining fair and consistent standards in all aspects of the material being taught. In order to feel satisfaction, the learner must perceive that fair treatment and consistent standards are applied to everyone.

In summary, with its four categories and twelve subcategories (Table 1), Keller’s ARCS model attempts to synthesize behavioral, cognitive, and affective learning theories and demonstrate that learner motivation can be influenced through external conditions (Moller, 1993). With its Attention, Relevance, Confidence, and Satisfaction

categories, the model serves as a framework for capturing and maintaining learner attention, establishing relevance of the material being taught, improving and sustaining learner confidence, and providing a sense of learner satisfaction through intrinsic and extrinsic rewards, as well as fair and equitable treatment and consequences. According to Keller (1987a), each of the categories can be applied to a variety of instructional contexts, and "motivational interventions can be focused within a general category, or specific subcategory of the model" (p. 6). In the case of this study, the category of confidence is the primary focus of the investigation and is explored in greater detail in the next section.

Table 1

Keller's ARCS Model Summary (Keller, 1987a, 1987b)

Attention	Relevance	Confidence	Satisfaction
A1 Perceptual Arousal	R1 Goal Orientation	C1 Learning Requirements	S1 Natural Consequences
A2 Inquiry Arousal	R2 Motive Matching	C2 Success Opportunities	S2 Positive Consequences
A3 Variability	R3 Familiarity	C3 Personal Control	S3 Equity

Confidence

Confidence has been described in the literature as a personality trait (McKinney, 1960). If this is the case, then it stands to reason that those lacking in confidence would remain that way regardless of attempts by educators, or anyone else for that matter, to increase learner confidence. However, confidence is more universally accepted as

situation-specific; that is, confidence can be manipulated by internal and external factors (Keller, 1979; Moller 1993). It is this belief which guides this study.

In his development of social learning theory, Rotter (1954) argued that people have a tendency to ascribe their failures or successes to internal or external factors. Given this, he found that people tend to pursue that which brings about the most rewarding consequence; this is known as *expectancy* and is a key concept of social learning theory. Bandura (1977) further elaborated on this concept when he explained that an individual's expectancy is related to his/her estimate of the outcome of a given behavior. He used the term *self efficacy* to describe one's belief that one's abilities and knowledge are sufficient to be successful at a given task (Bandura, 1986).

For example, if the learner has a high expectancy of success, confidence increases. A low expectancy of success, or fear of failure, causes confidence to drop. However, success does not have to be a given for the learner to feel successful. Many learners prefer a challenge as long as "it is within acceptable boundaries" (Naime-Diefenbach, 1991, p. 12).

Keller (1983) describes confidence as expectancy. He defines confidence as "Helping the learners believe/feel that they will succeed and control their success" (Keller, 1987a, p. 2). Confidence is the interplay between learners' desire for success, and their fear of failure. These opposing forces vie for control of the learning experience. Keller and Suzuki (1988) list the three most important dimensions to confidence: perceived competence, perceived control, and expectancy for success. These parallel and complement the aforementioned components of confidence: learning requirements, personal control, and success opportunities.

Perceived Competence

Confidence is about self-perception: perception of one's abilities and perception of one's control within the learning context. In terms of self-perception, if the challenge in the learning environment is too great, anxiety and a sense of helplessness may result, and confidence and performance may wane. If the degree of challenge is too low, boredom may set in, and learners will not perform at their highest level. Learners who believe in their potential success are more likely to exert the effort required to be successful (Bickford, 1989). Learner expectations and perceptions can potentially be very different from their actual chances at success. However, expectations, even when they are out of line with actual ability, can still positively influence outcomes (Bickford, 1989).

Students with a poor perception of their abilities may become anxious and perform less well than their counterparts with higher confidence in their abilities (Naime-Diefenbach, 1991). Moller (1993) describes learners with high anxiety as often "misdirecting effort from learning to task-irrelevant concerns. Learners high in anxiety are often low in self-esteem and, as such, avoid evaluative situations" (p. 7). In contrast, learners with normal anxiety levels feel more confident and motivated in situations where they must be evaluated (Moller, 1993).

Perceived Control

Confidence is also about the perception of control. This relates to locus of control—a concept introduced by Rotter in 1954. When learners believe that the effort they expend and the choices they make directly relate to the consequences and

outcomes of those efforts and choices, they feel more confident (Bandura, 1977; Keller & Suzuki, 1988). This fosters a higher internal locus of control and a greater sense of self-pride and accomplishment (Moller, 1993). In contrast, learners who believe luck or other uncontrollable outside forces are in charge of their successes or failures tend to feel more helpless, less confident, and perform at lower levels. As regards locus of control, learners are often labeled as “internals” or “externals.” Those learners with an internal locus of control are more likely to attribute their performance failures to themselves. Externals, on the other hand, are more likely to project their failures to external factors such as the teacher or the class. Keller (1979) finds that locus of control is more closely related to “attitudes toward performance than to actual performance” (p. 31).

This concept of control may be particularly relevant to distance learning environments. Roblyer (1999) found that students who chose distance education classes over face-to-face classes often did so out of a greater desire or need for control over their own learning outcomes.

According to Keller and Suzuki (1988), “Features in the instruction that promote feelings of personal control over outcomes will help develop confidence and persistence” (p. 405). This is supported by researchers such as Carroll (1963), Bloom (1976), and Kinzie and Sullivan (1989) who suggest allowing for learners to control the pace of instruction. However, research is mixed about how much control is actually beneficial to learners (Klein & Keller, 1990). Steinberg (1989) cited numerous studies that show learners with little prior knowledge of the subject matter are likely to perform poorly with increased learner control.

Keller (1987a) suggests one strategy for fostering control is to give students knowledge of what is expected of them. However, giving learners knowledge of what is expected of them is not enough to guarantee confidence. In any learning situation, learners may understand what steps are necessary to complete the task at hand. However, if they do not have confidence in their ability to successfully complete those tasks, confidence will wane, and the students may not perform successfully (Moller, 1993). The key is having confidence in one's *success* at a given task.

Expectancy for Success

Expectancy for success is also a key component of confidence. To be motivated, learners need a reasonable assumption of success (Naime-Diefenbach, 1991). This is related to the concept of the self-fulfilling prophecy (Jones, 1977; Keller & Suzuki, 1988; Naime-Diefenbach, 1991). In education, a learner may have particular expectations or beliefs that actually influence outcomes. For example, if the learner believes he will be successful at a given task, such belief may result in greater effort expended; this, in turn, improves success. On the opposite end of the spectrum is the concept of learned helplessness (Keller, 1979; Seligman, 1975). According to Keller (1979), learned helplessness may be "established by inability, impossibility of the task, or a negative set" (p. 31). However it is established, once learned helplessness has taken hold, it can be a powerful impediment to success.

In general, Keller (1987a, 1987b) calls for increasing confidence by providing for success opportunities that are meaningful, provide adequate challenge, bolster achievement, and avoid boredom.

In summary, confidence is clearly related to fear of failure and to expectancy of success. To increase learner confidence, the instructional designer needs to consider learner anxiety and provide for instruction that helps learners feel competent, in control, and successful. It is important to note that while fear of failure can strongly affect motivation in traditional learning environments, it may be an even greater factor in distance education (Visser, 1998). Even with highly-motivated students, learner isolation, an unfamiliar distance environment, the technology required in distance courses, the distance separating learner and instructor, and other mitigating factors have an effect on learner confidence. Studies have shown that technology brings with it new attitudes and anxiety levels that can have a direct effect on confidence (Yaghi & Ghaith, 2002). The instructor of the distant course must be especially concerned with increasing and maintaining learner confidence.

Motivational Messages

There is little research regarding the ARCS model and motivational messages in education (Visser, 1998). In conventional education, J. Visser (1990) showed an increase in learner motivation through the use of motivational messages. In a study of adult students in Mozambique, Visser and Keller (1990) delivered ARCS-based motivational messages to students and showed improvement in motivation. They stress the potential of motivational messages in distance education. Keller and Suzuki (2004) cited a 1998 report by Visser outlining a 70-80% improvement in retention rates of distance learners when motivational messages based on the ARCS model were used. Visser, Plomp, and Kuiper in studies in 1999 and 2002 used the ARCS model as a

guide for developing motivational communications with international distance education students. They found positive outcomes for learner motivation and found that motivational messages "considerably increased the completion rates of students" (2002, p. 410). Gabrielle (2003) used Keller's ARCS model as the basis for interventions and messages designed to improve learner motivation and performance in a study of undergraduate students in a public military school. She found statistically significant differences between the groups regarding motivation, academic performance, and self-directed learning and added that strategies based on Keller's ARCS model are worthy instructional design considerations.

One can speculate that the social aspect or sense of community created through motivational communications may be part of the necessary support structure distance learners need (Cathcart, Samovar, & Henman, 1996; Kember, Lai, Murphy, Shaw & Yuen, 1994; Moller, 1998).

In addition to overall motivation, learner confidence can be improved through the use of systematically designed messages and emails. Confidence, along with motivation, is enhanced through verbal persuasion and reassurances, expressions of personal interest by the instructor, and other words of encouragement found within the communication (Bandura, 1977; Driscoll, 2000; Moller et al., 2005). L. Visser (1998) conducted a pilot study and a main study using the motivational messages support system (MMSS), upon which the emails in this study are partly based. In both studies, she found that "the messages increased the confidence of students" (p. 172). Of equal importance, she found no statistically significant difference in the use of mass messages versus personalized messages in terms of effectiveness. She recommended

using mass messages to avoid problems (namely, time) associated with designing, developing, and preparing individualized messages.

Chapter Summary

In summary, motivation is an essential and critical element of learning, and external conditions can be manipulated to improve learner confidence. Confidence is clearly related to fear of failure, to perceived confidence, to perception of control, and to expectancy of success. To increase learner confidence, the instructional designer needs to manage learner anxiety and provide for instruction that helps learners feel competent, in control, and successful.

This review serves to demonstrate that while there is much in the literature concerning the importance of motivation in education, there is little empirical research regarding the systematic application of the ARCS model to improve learner confidence in distance education. There is even less research examining the effects of ARCS-based confidence-enhancing emails on confidence levels of distance students. Specifically, this literature review addresses the following areas: (a) the literature surrounding motivation in education and in distance instruction, (b) a review of Keller's ARCS model of motivation, (c) the literature surrounding learner confidence and, (d) the use of motivational or confidence-enhancing email messages in education.

Finally, there is a noted absence of empirical research regarding motivation in technology-based learning environments (Gabrielle, 2003). The use of the confidence interventions in this study are designed to further the body of research regarding distance learner motivation, confidence, and performance.

CHAPTER 3

METHODOLOGY

Subjects

The subjects in this study were undergraduate students enrolled in a for-credit course at a Texas university rated Carnegie Doctoral/Research Universities—Extensive. Subjects were selected from participants in a freshman-level computer course and were randomly assigned to either the treatment or the control group. Students were not informed of the specific research questions. Instead, they were informed that a study was being undertaken to assess potential instructional enhancements to the course. IRB approval as well as informed consent for participation was obtained (see Appendix A).

This study was conducted over a period of approximately five and one-half weeks. The initial sample consisted of 81 (treatment *n*=41; control *n*=40) total students and included 37 males (treatment *n*=18; control *n*=19) and 44 females (treatment *n*=23; control *n*=21). A total of 79 students reported additional demographic data. Of these, 58 of the students self-reported to be white (non-Hispanic), 3 were Hispanic or Mexican-American, 13 were black or African-American, 4 were Asian or Pacific Islander, and 1 was American Indian or Alaskan Native. Twenty-seven subjects reported their age as 18-20. Thirty-six were 21-24, 8 were 25-30, and 8 were 31 or older. This is in line with university-reported demographics concerning the campus undergraduate population as a whole. As of 2003, the university reported demographics as follows: white (71%), Hispanic or Mexican-American (8.7%), black or African-American (10.1%), Asian or Pacific Islander (4%), and American Indian or Alaskan Native (.9%) with females

accounting for 57% of the total population and males 43%. Undergraduates make up approximately 75% of the total university population (University of North Texas Institutional Research & Accreditation, 2006).

Twelve subjects reported enrollment of part-time (less than 12 hours), and 67 subjects reported full-time enrollment (12 hours or more) at the university. For the semester in which this study was conducted, 35 subjects reported this section as their first attempt at an online class, while 44 reported having taken at least one online course in the past.

In addition, 5 subjects rated their experience and proficiency with computers as "beginning user." Fifty-seven students ranked themselves as an "intermediate user." Lastly, 15 rated themselves as an "advanced user" with 2 self-reporting as an "expert user."

One student opted not to participate in the surveys. Four students dropped the course before completing either survey, and 4 more were excluded from the Instructional Materials Motivation Survey (IMMS) results for incomplete or incorrect submission of the survey.

In previous studies similar to this one, Moller (1993) used a mixture of 66 total graduate and undergraduate subjects in two groups, and Naime-Diefenbach (1991) used a total of 111 undergraduate subjects in three groups. Similarly, Gabrielle (2003) used 784 undergraduate students divided into 12 sections with randomly assigned treatment and control groups, while Keller and Song (2001) used a total of 60 tenth-grade students from a Developmental Research School affiliated with a Florida university.

Cohen's Power Tables (1988) provide support for the selected sample size. With two approximately equal groups, and assuming a medium effect size at 2/3 power and an alpha of .05, Cohen (1988) recommends 34 per group (at alpha .01 the recommended number is 62 per group) (p. 313).

Research Design

This study used a true experimental, posttest-only, control-group design, and was undertaken using quantitative methods (Gall, Gall, & Borg, 2003). Two quantitative surveys were used to measure confidence and motivation: (a) the Course Interest Survey (CIS), designed by Keller and based on the ARCS model, which gauges student motivation related to the course being taught with 34 Likert-type scale responses; and (b) the IMMS, also developed by Keller and based on the ARCS model with 36 Likert-type scale responses. The IMMS gauges the motivational effect of instructional materials. These two surveys were delivered in Web-based format.

Performance was also measured based on the differences between posttest scores automatically generated in SAM 2003. With the unique nature of this study, adopting a pretest/posttest model was inappropriate. In this study, a comparable pretest/performance exercise was used as a confidence treatment. There were also concerns about potential test effects and the short delay between a complimentary pretest and posttest; this led to the decision to use a posttest-only design (Gall, Gall, & Borg, 2003).

The attention, relevance, and satisfaction components of the ARCS model were not intentionally incorporated into the design of this study in order to better isolate the

variable of Confidence in question. Summaries of the research design can be found in Table 2 and in Table 3. A summary of hypotheses, instruments, and statistical analyses can be found at the end of this chapter in Table 7.

Table 2

Summary of Research Design and Data Collection

Group	CIS	Posttest	IMMS	CT
Control	X	X	X	
Treatment	X	X	X	X

Note. CIS=Course Interest Survey, IMMS=Instructional Materials Motivation Survey, CT=Confidence Tactics.

Table 3

Research Design in Standard Notation

Control Group	R		O
Treatment Group	R	X	O

Note. R=Random Assignment, X=Experimental Treatment, O=Observations.

Independent Variables

The treatment consisted of ARCS confidence tactics (see Table 4) distributed through SAM 2003 and through confidence-enhancing email messages in the WebCT Campus Edition™ software* environment (see Table 6). Appendix D provides examples of the confidence-enhancing emails. This treatment was designed to improve learner confidence and performance.

* Blackboard, Inc. www.blackboard.com

Within the larger framework of confidence, Keller (1979) provides three components that can be manipulated to reduce a sense of helplessness and increase learner confidence: learning requirements, success opportunities, and personal control. These components were manipulated for the treatment group. ARCS-based, confidence-enhancing email messages from the instructor were also created and distributed with the intent of conveying the confidence tactics designed to improve learner confidence and performance in the treatment group.

Dependent Variables

There were two main dependent variables under investigation:

1. Confidence
2. Academic performance

In addition, scores for the remaining ARCS components of Attention, Relevance, and Satisfaction as well as an overall motivation score (ARCS total score) were calculated for comparison purposes.

Measurement of Dependent Variables

For measuring Confidence, the remaining ARCS subsections, and overall motivation, research has obtained reliable scores for both the CIS and IMMS surveys. Gabrielle (2003) used the CIS to track changes in learner interest and motivation in undergraduate students at a military school (reliability alpha of .81). Likewise, Amirault (2003) used the CIS to collect data regarding the motivation levels of graduate students

at Florida State University (reliability alpha of .83). Information regarding the development of the CIS can be found in Keller and Subhiyah (1993).

The IMMS was also developed by Keller and based on the ARCS model. The IMMS gauges the motivational effect of instructional materials. Numerous researchers have used full and modified versions of the IMMS and support its reliability and validity (Bickford, 1989; Gabrielle, 2003; Hirumi and Bowers, 1991; Klein and Keller, 1990; Ley, 1989; Naime-Diefenbach, 1991; Moller et al., 2005; Moller, 1993; Song & Keller, 2001). More specific details regarding the development and use of the IMMS can be found in Keller (1993).

Academic performance was measured by the differences in posttest scores between the treatment group and the control group. The treatment group received more than one attempt at the posttest, so only the first attempt was used to gather data to measure performance.

Instruments

Two surveys were used to measure confidence and motivation: (a) the CIS, which was designed by Keller to gauge student motivation related to the course being taught; and (b) the IMMS, also developed by Keller and based on the ARCS model. The IMMS gauges the motivational effect of instructional materials. These two surveys were converted to a Web-based format.

The Course Interest Survey (CIS)

This study used the CIS, which was designed by Keller to gauge student

motivation related to the course being taught. This survey uses a Likert-type scale of 1-5 where nine items of the 34 are reverse items. In relation to the course, it was designed to assess the four components of the ARCS model (attention, relevance, confidence, and satisfaction), as well as an overall motivation score. In the case of this study, an individual measure of learner confidence was highlighted.

Reliability and Validity

Prior scores obtained with this instrument have resulted in a Cronbach's alpha for all five components (attention, relevance, confidence, satisfaction and total ARCS score) in excess of .80 (Gabrielle, 2003). The Web-based format of the CIS used in this study was nearly identical to that used by Gabrielle (2003). In that study, the scores indicated that the conversion of the CIS to a Web-based format was found to have a total reliability alpha of .81. For this study, scores on the Web-based CIS were found to have a total reliability alpha of .93. The reliability alphas for the computed scores of the individual subsections in this study were as follows: attention (.80), relevance (.83), confidence (.80), and satisfaction (.83).

The Instructional Materials Motivation Survey (IMMS)

The IMMS was also developed by Keller and based on the ARCS model. The IMMS gauges the motivational effect of instructional materials and uses 36 ARCS-related questions. This survey uses a Likert-type scale of 1-5 where 10 of the 36 items are reverse items. In relationship to the instructional material, it was designed to assess the four components of the ARCS model (attention, relevance, confidence, and

satisfaction), as well as an overall motivation score. In the case of this study, an individual measure of learner confidence was highlighted.

Reliability and Validity

Prior scores obtained with this instrument (attention, relevance, confidence, satisfaction, and total ARCS score) have resulted in an overall Cronbach's alpha in excess of .80. The confidence subscale has previously shown a Cronbach's alpha of .90 (Keller, 1990; Moller, 1993). The Web-based format of the IMMS used in this study was nearly identical to that used by Gabrielle (2003). In that study, the conversion of the IMMS to Web-based format was found to have a total reliability alpha of .84 based on the obtained scores. For this study, the Web-based IMMS was found to have a total reliability alpha of .93 based on the obtained scores. The reliability alphas for computed scores of the individual subsections in this study were as follows: attention (.86), relevance (.80), confidence (.85), and satisfaction (.86).

Posttest

Academic performance was measured using posttests generated by SAM 2003 after students completed the training/instructional materials. For this study, the posttest was found to have a total reliability alpha of .86 based on obtained scores.

Procedures and Materials

Students were assigned to either the control group or the treatment group using a table of random numbers matched to the last four digits of their student identification

number. The control group received none of the confidence-building tactics. The treatment group received confidence tactics (see Table 4) through SAM 2003 and through confidence-enhancing emails in WebCT (see Table 6 and Appendix D). Participation in this study was voluntary. This experiment was conducted in the context of a for-credit course, and students were given class credit for completing assignments used in this experiment. Grades were averaged across control and treatment groups for the duration of the study. If the student's individual grades were higher than the average, they were allowed to use those scores for final grade calculation. Students were also allowed to substitute grades from other assignments to take the place of those used in this experiment. In any regard, no student's grade was negatively impacted through participation.

Treatment was provided in four steps:

1. The instructor selected SAM 2003's simulation of Microsoft® Access software* to be used for the duration of this experiment and WebCT for the delivery of confidence-enhancing emails (CEE) and demographic surveys.

2. As described in Table 4, the instructor modified SAM 2003's Access simulation based on the component of Confidence in Keller's ARCS model for the treatment group.

3. The instructor composed supplementary CEEs to help disseminate the confidence-enhancing tactics based on Keller's ARCS model for the treatment group.

4. The instructor presented the materials, with and without modification, to the respective treatment and control groups.

While a total ARCS motivation score was calculated for comparison purposes, this study's main interest was in isolating the variable of Confidence.

* Microsoft Corporation, www.microsoft.com

Materials

This study examined the effects of ARCS confidence-building strategies on distance learner confidence and academic performance. These strategies were incorporated into the Web-based delivery platform of SAM 2003 and WebCT. This process is discussed in the Application of Confidence Tactics within the Materials subsection of this chapter.

SAM 2003 was chosen for these reasons:

1. It was required instructional material for the course.
2. It was not overly burdensome in price (around $60).
3. It has been widely used by students and instructors across this and other countries.
4. It has proven itself reliable and easy to control during previous semesters.
5. It has enough flexibility to allow for manipulation of the materials to fit the selected confidence tactics.

Since three past surveys of students indicated that Access was the program with which the students were the *least* familiar, SAM 2003's simulation of Microsoft Access was used for the duration of this experiment. Access was chosen to help control for any variance in student ability. WebCT was also used for the delivery of the confidence-enhancing emails (CEE) and demographic surveys.

Modification of Materials

The following section outlines how Keller's ARCS strategies were incorporated into SAM 2003 and into the confidence-enhancing emails to students. As stated earlier, with the use of the ARCS model, Keller (1979) lists confidence (expectancy for success), along with attention, relevance, and satisfaction, as one of four general

subsections that must be considered to influence student motivation to learn. Within the framework of confidence, Keller (1979) provides three components that can be manipulated to reduce a sense of helplessness and increase learner confidence: learning requirements, success opportunities, and personal control.

The purpose of this section is to detail how I manipulated the components of confidence found in Keller's ARCS model to enhance student confidence and performance in online, computer-assisted instruction using SAM 2003 software delivery. Confidence-enhancing email messages from the instructor, based on the confidence tactics appropriate to this study, were also created and distributed with the intent of improving learner confidence and performance in the treatment group.

Designing and Developing Materials with Motivational Components

Keller (1999a) lists ten steps instructors should follow when designing motivational systems:

1. Obtain course information
2. Obtain audience information
3. Analyze audience
4. Analyze existing materials
5. List objectives and assessments
6. List potential tactics
7. Select and design tactics
8. Integrate with instruction
9. Select and develop materials

10. Evaluate and revise

These guidelines, as well as research by Moller (1993) and Gabrielle (2003), led to the following adaptations to fit this study:

1. Obtain course information: I was also the instructor for this course and had taught similar sections on three previous occasions. As a result, I had intimate knowledge of instructional materials, student population, and the delivery platform.

2. Obtain audience information: Over several semesters, learners were given informal surveys to fill out at the beginning of the semester which detailed demographic information; information concerning hobbies, activities and other interests; computer experience; attitudes and comfort level with computers; as well as specific information about experience with operating systems, applications, and computer languages.

3. Analyze audience: The above survey information, along with my past experience, helped to identify potential strengths of students as well as areas of concern.

4. Analyze existing materials: Three previous semesters led to a good understanding of the strengths and deficiencies of the SAM 2003 software. Feedback from learners was an invaluable tool for materials analysis.

5. List objectives and assessments: Objectives and assessments were listed according to confidence tactics (see Table 4).

6. List potential tactics: This initial brainstorming activity led to the modification of existing materials detailed in the next section (see Table 4). Tactics for confidence-enhancing emails are detailed in Tables 4 and 6.

7. Select and design tactics: Tactics and modifications of existing materials were designed based on the component of Confidence from Keller's ARCS model to enhance student confidence and performance in online, computer-assisted instruction using SAM 2003 software delivery. Specifics are detailed in the next section.

8. Integrate with instruction: This step was done in conjunction with course objectives.

9. Select and develop materials: SAM 2003 was chosen as the delivery platform, based on my prior experience that this platform did an effective job of advancing student skills in Microsoft Office 2003. SAM 2003 was also selected, since it was a relatively new technology that employed

simulation as a learning tool. According to the Thomson Company, "SAM 2003 has helped hundreds of thousands of educators and students assess and improve their skills in the Microsoft Office 2003 suite and essential computer concepts." (Course Technology Website, 2005).

10. Evaluate and revise: The previous three semesters of using this software served as an informal pilot study for some of the procedures used in the research. No formal pilot study was conducted. Personal experience and student feedback were an invaluable resource for evaluating SAM 2003, and WebCT, as well as improving instructional delivery. Past experience with the instructional materials served as a guiding impetus for the confidence and performance-enhancing strategies used in this study.

Application of Confidence Tactics within the Materials

While working through Keller's previously described series of ten steps, tactics that could be applied to improve learner confidence and performance began to emerge. It should be noted that SAM 2003 and Web-based instruction contain potential "enhancements" such as novelty effects generated through the simulation program, that may improve confidence that cannot be removed. Another such built-in enhancement could be student choice over study location. Table 5 details where control and treatment tactics for this study were identical. In addition, Keller and Song (2001) list two types of motivational strategies for confidence that should be considered when designing computer-based instruction: confidence sustaining strategies (CSS) and confidence enhancing strategies (CES). Some of their suggestions were inherent to SAM 2003 and could not be removed. The specifics are detailed in Table 8.

This section detailed specific tactics and their applications to the treatment and control groups (see Table 4). The tactics presented here were the result of analysis of Keller's work on the ARCS model as well as that of numerous other researchers. Specifically, the following was an adaptation of Moller's (1993) confidence-enhancing

tactics (CT). A summary of the confidence tactics and their availability by group can be found in Table 5.

Table 4

Confidence Tactics (CT)

Component	Treatment Group	Control
LR1: Are there clear statements, in terms of observable behaviors, of what is expected of the learners?	Objectives were stated in SAM at the beginning of each lesson and restated on guide-sheets. Reminders were stated in the confidence-enhancing emails (CEE). In addition, a pretest (see Success Opportunities Criterion A) served to familiarize learners with what was expected of them.	Objectives were not stated, and a pretest was not provided.
LR2: Is there a means for learners to write their own goals or objectives?	SAM 2003 is a self-contained simulation environment, so this was not an option.	SAM 2003 is a self-contained simulation environment, so this was not an option.
SO1: Multiple entry points: Provide a pretest and multiple entry points into the instructional material.	The treatment group received a pretest/performance exercise that determined the level of expertise the learner brought to each exercise, and this allowed for the learner to enter the training/instructional material at differing points. Each learner received training/instructional materials only in areas of demonstrated deficiency. Learners were reminded of this in the CEEs.	The control group received no such pretest/performance exercise and was required to take all of the training/instructional material regardless of previous knowledge, experience or expertise.
SO2: Is the content organized in a clear, easy-to-follow sequence?	The content was organized in a pretest-training-posttest sequence. The treatment group received a statement with each lesson assuring them the material was clear and easy-to-follow along with directions highlighting how to proceed through the pretest-training-posttest sequence. Learners were reminded of this in the CEEs.	This group received no such explanation.

(table continues)

Table 4 *(continued).*

Component	Treatment Group	Control
SO3: Are the tasks sequenced from simple to difficult within the material?	Materials in SAM 2003 follow a logical sequence and are generally sequenced from easy to more difficult in each lesson. However, only the treatment group received a statement assuring them of this fact. Learners were reminded of this in the CEEs.	The tasks were sequenced from simple to difficult; however, the control group received no statement.
SO4: Is the overall challenge level appropriate for this audience?	Yes, but only in the treatment group was this stated to the learner. Learners were reminded of this in the CEEs.	Yes, but not stated.
SO5: Are the materials free of "trick" or excessively difficult questions or exercises?	Yes, but only this version stated this fact to the learner, and learners were reminded of this in the CEEs. It should be noted, however, that each student came to the program with differing levels of expertise, so it was impossible to gauge the difficulty level for everyone. To control for this variable, a pretest was made available to the treatment group to assess initial ability and allow for multiple entry points into the instruction. Also, SAM 2003's simulation of Microsoft Access was used for the duration of this experiment, since three past surveys of students have indicated that Access was the program with which they were the least familiar.	Yes, but no pretest was administered, and this fact was not stated.
SO6: Are the exercises consistent with the objectives?	Yes, however, only this version stated the objectives to the learner before beginning. Learners were also reminded of this in the CEEs.	Yes, but objectives were not stated.

(table continues)

Table 4 *(continued).*

Component	Treatment Group	Control
SO7: Are there methods for self-evaluation?	Yes, SAM 2003 was set to display simple feedback for each task (e.g., correct or incorrect). Results were also displayed at the end of each exam as a percentage (e.g., 90% correct). Learners were reminded of this in the CEEs.	No feedback was provided, and no results were displayed.
PC1: Are learners given choices in sequencing? Can they sequence their study of different parts of the material?	All exercises in each module were presented at once, and learners were able to approach the lessons in any order they chose. Learners were reminded of this in the CEEs.	Learners were given the lessons in a particular sequence, one-at-a-time, with a specific due date.
PC2: Are learners allowed to go at their own pace?	Self-pacing was allowed with a due date established clearly up front, and all assignments were opened at the same time and stayed open until the due date with no time-limits for self-pacing. Learners were reminded of this in the CEEs.	Each exercise was timed. The time-limit was decided as follows: (a) examine the time it took for the students in the previous semester to complete exercises, (b) select the longest time for completion, and (c) add thirty minutes. The control group had ample time to complete the exercises but was not informed of this. Every control group subject finished each exercise before time had expired.
PC3: Are learners given opportunities to create their own exercises or methods of demonstrating competency?	Learners were given the opportunity for demonstrating further competency by creating their own exercises (such as an Access database) for extra credit or to take the place of a low test score. Learners were reminded of this in the CEEs.	Learners were given no such opportunity.

(table continues)

Table 4 *(continued).*

Component	Treatment Group	Control
PC4: Are learners given choice over study location?	Yes—this was an Internet-based class. Learners were reminded of this in the CEEs.	Yes—this was an Internet-based class.
PC5: Are learners given the opportunity to record comments on how the materials could be made more interesting?	A blog and threaded discussion concerning the materials was set up to allow for comments. Learners were encouraged to participate in the CEEs.	There was no access to a blog or threaded discussion about materials.
PC6: Are learners given the opportunity for feedback and practice in a "low risk" environment where it is acceptable to make mistakes and learn from them?	On the pretest, training, and posttest, learners were given feedback regarding performance and were allowed multiple attempts at the posttest. They were reminded about these multiple attempts at the beginning of each exercise and in the CEEs.	The control group received no pretest, one timed attempt at the training with minimal computer-generated feedback, and one attempt at the posttest with no feedback concerning final performance.

Note: Adapted from Moller (1993) and Moller and Russell (1994). LR = learning components; SO = success opportunies; PC = personal control; CEE = confidence-enhancing emails.

Table 5

Summary of Confidence Tactics and Their Availability by Group

Confidence Tactics (CT)	Stated and/or available to control	Stated and/or available to treatment
Are there clear statements, in terms of observable behaviors, of what is expected of the learners?	Not stated	Stated
Is there a means for learners to write their own goals or objectives?	No	No
Multiple entry points: Provide a pretest and multiple entry points into the instructional material.	No	Yes
Is the content organized in a clear, easy-to-follow sequence?	Not stated	Stated
Are the tasks sequenced from simple to difficult within the material?	Not stated	Stated
Is the overall challenge level appropriate for this audience?	Not stated	Stated
Are the materials free of “trick” or excessively difficult questions or exercises?	Not stated	Stated
Are the exercises consistent with the objectives?	Not stated	Stated
Are there methods for self-evaluation?	No	Yes
Are learners given choices in sequencing? Can they sequence their study of different parts of the material?	No	Yes
Are learners allowed to go at their own pace?	No	Yes
Are learners given opportunities to create their own exercises or methods of demonstrating competency?	No	Yes
Are learners given choice over study location?	Yes	Yes
Are learners given the opportunity to record comments on how the materials could be made more interesting?	No	Yes
Are learners given the opportunity for feedback and practice in a “low risk” environment where it is acceptable to make mistakes and learn from them?	No	Yes

Enhancing Materials With Confidence-Based Emails

Based on the motivational messages support system developed by L. Visser (1998) as well as research by J. Visser (Visser, 1990; Visser & Keller, 1990) and Visser, Plomp, Amirault and Kuiper (2002), four confidence-enhancing emails (CEE) were designed and sent to students in the treatment group at approximately 10-day intervals. The emails were delivered through WebCT. Each CEE drew its content from ARCS-based strategies designed to improve student confidence and performance. These confidence-enhancing emails were designed using my interpretation of the literature. They were intended to communicate and to reiterate the specific confidence tactics in Table 4 as well many of the confidence-sustaining strategies (CSS) and confidence-enhancing strategies (CES) found in Table 8.

The following Table (6) is an adaptation of Visser, Plomp, Amirault and Kuiper's (2002) motivational letters to students, paying particular interest to the aforementioned components of confidence: learning requirements, success opportunities, and personal control.

Table 6

Confidence-Enhancing Emails (CEE)

Message	Time	Goals	ARCS Component Emphasized
CEE 1	Week 1	Welcome, advise students of potential success in class, remind students of class objectives, lesson structure, and other confidence tactics.	C
CEE 2	Week 2	Show personal interest, reassure learners about any confusion they may be experiencing, remind learners of self-pacing deadlines, the blog and discussion, solicit feedback, and other confidence tactics.	C
CEE 3	Week 3	Encourage students to participate in WebCT discussions about course or content issues, reassure students of their continued success, and other confidence tactics.	C
CEE 4	Weeks 4-5	Remind students of assignment deadline, congratulate them on getting this far, reassure them of continued success, remind them to check their progress with the SAM 2003 reporting tools, offer reminder about multiple posttest attempts and other confidence tactics.	C

Note. Adapted from Visser, Plomp, Amirault and Kuiper (2002). CEE=Confidence-enhancing emails.

Present Materials

This section describes the specific steps involved in the delivery of the materials to treatment and to control groups.

1. Obtain list of all subjects, and randomly divide into treatment and control groups using a table of random numbers and the last four digits of the student identification number. There were two groups (one treatment and one control), each with approximately 1/2 of the total participants.

2. Place randomly selected groups into two separate, corresponding WebCT and SAM 2003 sections.

3. Email all participants, post in WebCT discussion, and explain:

a. A research project is being conducted to examine the effects of different instructional strategies in WebCT and SAM 2003.

b. Participants will be asked to complete four demographic surveys, assignments in WebCT and SAM 2003 (including posttests), the CIS and IMMS, and an evaluation questionnaire.

c. The above work will require minimal extra effort, around 30 minutes to one hour, beyond that of what is normally expected in the class for the semester.

d. Course credit will be given for participation and completion of all assignments.

e. Course grades will be averaged across treatment and control groups for the duration of the experiment and overall course grade will not be negatively impacted through participation. However, students will be encouraged to approach all work as if their grade will be affected.

f. Any individual results will be kept confidential.

4. Request voluntary participation through Web-based letter (see Appendix A). Students can continue with survey to accept participation, or they can decline to fill out the survey. Wording was: “By completing the survey questionnaires, I agree to my participation. I may decline participation by scrolling to the end of the survey and submitting the form without making any changes to the base responses.” In order to assure greater participation, students were offered minimal extra credit and chance to win a $50 gift certificate in a random drawing. It is unknown what external confidence-enhancing effect this may have had on the subjects beyond the effects designed for the treatment. However, since both groups were offered the extra credit and chance at the drawing, the overall effect was probably negligible.

5. Place follow-up emails and phone calls to any student not completing/declining participation in a timely manner. Results of declining participants were not used for the study.

6. Administer initial demographic surveys to all groups.

7. Remind subjects to register only for their assigned sections, and double-check placement in WebCT and SAM 2003.

8. Administer treatment to appropriate group.

9. At conclusion of treatment period, administer CIS and IMMS to all remaining subjects.

10. Explain to all subjects the purpose of the research, and offer to share results with those interested.

Table 7

Hypotheses, Instruments, and Statistical Analyses

Hypothesis	IMMS	CIS	Post test	Variables	Stat. Test
H_o1: There will be no statistically significant difference between the control group and the treatment group in terms of learner confidence.	C	C		IND=CT DEP=CIS score, IMMS score	Independent Samples t-test
$H_0 2$: There will be no statistically significant difference between the control group and the treatment group in terms of learner performance on posttest results.			Yes	IND=CT DEP= Posttest scores	Independent Samples t-test
$H_0 3$: There will be no statistically significant differences between the control group and the treatment group in terms of the remaining ARCS subsections of Attention, Relevance, and Satisfaction.	A,R,S	A,R,S		IND=CT DEP=CIS scores, IMMS scores	Independent Samples t-test
$H_0 4$: There will be no statistically significant differences between the control group and the treatment group in terms of overall motivation as measured by the total ARCS score.	TS	TS		IND=CT DEP=CIS score, IMMS score	Independent Samples t-test

Note. C=ARCS subscore for Confidence, A=ARCS subscore for Attention, R=ARCS subscore for Relevance, S=ARCS subscore for Satisfaction, CIS=Course Interest Survey, IMMS=Instructional Materials Motivation Survey, CT=Confidence Tactics, TS=ARCS total score.

Table 8

Availability of Confidence-Sustaining Strategies (CSS) and Confidence-Enhancing Strategies (CES) per Group

Confidence Strategies	Control	Treatment
CSS1: Allow the learner to escape and return to the menu at any time, and, if feasible, to page backwards.	Yes	Yes
CSS2: Give the learner control over pacing by hitting a key to go from one screen to the next.	Yes	Yes
CSS3: Match learning requirements to prerequisite knowledge and skills to prevent excessive challenge or boredom.	No	Yes
CES1: Use words and phrases that help attribute success to the learners' effort and ability.	No	Yes
CES2: Clearly present the objectives and the overall structure of the lesson.	No	Yes
CES3: Explain the evaluative criteria and provide opportunities for practice with feedback.	No	Yes
CES4: Mention the prerequisite knowledge, skills, or attitudes that will help the learner succeed at the task.	No	Yes
CES5: Tell the learner how many items are going to be in the test or drill and whether or not it will be timed.	No	Yes
CES6: Provide a summary.	No	Yes
CES7: Use a menu-driven structure to provide learner control over access to different parts of the courseware	Yes, but limited by deadlines	Yes

Note. Adapted from Song and Keller (2001).

CHAPTER 4

RESULTS

Introduction

The main purpose of this experiment was to test whether confidence-enhancing tactics would have an effect on distance learner confidence and performance. In addition, this study examined whether the confidence-enhancing tactics had any unanticipated effects on the other three ARCS components: attention, relevance and satisfaction. Lastly, this study explored whether the aforementioned tactics would produce statistically significant differences between the control group and the treatment group in terms of overall learner motivation. This experiment used SAM 2003 and WebCT Campus Edition™ software[*] for the delivery and presentation of the tactics, strategies, confidence-enhancing emails (CEE), and instructional course content. The confidence-enhancing effects of said tactics were gauged using two self-reporting surveys: the Course Interest Survey (CIS) and the Instructional Materials Motivation Survey (IMMS). Performance was based on posttest scores automatically generated in SAM 2003.

Four research questions were examined during the course of this study:

1. Will the confidence tactics used in this study produce statistically significant differences between the control group and the treatment group in terms of learner confidence as measured by the Confidence subsection of the CIS and IMMS?

2. Will the confidence tactics used in this study produce statistically significant differences between the control group and the treatment group in terms of learner performance based on posttest scores automatically generated in SAM 2003?

[*] Blackboard, Inc., www.blackboard.com

3. Since no intentional effort was made to enhance the Attention, Relevance and Satisfaction components of the ARCS model, will the confidence tactics used in this study produce any unintentional statistically significant differences in the scores of the remaining ARCS subsections of Attention, Relevance, and Satisfaction?

4. Will the confidence tactics used in this study produce statistically significant differences between the control group and the treatment group in terms of overall learner motivation as measured by the ARCS total score on the CIS and IMMS?

Review of the Research Methods Used

This study used a true experimental, posttest-only control-group design and was undertaken using quantitative methods (Gall, Gall & Borg, 2003). Two quantitative surveys were used to measure confidence and motivation: (a) the CIS, and (b) the IMMS. These two surveys were delivered in Web-based format. More detailed information concerning the two surveys used in this study may be found in the Instruments subsection of Chapter 3. Performance was also measured based on the difference between posttest scores automatically generated in SAM 2003.

The attention, relevance and satisfaction components of the ARCS model were not intentionally incorporated into the design of this study in order to better isolate the variable of Confidence in question.

Demographic Summary

The subjects in this study were undergraduate students enrolled in a for-credit course at a Texas university rated Carnegie Doctoral/Research Universities—Extensive. Subjects were selected from participants in a freshman-level computer course and were randomly assigned to either the treatment or the control group. This study was

conducted over a period of approximately five and one-half weeks. The initial population consisted of 81 (treatment *n*=41; control *n*=40) total students and included 37 males (treatment *n*=18; control *n*=19) and 44 females (treatment *n*=23; control *n*=21). More detailed demographic information about the participants can be found in the Subjects subsection of Chapter 3.

Data Analysis

The results of the study will be discussed beginning with Research Question 1 and concluding with Research Question 4. All statistical data were analyzed using SPSS version 13.0 for Windows with a preset alpha of .05.

Research Question 1

Research Question 1: Will the confidence tactics used in this study produce statistically significant differences between the control group and the treatment group in terms of learner confidence?

Research Question 1 examined whether or not the treatment materials had any effect on learner confidence. An independent samples *t*-test was chosen to compare the survey responses. An independent samples *t*-test is used when researchers want to compare the means of two independent groups on the dependent variable (Hinkle, Wiersma, & Jurs, 2003).

The specific null hypothesis tested:

H_o1 There will be no statistically significant differences between the control group and the treatment group in terms of learner confidence.

For the CIS, the computed p value of p=.004 causes one to reject the null hypothesis that the difference of the means between the treatment (*n*=38) and control

(*n*=37) groups is equal to zero. For the IMMS, the computed value (*p*=.080) causes one to fail to reject the null hypothesis that the difference of the means between the treatment and control groups are equal to zero.

To answer Question 1, the differences in learner confidence were analyzed using self-reported data from the CIS and the IMMS. Prior testing of all five components of this instrument (A, R, C, S and total ARCS score) has resulted in an overall Cronbach's alpha in excess of .80 for both the CIS and IMMS. For this study, the reliability alpha was .80 for the Confidence subscale of the CIS and .85 for the Confidence subscale of the IMMS.

Confidence as Measured by the CIS

The Confidence subsection of the CIS is a situational measure of the student's level of confidence for this particular online learning class. This surveys goal was to determine how confident students felt about this particular course. Table 9 shows the descriptive statistics for the Confidence subsection of the CIS. Table 10 reports the CIS Confidence results of the independent samples t-test for the treatment and control groups.

Table 9

Descriptive Statistics for Confidence Subsection as Measured by the CIS

Section	*N*	Mean	Std. Dev	Skewness	Kurtosis
Treatment	38	34.79	4.916	-1.010	.583
Control	37	31.46	4.857	-1.269	.759
Total	75	33.15	5.135	-.928	.863

Table 10

Results of t*-test for Confidence as Measured by the CIS*

Equal Variances Assumed per Levene's?	*t*	*Df*	*p*	Mean Difference	Std. Error Difference
Y	2.950	73	.004	3.330	1.129

The results from this survey showed a statistically significant difference between the treatment and control groups in terms of confidence for this course. Using the more traditional alpha of .05 (*p*=.05), the initial data output showed a statistically significant difference between the treatment and control groups on the Confidence subsection of the CIS. However, using the data to examine more than one possible comparison runs a risk of experimentwise error. *Experimentwise error rate* is defined "as the probability of making at least one Type 1 error for the set of all possible comparisons in an experiment" (Hinkle, Wiersma, & Jurs, 2003, p. 372).

To compensate for potential error, Hinkle, Wiersma, and Jurs (2003) recommend computing the experimentwise error rate using the following formula: $\alpha_E=c(\alpha)$ where *c* equals the number of comparisons, and *α* equals the comparisonwise error rate for each comparison. Since we are examining five possible comparisons with the ARCS survey instrument (A, R, C, S, and total score), the formula reads: .05=5(α) or α≤.01. In the case of the CIS confidence measure, the comparisonwise error rate was estimated to be α≤.01.

The problem with using this formula to control for experimentwise error is that it is highly conservative. According to Hinkle, Wiersma, and Jurs (2003), while this formula will control for experimentwise error, "it is extremely conservative and may result in no significant comparisons even when the *F* ratio . . . is significant" (p. 372).

However, for comparison purposes alpha was estimated at a conservative .01 (α≤.01) for all comparison measures in this study. Examining the original output with these new parameters for experimentwise error rates (p≤.01), one would still reject the null hypothesis. There was a statistically significant difference in confidence between the treatment and control groups as measured on the Confidence subsection of the CIS.

In addition to calculating statistical significance, it is important to calculate effect size. Cohen's *d* is an effect size measure based on the standard difference between two different means. Effect size gives a researcher "another measure of the magnitude of the difference expressed in standard deviation units in the original measurement" (Hinkle, Wiersma, & Jurs, 2003, p. 249). This aids researchers in determining the degree of practical importance of statistically significant findings.

Cohen (1988) hesitantly provided a guideline for interpreting effect sizes: small=.20; medium=.50; and large=.80 or greater. The decision to reject the null hypothesis on this measure was further supported by the relatively impressive effect size (d=.65) and estimated power (.65) at alpha .01. Table 11 displays the approximate effect size (d) and power of the results for the Confidence subsection of the CIS.

Table 11

Effect Size and Approximate Power for the Confidence Subsection of the CIS

Mean Difference	Pooled Estimate of Pop. Standard Dev.	*p*	Effect Size (*d*)	Approx. Power (*p*=.05)	Approx. Power (*p*=.01)
3.330	5.135	.004	.65	.87	.65

The distribution of the CIS scores on the Confidence variable for the treatment group can be compared to those of the control group (see Figure 1).

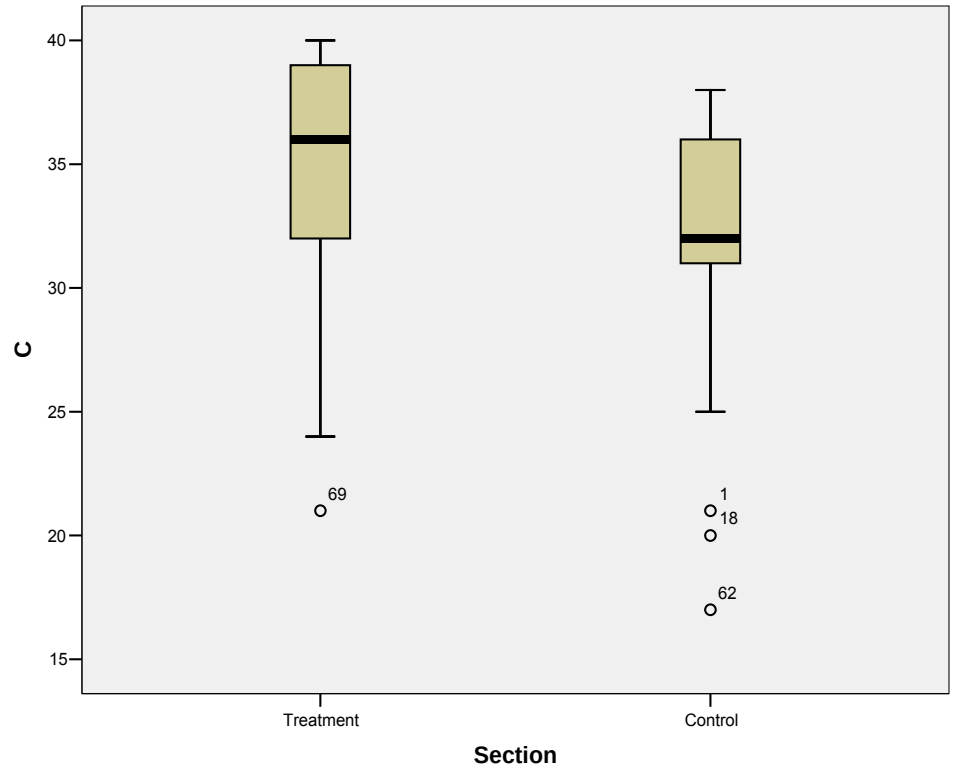


Figure 1. Distribution of scores on Confidence subsection of CIS survey for treatment and control groups. *Note*. C=Confidence.

Confidence as Measured by the IMMS

The Confidence subsection of the IMMS is a situational measure of the student's level of confidence for a particular set of instructional materials: in this case, the Access lessons presented in SAM 2003. The goal was to determine how confident students felt about this group of assignments. Table 12 shows the descriptive statistics for the Confidence subsection of the IMMS. Table 13 reports the IMMS Confidence results of the independent samples t-test for the treatment and control groups.

Table 12

Descriptive Statistics of Confidence Subsection as Measured by the IMMS

Section	*N*	Mean	Std. Dev	Skewness	Kurtosis
Treatment	35	31.77	7.276	-.607	-.207
Control	37	28.70	7.356	-.159	-.641
Total	72	30.19	7.428	-.348	-.619

Table 13

Results of t*-Test for Confidence as Measured by the IMMS*

Equal Variances Assumed per Levene's?	*t*	*df*	*p*	Mean Difference	Std. Error Difference
Y	1.779	70	.080	3.069	1.725

Examining the output with the established experimentwise error rate (p≤ .01), one would fail to reject the null hypothesis. The results from this survey did not show a statistically significant difference between the treatment (*n*=35) and control (*n*=37) groups in terms of Confidence as measured on the IMMS. However, the reported effect size (*d*=.41) and estimated power (.27) at alpha .01 cannot be dismissed as insignificant. Further study is warranted before a definitive conclusion can be drawn. Table 14 displays the approximate effect size (*d*) and power of the findings for the Confidence subsection of the IMMS. The computed value p=.080 causes one to fail to reject the null hypothesis that the difference of the means between the treatment and control groups are equal to zero.

Table 14

Effect Size and Approximate Power for the Confidence Subsection of the IMMS

Mean Difference	Pooled Estimate of Pop. Standard Dev.	*p*	Effect Size (*d*)	Approx. Power (*p*=.05)	Approx. Power (*p*=.01)
3.069	7.428	.080	.41	.53	.27

The distribution of the IMMS scores on the Confidence variable for the treatment group can be compared to those of the control group (see Figure 2).

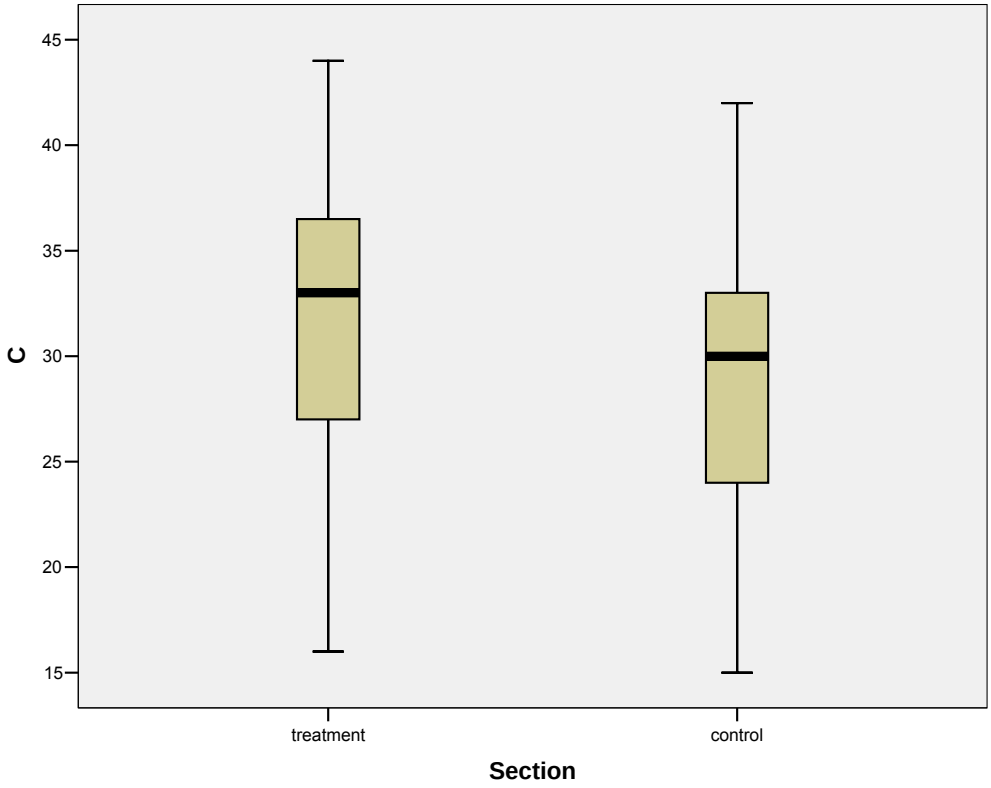


Figure 2. Distribution of scores on Confidence subsection of IMMS survey for treatment and control groups. *Note*. C=Confidence.

Research Question 2

Research Question 2: Will the confidence tactics used in this study produce statistically significant differences between the control group and the treatment group in terms of

learner performance as based on posttest scores automatically generated in SAM 2003?

Research Question 2 examined the effect of the confidence tactics on academic performance. In the case of this study, academic performance was defined as the comparison of posttest scores in SAM 2003 between the treatment and control groups.

To my knowledge, no prior reliability studies on the SAM 2003 posttests have been conducted. This study was the first to conduct a reliability measure for the scores on the Access posttests generated for use in this experiment. The overall reliability alpha for the Access SAM 2003 posttest scores was .86.

The specific null hypothesis tested:

H_o2 There will be no statistically significant differences between the control group and the treatment group in terms of learner performance as based on posttest scores automatically generated in SAM 2003.

Using established comparison parameters, one would reject the null hypothesis on the overall average ($p<.001$).

To answer Research Question 2, differences in academic performance were measured between the control group and the treatment group using automatically generated test scores in SAM 2003. Again, an independent samples *t*-test was chosen to compare posttest performance. There were eight posttest subsections delivered over the treatment period. The results examined each of these posttest subsections individually and then as an aggregate mean score for those completing all eight tests. Not every student completed every exam, which resulted in a slightly different *n* for each exam. Only those completing all eight exams were included in the aggregate mean score. For a break down of posttest performance by exam, see Appendix G. Table 15

provides the descriptive statistics for the overall average. Table 16 highlights average posttest performance.

Table 15

Descriptive Statistics for Average of Posttest Measures

Section	*N*	Mean	Std. Dev	Skewness	Kurtosis
Treatment	30	93.40	5.43189	-.702	.002
Control	26	86.10	7.38568	-.865	1.730
Total	56	90.0	7.33922	-.896	1.354

Table 16

Posttest Performance

Section	*N*	Mean	Std. Deviation	Std. Error Mean
Treatment	30	93.3958	5.43189	.99172
Control	26	86.0913	7.38568	1.4484

Table 17 shows that for the overall average ($p<.001$), one would reject the null hypothesis that there was no statistically significant difference in performance between the treatment and control groups with the most conservative of estimates.

Table 17

Results of Independent Samples t-test for Average

Equal Variances Assumed per Levene's?	*t*	*df*	*p*	Mean Difference	Std. Error Difference
Y	4.252	54	<.001	7.3044	1.718

Worthy of note was the effect size of 1 for the average mean score. This can be interpreted to mean that the treatment group (*n*=30), on average, scored approximately one standard deviation above the average mean of the control group (*n*=26). Another way of looking at it is that the mean of the treatment group was at approximately the 84th percentile of the control group. Though Cohen (1988) does caution against applying his guideline too rigidly, this most likely can be interpreted as a large effect size with substantial power (.91). Effect size and approximate power are shown in Table 18.

Table 18

Effect Size and Approximate Power for Average

Mean Difference	Pooled Estimate of Pop. Standard Dev.	*p*	Effect Size (*d*)	Approx. Power (*p*=.05)	Approx. Power (*p*=.01)
7.3044	7.3392	<.001	1	.98	.91

Figure 3 provides a box-plot of the score distribution for the average score.

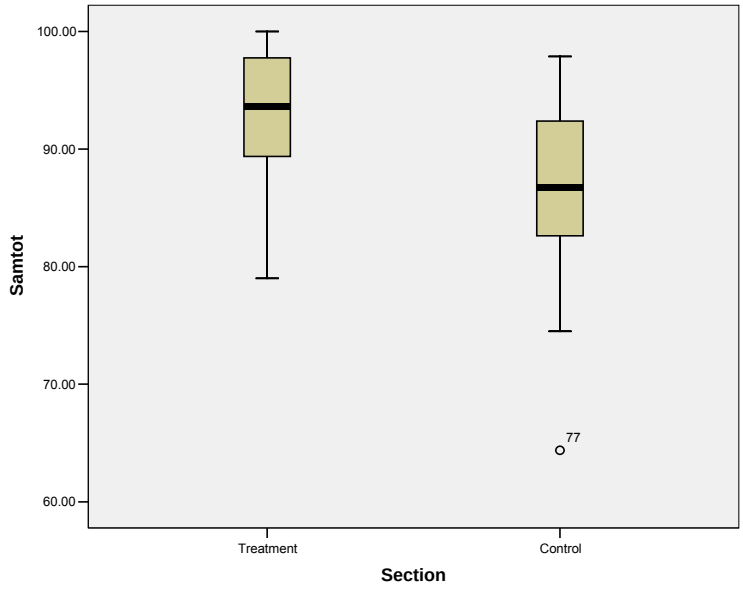


Figure 3. Score distribution of average posttest scores for subjects who completed all eight posttests in the treatment and control groups. *Note.* Samtot=Average of SAM 2003 scores for all eight posttest measures.

Research Question 3

Research Question 3: Will the confidence tactics used in this study produce any unintentional statistically significant differences in the scores of the remaining ARCS subsections of Attention, Relevance, and Satisfaction?

Research Question 3 examined whether the confidence-enhancing tactics had any unintentional effects on the remaining Attention, Relevance and Satisfaction subscales of the ARCS model.

The specific null hypothesis tested:

H_o3 There will be no statistically significant differences between the control group and the treatment group in terms of the remaining ARCS subsections of Attention, Relevance, and Satisfaction.

Research Question 3 addresses three separate hypotheses: one for each subsection. The results indicated that on the Attention subsection, for both the CIS and IMMS, one would fail to reject the null hypothesis. However, one would reject the null for the Relevance and Satisfaction subsections on both measures across the two groups. The results for each of these subsections are examined in detail below.

Attention

Like Confidence, Attention was measured using a subscale of the CIS and IMMS surveys. A detailed description on the Attention component of the ARCS model can be found under the Keller's ARCS Model subheading in Chapter 2 of this paper.

Prior testing of all five components of this instrument (A, R, C, S and total ARCS score) has resulted in an overall Cronbach's alpha in excess of .80 for both the CIS and IMMS. The Attention subscale of the CIS consists of 8 items; two of which are reverse items, and the obtained scores on this subscale have previously shown a reliability

alpha of .84 (Keller & Subhiyah, 1993). The Attention subscale of the IMMS consists of 12 items; five of which are reverse items, and the subscale has previously shown a Cronbach's alpha of .89 (Moller, 1993). For this study, the reliability alpha was .80 for the Attention subscale of the CIS and .86 for the Attention subscale of the IMMS.

An independent samples t-test was conducted to compare the results of the Attention subscale for both the CIS and IMMS surveys. Table 19 presents the results.

Table 19

Results of the Attention Subscale for Both the CIS and IMMS Surveys

Survey	Section	*N*	Mean	Std. Dev	*p*	Effect Size (*d*)	Approx. Power (*p*=.05)	Approx. Power (*p*=.01)
CIS	Treatment	38	25.79	5.813				
	Control	37	22.51	5.475				
	Total	75	24.17	5.848	.014	.56	.76	.49
IMMS	Treatment	35	38.63	8.558				
	Control	37	33.76	7.935				
	Total	72	36.13	8.545	.015	.57	.75	.48

As expected, at alpha .01 ($p \leq .01$) there was no statistically significant difference between the control (n=37) and treatment (n=38) groups for the Attention subscale on the CIS. In addition, there was no statistically significant difference between the control (n=37) and treatment (n=35) groups on the IMMS survey measure. The computed values of p=.014 for the CIS and p=.015 for the IMMS cause one to fail to reject the null hypothesis for both measures that the difference of the means between the treatment and control groups is equal to zero.

However, the medium effect sizes (CIS *d*=.56; IMMS *d*=.57), moderate power ratings (CIS=.49; IMMS =.48), and the relative consistency of findings across the other subsections warrant further study (perhaps with larger sample sizes) before a definitive conclusion can be drawn about the statistical and practical implications of the applied treatment.

Relevance

Relevance was also measured using a subscale of the CIS and IMMS surveys. A detailed description on the Relevance component of the ARCS model can be found under the Keller's ARCS Model subheading in Chapter 2 of this paper.

The Relevance subscale of the CIS consists of nine items; two of which are reverse items, and the obtained scores on this subscale have previously shown a reliability alpha of .84 (Keller & Subhiyah, 1993). The Relevance subscale of the IMMS consists of nine items; one of which is a reverse item, and the subscale has previously shown a Cronbach's alpha of .81 (Moller, 1993). For this study, the reliability alpha was .83 for the Relevance subscale of the CIS and .80 for the Relevance subscale of the IMMS.

An independent samples t-test was conducted to compare the results of the Relevance subscale for both the CIS and IMMS surveys. Table 20 presents the results.

Table 20

Results of the Relevance Subscale for Both the CIS and IMMS Surveys

Survey	Section	*N*	Mean	Std. Dev	*p*	Effect Size (*d*)	Approx. Power (*p*=.05)	Approx. Power (*p*=.01)
CIS	Treatment	38	36.79	6.156				
	Control	37	31.35	5.412				
	Total	75	34.11	6.379	<.001	.85	.97	.88
IMMS	Treatment	35	30.91	6.128				
	Control	37	26.43	5.091				
	Total	72	28.61	6.018	.001	.75	.93	.80

At alpha .01 ($p \leq .01$), *unexpectedly*, there was a statistically significant difference between the control (n=37) and treatment (n=38) groups for the Relevance subscale on the CIS. In addition, there was a statistically significant difference between the control (n=37) and treatment (n=35) groups on the IMMS survey measure. The computed values of $p<.001$ for the CIS and $p=.001$ for the IMMS cause one to reject the null hypothesis for both measures that the difference of the means between the treatment and control groups is equal to zero.

The impressive effect sizes (CIS d=.85; IMMS d=.75) and considerable power ratings (CIS=.88; IMMS =.80) lend credence to the claim that the treatment produced unintended effects on the participants' perception of Relevance for both the course (CIS) and the instructional materials (IMMS).

Satisfaction

Lastly, satisfaction was also measured using a subscale of the CIS and IMMS surveys. A detailed description on the Satisfaction component of the ARCS model can be found under the Keller's ARCS Model subheading in Chapter 2 of this paper.

The Satisfaction subscale of the CIS consists of nine items; two of which are reverse items, and the obtained scores on this subscale have previously shown a reliability alpha of .88 (Keller & Subhiyah, 1993). The Satisfaction subscale of the IMMS consists of six items with no reverse items, and the subscale has previously shown a Cronbach's alpha of .92 (Keller, 1993). For this study, the reliability alpha was .83 for the Satisfaction subscale scores of the CIS and .86 for the Satisfaction subscale scores of the IMMS.

An independent samples t-test was conducted to compare the results of the Relevance subscale for both the CIS and IMMS surveys. Table 21 presents the results.

Table 21

Results of the Satisfaction Subscale for Both the CIS and IMMS Surveys

Survey	Section	*N*	Mean	Std. Dev	*p*	Effect Size (*d*)	Approx. Power (*p*=.05)	Approx. Power (*p*=.01)
CIS	Treatment	38	35.05	6.102				
	Control	37	29.51	7.136				
	Total	75	32.32	7.153	.001	.78	.94	.83
IMMS	Treatment	35	18.94	5.104				
	Control	37	15.05	5.077				
	Total	72	16.94	5.420	.002	.72	.90	.73

At alpha .01 ($p \leq .01$), *unexpectedly*, there was a statistically significant difference between the control (n=37) and treatment (n=38) groups for the Satisfaction subscale on the CIS. In addition, there was a statistically significant difference between the control (n=37) and treatment (n=35) groups on the IMMS survey measure. The computed values of p=.001 for the CIS and p=.002 for the IMMS cause one to reject the null hypothesis for both measures that the difference of the means between the treatment and control groups is equal to zero.

The impressive effect sizes (CIS d=.78; IMMS d=.72) and considerable power ratings (CIS=.83; IMMS =.73) lend credence to the claim that the treatment produced unintended effects on the participants' perception of Satisfaction for both the course (CIS) and the instructional materials (IMMS).

In summary, for Research Question 3, one finds a consistent pattern of results across the two surveys. As expected, for both the CIS and IMMS, the Attention subsection showed no statistically significant change across the two groups. Most interesting, however, was the consistent pattern of statistically significant differences and respectable effect sizes for the Relevance and Satisfaction subsections on both measures across the two groups. Potential explanations for these findings are explored in Chapter 5.

Research Question 4

Research Question 4: Will the confidence tactics used in this study produce statistically significant differences between the control group and the treatment group in terms of overall learner motivation as measured by the ARCS total score on the CIS and IMMS?

The specific null hypothesis tested:

H_o4 There will be no statistically significant differences between the control group and the treatment group in terms of overall motivation as measured by the total ARCS score.

The computed values of $p<.001$ for the CIS and $p=.002$ for the IMMS cause one to reject the null hypothesis for both measures.

Both the CIS and IMMS generate an ARCS motivation score comprised of point totals from the four subsections. The ARCS total score represents the subjects' overall motivation for the course (CIS) and the instructional materials (IMMS). A detailed description of the ARCS model can be found under the Keller's ARCS Model subheading in Chapter 2 of this paper.

For this study, the reliability alpha for the total ARCS score was .93 for the CIS and .93 for the IMMS. An independent samples *t*-test was conducted to compare the results of the total ARCS score for both the CIS and IMMS surveys. Table 22 presents the *t*-test results.

Table 22

Results of the Total ARCS Score for Both the CIS and IMMS Surveys

Survey	Section	*N*	Mean	Std. Dev	*p*	Effect Size (*d*)	Approx. Power (*p*=.05)	Approx. Power (*p*=.01)
CIS	Treatment	38	132.42	19.868				
	Control	37	114.84	18.687				
	Total	75	123.75	21.109	<.001	.83	.96	.85
IMMS	Treatment	35	120.26	22.402				
	Control	37	103.95	20.141				
	Total	72	111.88	22.658	.002	.72	.90	.73

At alpha .01 ($p \leq .01$), there was a statistically significant difference between the control (n=37) and treatment (n=38) groups for the total ARCS score on the CIS. In addition, there was a statistically significant difference between the control (n=37) and treatment (n=35) groups on the IMMS survey measure. The computed values of p<.001 for the CIS and p=.002 for the IMMS cause one to reject the null hypothesis for both measures that the differences of the means between the treatment and control groups are equal to zero.

Further, the significant differences found for these measures showed impressive effect sizes (CIS d=.83; IMMS d=.72) with notable power levels (CIS=.85; IMMS =.73). Therefore, the conclusion that the students in the treatment group had greater overall levels of motivation than those in the control group for both the course (CIS) and the instructional materials (IMMS) is supported.

Figure 4 shows a comparison of mean ARCS scores on all sections for the CIS. Figure 5 shows a comparison of mean ARCS scores on all sections for the IMMS.

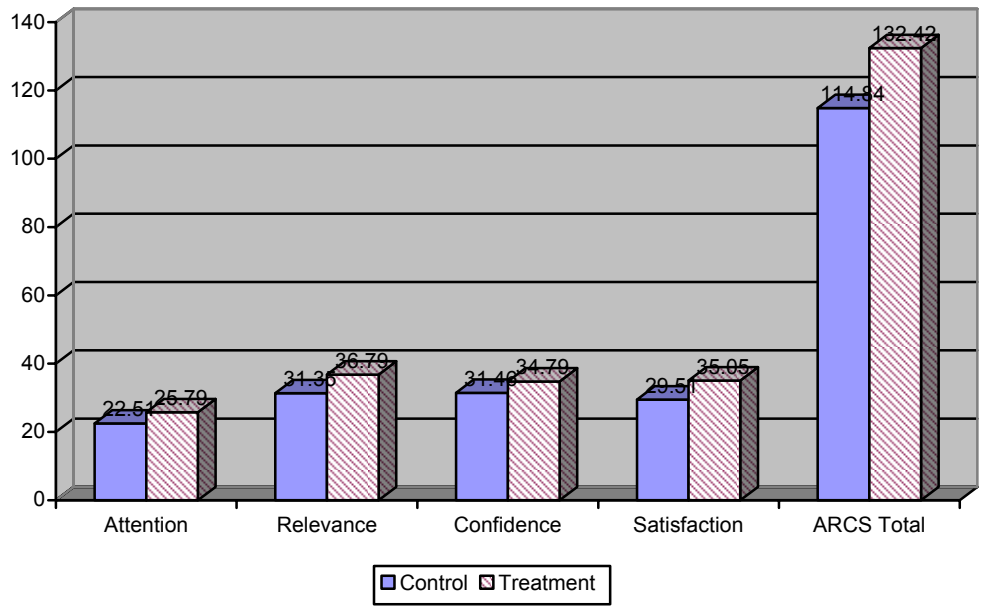


Figure 4. Comparison of mean ARCS scores for the CIS.

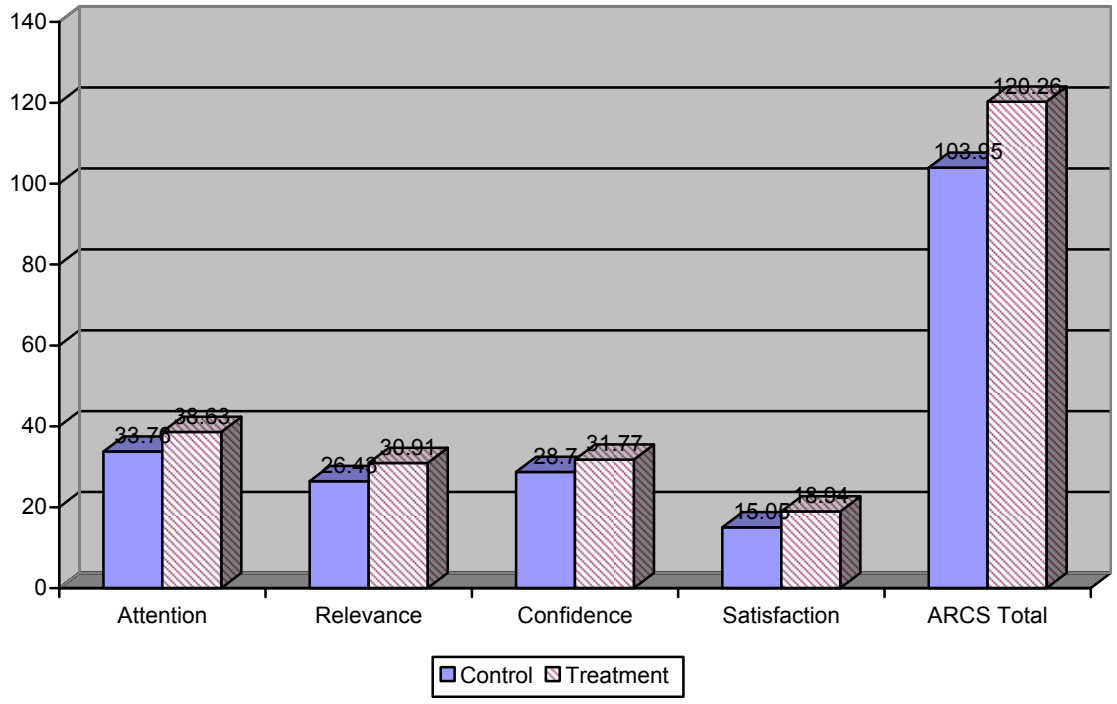


Figure 5. Comparison of mean ARCS scores for the IMMS.

Summary of Research Findings

For Research Question 1, quantitative results indicated there was a statistically significant difference between the treatment and control groups for Confidence as measured by the CIS (p=.004). This finding was further supported by the relatively impressive effect size (d=.65) and estimated power (.65) at alpha .01 for the Confidence subsection of the CIS.

In addition, results indicated there was not a statistically significant difference between the treatment and control groups for Confidence as measured by the IMMS (p=.080). However, the reported effect size (d=.41) and estimated power (.27) at alpha .01 cannot be dismissed as insignificant. Further study is warranted before a definitive conclusion can be drawn.

The results for Research Question 1 were mixed. The results suggest one can reject the null hypothesis as regards learner confidence for the class as measured by the CIS. However, one would fail to reject the null hypothesis as regards learner confidence when it comes to the instructional materials (IMMS). Possible reasons for this interesting discrepancy are explored in the next chapter.

For Research Question 2, a comparison of posttest scores between the treatment and control groups resulted in a rejection of the null hypothesis for the overall average (p<.001). Worthy of note was the effect size of 1 for the average mean scores of those who completed all of the posttests. This can clearly be interpreted as a large effect size with substantial power (.91). This supports the contention that the students in the treatment group, on average, outperformed the control group on the posttest measures.

Lastly, there were statistically significant differences in learner Relevance (CIS p<.001; IMMS p=.001), Satisfaction (CIS p=.001; IMMS p=.002), and total motivation (CIS p<.001; IMMS p=.002), as measured by the CIS and IMMS. Each of these variables had respectable effect sizes and power levels.

There were no statistically significant differences in learner Attention (CIS p=.014; IMMS p=.015) on either measure. However, the medium effect sizes (CIS d=.56; IMMS d=.57), moderate power ratings (CIS=.49; IMMS =.48), and relative consistency of findings across the other subsections merit further study (perhaps with larger sample sizes) before a definitive conclusion can be drawn about whether the treatment had any unintentional effect on Attention. Tables 23 presents a summary of the research findings.

Table 23

*Research Findings for CIS and IMMS (*p=*.01)*

	Stat. Sig. CIS?	Stat. Sig. IMMS?	Effect Size CIS	Effect Size IMMS
Attention	N	N	M	M
Relevance	Y	Y	M to L	L
Confidence	Y	N	M	S to M
Satisfaction	Y	Y	M to L	M to L
Total ARCS motivation score	Y	Y	L	M to L

Note. S=Small; M=Medium; L=Large.

This research study suggests the feasibility of improving learner motivation and performance through external conditions such as systematically applied confidence enhancing tactics. In addition, new and ubiquitous technologies such as SAM 2003 and WebCT appear to be effective vehicles for the efficient delivery of said tactics and emails. What was unclear in this study was whether individual subsections of the ARCS model (such as Confidence) can be individually manipulated. This study does not further claims about the discriminate validity of the separate categories of the ARCS model–a notion that has been supported by some researchers in the past (Keller, 1987a; Naime-Diefenbach, 1991).

Chapter 5 explores the findings in greater detail. It also discusses limitations and presents suggestions for future research.

CHAPTER 5

DISCUSSION

Introduction

Chapter 5 begins with a report and interpretation of the results of this study. The chapter continues with an examination of the implications of the results as well as a discussion of the limitations of the study. Finally, this chapter finishes with suggestions for future research.

General Report of Results

The present study was designed to ascertain whether learner confidence and performance could be affected by external conditions. The external conditions, in this case, were systematically applied confidence tactics based on the ARCS model. These tactics were delivered at a distance using SAM 2003 and WebCT Campus Edition™ software.*

This study also tested whether the aforementioned confidence tactics had any unintentional effect on the remaining Attention, Relevance and Satisfaction subscales of the ARCS model as well as on learners' overall motivation for the class and the instructional materials.

The study population consisted of 81 (treatment *n*=41; control *n*=40) undergraduate students enrolled in a distance education course where the ARCS-based confidence strategies and confidence-enhancing email messages were incorporated

* Blackboard, Inc., www.blackboard.com

into the SAM 2003 software and the WebCT environment. The content of the instructional materials involved training simulations of Microsoft® Access software. *

The treatment group showed statistically significant gains over the control group in terms of learner confidence on the Course Interest Survey (CIS) (p=.004) but not the Instructional Materials Motivation Survey (IMMS) (p=.080). In terms of performance, the treatment group outperformed the control group on all of the individual posttest measures and, most importantly, on the overall aggregate mean performance score (p<.001; d=1).

The results showed no statistically significant difference on the Attention subsection of the ARCS model between the groups for either the CIS or IMMS using a conservative alpha measure of p=.01.

Statistically significant differences were noted for the Relevance and Satisfaction subscales of the model even though no intentional effort was made to enhance any variable except Confidence. There was also a statistically significant difference in overall learner motivation as measured on both the CIS and IMMS.

This research study suggests the feasibility of improving overall learner motivation and performance through external conditions such as systematically applied confidence-enhancing tactics. The research further supports claims about the effectiveness of the ARCS model as a viable tool for enhancing learner motivation and performance. Based on obtained scores, this study also joins numerous others in establishing the overall reliability of the CIS survey (.93) and the IMMS survey (.93) as well as each of the individual subsections for both surveys (p≥.80 on all subsections).

* Microsoft Corporation, www.microsoft.com

These reliability findings further support Gabrielle's (2003) adaptation of the surveys to a Web-based format.

In addition, new and ubiquitous technologies such as SAM 2003 and WebCT appear to be effective vehicles for the efficient delivery of confidence-enhancing tactics. What was unclear in this study was whether individual subsections of the ARCS model, such as Confidence, can be independently manipulated. This study does not further assertions about the discriminate validity of the separate categories of the ARCS model–a claim that has been supported by some researchers in the past (Keller, 1987a; Naime-Diefenbach, 1991).

Interpretation of Research Questions

1. Will the confidence tactics used in this study produce statistically significant differences between the control group and the treatment group in terms of learner confidence as measured by the Confidence subsection of the CIS and IMMS?

The first research question intended to examine whether the treatment materials had any effect on learner confidence as measured by the CIS and the IMMS surveys. For Research Question 1, the treatment group's quantitative results indicated there was a statistically significant difference between the treatment and control groups for the Confidence subscale as measured by the CIS (p=.004). This is in contrast to the results of Gabrielle (2003), which did not show a difference on the Confidence subscale between groups.

In addition, results indicated there was not a statistically significant difference between the treatment and control groups for Confidence as measured by the IMMS (p=.080). This, too, is in contrast to Gabrielle's (2003) results; she found statistically

significant differences between groups as measured by the IMMS. However, this study's findings are supported by other researchers who specifically targeted confidence but failed to detect a statistically significant change in student confidence regarding the instructional materials (Moller, 1993; Naime-Diefenbach, 1991). For this study, one can reject the null hypothesis as regards learner confidence for the class (CIS). However, one would fail to reject the null hypothesis as regards learner confidence when it comes to the instructional materials (IMMS).

Theoretically, in this study, one would expect the results to reflect an increase in learner confidence on both the IMMS and CIS measures. In fact, given that many of the confidence tactics used in this study were specially designed to enhance the instructional materials, one would expect the IMMS to show a noticeable increase in learner confidence even if the CIS did not. However, quite the opposite was the case: the students in the treatment group found the tactics confidence-enhancing as regards the class as a whole but not the instructional materials. Moller (1993) failed to obtain changes in confidence as regards instructional materials and listed three possible explanations:

> 1) The ARCS model is insufficient for improving learner confidence; 2) the resulting tactics and methods used in the research were inappropriate for these subjects or implemented improperly; and 3) the differences were too small to measure using the selected empirical research methods. (p. 89)

To this and echoing (Babe, 1995), I would add: 4) perhaps the role of the confidence variable needs to be reexamined as one of the four main subsections of motivation.

Taking each of these possible explanations in turn, I agree with Moller (1993) that there is insufficient data to suggest that the ARCS model is somehow flawed or

incomplete when it comes to addressing learner confidence. The model has shown an ability to increase learner confidence even when confidence was not the focus of the investigations. The fact that the model, as a whole, can produce increases in confidence is not really in question. The question is more whether the individual subsection of Confidence can be targeted as a valid, independent construct that produces consistent results.

This study's rather mixed results suggest that confidence may indeed be a more abstract and complicated dimension in the overall realm of motivation than the ARCS model would lead one to believe. Naime-Diefenbach (1991) specifically targeted increases in learner attention and confidence and claims her study "validated the attention component of the ARCS model under controlled conditions" (p. 50). However, she could not make the same claim about confidence.

Much like this study, Moller (1993) failed to show increases in confidence (on the IMMS) for the treatment group in a study specifically designed to do so. Though overall motivation, performance and self-directed learning were the targets of Gabrielle's (2003) study, she found mixed returns on the Confidence subsection as well. Her results indicated a statistically significant difference between groups as regards Confidence on the IMMS but not the CIS. In a study designed only to enhance the Relevance subsection of the ARCS model, Babe (1995) also found statistically significant differences between groups for the Attention, Confidence and Satisfaction subsections as measured on the IMMS. Similar to this study, no enhancement strategies were employed in Babe's (1995) study for the subsections not under direct investigation.

Given the complexity of isolating confidence and of dealing with the cognitive and affective domains of the individual as well as concepts such as anxiety, locus of control, and fear of failure, it appears one weakness of the ARCS model may be its oversimplification of the abstract and highly complex concept of confidence. In order to obtain an increase in confidence, it may be necessary to take a more comprehensive approach to motivating students and include enhancements to the other ARCS components even if the desire is to focus on confidence alone. This is supported by researchers such as Marovitz and Buckley (1987) who felt the results of their experiment indicated "that the four factors of Keller's ARCS model are intricately bound together" (p.12). This would require a rethinking of the ARCS model as a series of related and not independent constructs for improving motivation (Babe, 1995).

The second possible explanation for the lack of a statistically significant difference in confidence regarding the instructional materials is that the confidence tactics and confidence-enhancing emails used in this study were ineffective or implemented improperly. This is always a possibility. As detailed in Tables 4 and 5, a few strategies that may have had an effect on confidence were "built-in" to the SAM 2003 software and could not be removed. This may have impacted this study. In addition, treatment group subjects indicated that they found some of the confidence tactics used in this study more effective than others.

Informal surveys of participants indicated they found the guide-sheets for each Access assignment and the email reminders, which incorporated all of the tactics under Component I: Learning Requirements and most of those under Component II: Success Opportunities, as confidence-boosting. However, only two students took advantage of

the opportunity, under Component III: Personal Control, to create their own exercises or methods of demonstrating competency. Also, under the same venue of personal control, only two students accessed the blog and threaded discussion on how to make the materials more interesting. Finally, even though students were given a choice to control their own sequencing, almost all chose to complete the assignments in the same order.

As stated earlier, researchers have linked increases in learner control to increases in confidence (and positive attitudes of learners) as well as decreases in learner anxiety (Bandura, 1977; Keller & Suzuki, 1988; Kinzie, 1990; Kinzie & Sullivan, 1989; Moller & Russell, 1994). Theoretically, it would seem that allowing for increased learner control would be confidence-boosting.

However, in this study, some members of the control group indicated an appreciation for the strict structure, deadlines and pacing. In contrast, a majority of treatment group students (64%), who were given personal control to complete the assignments at any time during a five-and-one-half-week window, waited until the last 72 hours to "cram in" most of the assignments before they were due. Only 24% of the treatment group finished the required assignments before the last week. According to Ferrari, Keane, Wolfe and Beck (1998) "as many as 70% of American college students engage in frequent academic procrastination" (p. 199). There is no real way of knowing how such procrastination affected the confidence levels of the treatment group, but one can imagine that procrastination brings with it an increase in learner anxiety. Anxiety has an inverse relationship to confidence, so the effect was probably not a positive one. Wolters (2003) cited more than a dozen studies linking procrastination to higher levels

of anxiety and lower levels of self-esteem. Milgram, Marshevsky, and Sadeh (1995) found that students with fewer abilities to manage their own learning requirements tended to procrastinate more when given a choice over when to begin their own tasks. This could account for the lack of difference in confidence as measured on the IMMS. If students are waiting to the last minute to complete the materials, the treatment really does not have very long to take effect.

This study involved a freshman level course. It is not unreasonable to assume that the subjects in this study (and undergraduates in general) may not be all that adept in managing the considerable demands on their time. Wolters (2003) recommended increasing proximal goals (timelines) for completion of assignments to increase students' self-efficacy. If this is true, one may need to reexamine certain aspects of personal control (including the tactics used in this study) to determine if they are indeed confidence-enhancing for subjects similar to those in this experiment. What seems clear is that the students in this study did not use some of the tactics as intended. In fact, some of the tactics used in this study (mostly those under Personal Control) may have the opposite effect of what was intended. Even Keller admits that allowing learners "to control the instructional strategy of a lesson may not be beneficial" (Klein and Keller, 1990, p. 145). Such findings further the idea that trying to isolate confidence when dealing with diverse groups of individuals, with differing levels of maturity, may be a more difficult process than first envisioned. This warrants further study.

In regards to the chosen duration of this study, a review of the research leads one to conclude that there has been no clear directive as to how much time it takes to note a statistically significant change in learner confidence. Moller (1993) writes:

> Assuming the longer an attitude is held the stronger it becomes, it may be unrealistic to assume that a measurable change [in confidence] can be detected using a short-term experimental design" (p. 92). Whether the model is effective at enhancing confidence over the short-term is questionable. Also, in question is what constitutes "short-term. (Moller, 1993)

Looking at previous studies one finds a diverse spectrum of study durations resulting in different assessments of subjects' confidence on the IMMS. For example, Moller (1993) and Naime-Diefenbach (1991) studied confidence using written instructional materials in one short, self-instructional lesson and showed no noticeable changes in confidence as measured on the IMMS. Babe (1995) used a longer instructional lesson with relevance-enhancing strategies and showed an increase in learner confidence on IMMS. This study used a five-and-one-half-week treatment period with no confidence changes on the IMMS but notable changes on the CIS. Gabrielle (2003) applied her treatments, to a highly homogenous group of military cadets, over one long semester and showed increases in confidence on the IMMS but not the CIS. In short, there is no clear picture of how much time is necessary to identify noticeable confidence changes for the instructional materials or the class as a whole.

Third, another way of stating differences may be too small to measure is to say perhaps the IMMS survey is not sensitive enough to detect short-term changes. Though I was unable to locate anything that would indicate that the IMMS survey is somehow lacking in sensitivity as regards confidence, it seems possible that the IMMS survey may not be sensitive enough to detect short-term changes. Perhaps the confidence enhancements are producing a desired effect, but the survey cannot consistently detect the changes over the short-term. Given the continuously changing motivational nature of learners over time, the survey would need to be highly sensitive and/or delivered at

precisely the right time to accurately reflect learner changes in confidence in the short term. Over a relatively brief period, learners may not even be aware enough of a change to report it accurately.

Lastly, and perhaps most controversial, is the idea that the Confidence subsection should be reexamined as one of the four main constructs of the ARCS model of motivation. As stated earlier, there are undeniably innate aspects to confidence. With issues of maturity, anxiety, locus of control, and fear of failure (to name a few), confidence may not lend itself to easy encapsulation inside of a model. There is no doubt that confidence is a part of motivation, but the ARCS model implies that there are specific strategies and variables related only to confidence. These strategies for improving confidence are independent of the other ARCS components and, hence, can be individually targeted and manipulated. To quote Keller (1987a), "motivational interventions can be focused within a general category, or specific subcategory of the model" (p. 6).

Naime-Diefenbach (1991) claimed to have validated the independent Attention component of the ARCS model. Babe (1995), Nwagbara (1993), and Chang (2001) validated the usefulness of targeting the Relevance component, but Babe (1995) questioned its independent nature. I could not locate studies specifically targeting the Satisfaction component, but one can speculate that targeting instruction for increases in student satisfaction would not possess the same degree of complexity as enhancing learner confidence.

To my knowledge, all studies to date, including this one, that have used the ARCS model to specifically target confidence have failed to achieve statistically

significant results as reported by the IMMS. Possibly, placing the more abstract and difficult dimension of confidence on equal footing with the other components diminishes the conceptual validity of the model. It is something future researchers wishing to specifically target confidence should think about.

2. Will the confidence tactics used in this study produce statistically significant differences between the control group and the treatment group in terms of learner performance based on posttest scores automatically generated in SAM 2003?

The second research question sought to ascertain whether the treatment materials correlated to any statistically significant differences between the control group and the treatment group in terms of learner performance as based on posttest scores automatically generated in SAM 2003.

For Research Question 2, a comparison of posttest scores between the treatment and control groups, using a conservative alpha level of .01, resulted in a rejection of the null hypothesis for the overall average (p<.001). The treatment group's mean score was higher on all measures, and the effect sizes and power rating of all measures were impressive (see Appendix G). It is important to acknowledge that greater performance did take place.

The overall average of the posttest sections is the most important measure to consider in these findings. Students are graded on their overall performance and not on the individual subsections. This supports the contention that the students in the treatment group, on average, outperformed the control group on the posttest measures. This is inline with previous research findings that suggest increases in motivation can

translate into increases in performance or achievement (Bickford, 1989; Gabrielle, 2003; Song & Keller, 2001).

Since the treatment group was exposed to a pretest/performance exercise as a confidence tactic, some of the difference in scores may be attributable to a "practice effect." However, it is my contention that this effect would not account for all the variance in scores. Hence, the confidence tactics used in this study were most likely effective in enhancing student performance.

3. Since no intentional effort was made to enhance the Attention, Relevance and Satisfaction components of the ARCS model, will the confidence tactics used in this study produce any unintentional statistically significant differences in the scores of the remaining ARCS subsections of Attention, Relevance, and Satisfaction?

The third question really combines three hypotheses and examines whether the treatment materials used in this study produced any unintentional statistically significant differences in the scores of the remaining ARCS subsections of Attention, Relevance, and Satisfaction. Since no intentional effort was made to enhance the Attention, Relevance and Satisfaction components of the ARCS, one would assume that no change would be found. However, this was not the case on all subsections. The Relevance and Satisfaction levels were statistically *unequal* across the treatment and control groups.

The results indicated that there were statistically significant differences in learner Relevance (CIS $p<.001$; IMMS $p=.001$), and Satisfaction (CIS $p=.001$; IMMS $p=.002$), as measured by the CIS and IMMS. Of interesting note, there were no statistically

significant differences in learner Attention (CIS *p*=.014; IMMS *p*=.015) on either measure.

Research Question 3 resulted in a rejection of the null hypothesis as regards Relevance and Satisfaction and a failure to reject the null hypothesis as regards Attention.

By way of comparison to other studies, Moller (1993) in a study specifically designed to enhance confidence, showed no changes in confidence or in any of the remaining ARCS subsections of the IMMS. Gabrielle (2003) employed systematically designed motivational interventions and motivational messages. Regarding the CIS, she found statistically significant differences only for Attention with a moderate difference for Satisfaction (*p*=.076) and no difference on the Relevance and Confidence subsections. Regarding the IMMS, she found statistically significant differences on all subsections. In a study that specifically manipulated the Attention and Confidence subsections, Naime-Diefenbach (1991) showed a statistically significant increase in Attention but no increases in Confidence or the remaining ARCS subsections of the IMMS. As one can see, consistency of findings is an issue across studies.

One particular reason for the mixed findings in this study may be an overlap of the confidence tactics (see Table 4) and confidence-enhancing emails (see Table 6 and Appendix D) into the Attention, Relevance and Satisfaction components. For instance, providing the treatment group the opportunity to create their own exercises or methods of demonstrating competency (PC3) and allowing the treatment group access to a blog and threaded discussion for comments (PC5) may have enhanced attention or even relevance. Tactics such as these might stimulate the learner's curiosity to think of ideas

for improvement that increase feelings of "connectedness," or relevance, to the material. Allowing learners multiple entry points into the instruction (SO1), which catered to individual skills and avoided wasting time, might have increased the learner's sense of satisfaction as well as confidence.

Even though the confidence-enhancing emails used in this study were designed to stress only the confidence tactics and strategies (see Table 4 and Table 8), it does not seem unreasonable that they had an indirect effect on the treatment group's sense of attention, relevance and satisfaction. Simply receiving the emails might serve to gain learner attention. The concern, verbal praise, and goal reminders expressed in the messages could have served to increase learner satisfaction and improve a sense of connectedness (relevance) to the subject matter. Also, SAM 2003 is a simulation program and simulations and real world settings are suggested by Keller for enhancing both satisfaction and relevance (Babe, 1995).

If one allows that it is exceedingly difficult to isolate any one subsection of the model without some "bleed over" into the other subsections, then findings such as those presented here, do call into question the discriminate validity of the separate categories of the ARCS model. At the very least, this study shows, once again, how difficult it can be to truly try and isolate confidence for independent enhancement.

4. Will the confidence tactics used in this study produce statistically significant differences between the control group and the treatment group in terms of overall learner motivation as measured by the ARCS total score on the CIS and IMMS?

The fourth and final research question sought to ascertain whether the treatment materials correlated to any statistically significant differences between the control group

and the treatment group in terms of overall learner motivation as measured by the CIS and IMMS. The data indicated a statistically significant finding for total motivation on both measures (CIS $p<.001$; IMMS $p=.002$). This is consistent with other research findings (Bickford, 1989; Gabrielle, 2003). Therefore, the null hypothesis can be rejected.

Perhaps the most important finding is that overall motivation can be enhanced in learners through the application of external factors. That was the belief which initially guided this study and, despite any disagreement about the validity of the independent components of the ARCS model, the model, as a whole, once again shows that it is an effective design tool for increasing overall learner motivation. The findings of this study confirm decades of previous research that motivation is a critical component to learning (Keller, 1979, 1987a, 1987b, 1987c; Means, Jonassen & Dwyer, 1997; Song & Keller, 2001). This study also furthers the body of research by affirming the ARCS model as a viable model for increasing motivation and performance in distance education settings.

Lastly, as regards the delivery platform, the study suggests that new and ubiquitous technologies such as SAM 2003 and WebCT email appear to be effective vehicles for the efficient delivery of the confidence-enhancing tactics and emails.

Implications of the Research Findings

The overwhelming body of research indicates that while motivation is an important aspect of learning, there is a noted lack of research concerning the motivational needs of learners (Astleitner & Keller, 1995; Gabrielle, 2003; Means, Jonassen & Dwyer, 1997; Shellnut, Knowlton & Savage, 1999; Visser & Keller, 1990).

However, even though literature supporting the need for enhancing learner motivation can be frequently found, the study of motivation in distance education, Web-based environments and other forms of distant CAI is sorely lacking (Gabrielle, 2003; Lee & Boling, 1996; Rezabeck, 1994).

This study sought to address this gap in the literature. Specifically, the study addressed three areas of the literature that needed further examination: (a) improving the confidence and motivation of distance learners through the systematic application of specifically designed interventions, (b) improving the performance of distance learners through the systematic application of specifically designed interventions, and (c) delivering these interventions through the use of emerging technologies.

The results of this study offer several suggestions for future researchers and instructional designers. Overall motivation can be enhanced in distance learners through the application of carefully crafted external factors such as confidence tactics and confidence-enhancing emails. The performance results of this study show that motivation is a powerful force in learning. This study confirms that systematically designed and carefully applied tactics can improve performance.

If one believes that distance environments pose greater challenges to learner motivation than their face-to-face counterparts, then a well-thought out systematic approach to manipulating distance learner motivation is an important design consideration.

Keller's ARCS model is an effective design tool for building motivational enhancements and emails into distance education environments, and one should not

shy away from using Keller's ARCS model as a conceptual framework for new and emerging technologies.

This study shows that targeting learner confidence can produce improvements in overall motivation and performance. This study offers many different confidence-enhancing tactics and emails examples that can be easily modified or adapted to fit a wide range of applications for both distant and face-to-face learning environments.

While the study did not support the discriminate validity of the separate category of Confidence, it does provide future designers with material proven useful for increasing overall motivation and performance. One implication future designers may wish to take from this study is to focus less on individual aspects of the ARCS model and more on a learner's overall sense of motivation. To this end, confidence is a powerful variable that needs to be included in instructional design.

Lastly, this study indicates that the use of new and emerging technologies such as SAM 2003 and WebCT email may be efficient and effective vehicles for incorporating ARCS-based enhancements designed to improve learner motivation and performance. SAM 2003 and WebCT are widely used applications, and the information presented in this study should be of benefit to the numerous instructors and designers who employ these ubiquitous applications.

Limitations of the Study

This study is intended to be generalized to the population that it represents. In this case, the study's subjects were undergraduate students at a large four-year university enrolled in a for-credit, distance education, basic computer skills class.

Additionally, a posttest-only design was used in this experiment so random assignment may not have been completely successful in eliminating all differences among the treatment and control groups. This may have had an adverse effect on the results though there was no indication of this.

Not all subjects completed all required assignments and some subjects were omitted from consideration due to incorrect/incomplete survey results. Participation was entirely voluntary. In order to assure greater participation, students were offered minimal extra credit and a chance to win a $50 gift certificate in a random drawing. It is unknown what external motivational effect this may have had on the subjects beyond the confidence-enhancing effects designed for the tactics. However, since both groups were offered the extra credit and chance at the drawing, the overall effect was probably negligible.

The confidence-enhancing tactics and emails used in this study were based on the my interpretation of what constituted confidence enhancements as well adaptations of earlier works by Moller (1993); Moller and Russell (1994); L. Visser (1998); Visser, Plomp, Amirault and Kuiper (2002); and Gabrielle (2003).

Recommendations for Future Studies

The results and discussion of this study offer some indications for future research. First, more studies are needed that specifically target and analyze the subsection of Confidence before a clear conclusion can be drawn regarding the independent validity of this component. In addition, future studies might want to focus on the relationship among the components rather than the independent nature of each

component. Studying how the subcategories interact with one another may provide new ways of looking at the model.

Further studies of confidence and its relationship to motivation would be helpful. Specifically, it may be worthwhile to examine just how much confidence accounts for changes in motivation. Also, further studies should be conducted to determine the best tactics and strategies for improving confidence in different instructional contexts with a variety of delivery systems (paper, distance education, Web-based, site-based, etc).

If this study is to be replicated, some specific suggestions come to mind:

1. Use an instrument to get a baseline measure of learner confidence before applying the treatment. Getting a read on how confident learners are before beginning instruction may help explain any changes in confidence or lack thereof.

2. Replicate the study over a longer period of time to see if the IMMS detects any changes in confidence.

3. Replicate the study with more diverse populations and/or with different subject matter. One particular area of interest might be targeting more advanced students (graduate students).

4. Analyze the confidence tactics and emails used in this study to determine which tactics or emails might be most effective in a given context or if certain tactics or emails should be changed or excluded altogether. In particular, one may wish to reexamine the tactics based on Personal Control to determine if they have varying effects with differing audiences.

5. Replicate the study using different delivery methods for the tactics and emails. For instance, delivery via video or audio may enhance visual appeal and help the current generation discriminate and interpret important information at a higher level.

APPENDIX A

HUMAN SUBJECTS COMMITTEE APPROVAL FORM

UNIVERSITY of NORTH TEXAS

Office of Research Services

July 18, 2005

Jason Huett
Department of Technology and Cognition University of North Texas

Re: Human Subjects Application No. 05-196

Dear Mr. Huett:

As permitted by federal law and regulations governing the use of human subjects in research projects (45 CFR 46), the UNT Institutional Review Board has reviewed your proposed project titled "The Effects of ARCS-based Confidence Strategies on Distance Learner Confidence and Achievement." The risks inherent in this research are minimal, and the potential benefits to the subjects outweigh those risks. The submitted protocol and informed consent form are hereby approved for the use of human subjects in this study. Federal Policy 45 CFR 46.109(e) stipulates **that IRB approval is for one year only.**

Enclosed is the consent document with stamped IRB approval.

It is your responsibility according to U.S. Department of Health and Human Services regulations to submit annual and terminal progress reports to the IRB for this project.

Please mark your calendar accordingly. The IRB must also review this project prior to any modifications.

Please contact Shelia Bourns, Research Compliance Administrator, or Boyd Herndon, Director of Research Compliance, at extension 3940, if you wish to make changes or need additional information.

Sincerely,

Scott Simpkins, Ph.D. Chair

Institutional Review Board

P.O. Box 305250 . Denton, Texas 76203-5250 . (940) 565-3940 Fax (940) 565-4277. TTY (800) RELAYTX. www.unt.edu

Informed Consent

Principal Investigator: Jason B. Huett

"This project has been reviewed and approved by the University of North Texas Committee for the Protection of Human Subjects (940) 565-3940."

I do hereby consent to participate in this CECS 1100.020 study being conducted at the University of North Texas during the Fall semester of 2005. I understand that participation is entirely voluntary; I can withdraw my consent at any time and have the results of the participation returned to me, removed from the experimental records, or destroyed. I also understand that my instructor is working to develop strategies related to improving instructional delivery of the course material, and if I choose to, I will be asked to complete surveys regarding my participation.

There are no foreseen risks in participating, and I understand that my grade will not be negatively impacted through participation. Participation carries no extra workload beyond the surveys, and I will be expected to complete all required classroom assignments regardless of participation in this study. The results of this participation will be confidential and will not be released in any individually identifiable form without the prior consent of the participant unless required by law. In case any questions arise, I may contact Jason B. Huett, Computer Education and Cognitive Systems (CECS) graduate student/teaching fellow for the Department of Technology and Cognition, at telephone number (940) 565-4238 or his major professor, Dr. Jon Young at the Department of Technology and Cognition at telephone number (940) 565-2579.

I understand my rights as a research subject, and I voluntarily consent to participate in this study. I have been afforded the opportunity to ask questions and to discuss my participation with my researcher/instructor. By completing the survey questionnaires, I agree to my participation. I may decline participation by scrolling to the end of the survey and submitting the form without making any changes to the base responses.

About 15 minutes of your time is all that is needed for you to complete each survey. Please read the instructions at the start of the survey.

Select here to begin survey

APPENDIX B

INSTRUCTIONS

TREATMENT

Please read ALL of the following before beginning the *Microsoft Access* assignments.

General Introduction and Instruction Sheet

The next paragraphs contain some vital information about the class. I recommend you read carefully (and perhaps more than once) to make sure you understand all that follows.

The following *Microsoft Access* exercises were designed to accommodate the novice through expert learner. No matter what your current skill level, these exercises will enable you to learn the material efficiently and easily. In addition to this general instruction sheet, you will be given a "guide" sheet for each of the *Access* exercises which spell out, in detail, your objectives for each exercise. Each *Access* exercise will be consistent with the stated objectives. Rest assured that the materials are organized in a clear and easy to follow sequence with tasks generally sequenced from simple to more difficult. As this is a distance class, you may work from anywhere at anytime on any machine that has the *SAM 2003* software installed.

When you login and open the assignment page in *SAM 2003*, you will note that all eight *Access* assignments are available. You may work at your own pace and work through the differing assignments in any order. However, the materials are generally sequenced for easy to more difficult so you may find it advantageous to start with number one and proceed in order. There are no "trick" or excessively difficult questions. If you run into problems, try and be patient and work through them. Please note the overall due date for the *Access* assignments of _____. No late submissions will be allowed under ANY circumstances.

The following offers a detailed explanation of how the *SAM 2003* environment will operate:

To improve your chances for success, each assignment offers a "pretest exercise" labeled with an "A." This pretest is not graded and has no effect on your final average. What test "A" allows for is multiple entry points into the instruction. By this I mean, you will only receive training on the items you MISS in test "A." That is why it important to do your best on this exam. After all, it makes no sense to train you on what you already know. If you don't know any of the material, just skip the question, and you will be trained on what you missed or skipped once you are done.

When you have finished test "A" hit the "refresh" button in the top right corner of your SAM assignment page and the training will open. This will be labeled as "training." Again, you will be trained only on items you missed in test "A" and the training is not graded. You may go through the training as often as you like. **In order to advance to the final "B" exam, you must complete the "Apply" section of the training.** When you have completed your training, hit refresh again, and you will see a new test open labeled test "B." This is the final test for the exercise and the only one that is graded. It will be very similar to test "A." You may take test "B" up to SIX TIMES if you desire. SAM will tell you your grade after each attempt at test "B." Only your HIGHEST grade will count. However, it is always a good idea to do your best on the

first attempt to save yourself some time. As you can see, you can practice as much as you like and make as many mistakes as is necessary to learn the materials. Your success depends on you, and you will be successful!

As a reminder, you may check your progress at any time by going to the reports section in SAM. Also, you may further demonstrate your competency of the material by creating an extra credit *Access* database. Simply follow the directions on the extra credit handout.

In addition, I encourage you to post questions, comments, complaints and suggestions to the threaded discussion in *WebCT* (each assignment has its own discussion) or post your comments on our class blog at http://_____
I am particularly interested in your comments regarding how to improve the materials.

I look forward to working with you!

Sincerely,

Jason Huett

CONTROL

Directions

1. Login and open the "Assignments" page in *SAM 2003*.
2. The materials are self-instructional. Please follow all provided directions.
3. Open assignment labeled *Access* 1 "Training" and complete all training exercises. Training is not graded. You must complete the "Apply" stage of the training for ALL of the questions for the next test to open.
4. After you complete the training and have studied the material thoroughly, hit the refresh button in the top right corner of the *SAM 2003* assignment page, and a test labeled *Access* 1 "TEST" will become available. This test is graded.
5. Take the test.
6. Repeat this exact process for *Access* training and tests 2-8 IN ORDER as they open. Please note all time limits and due dates for training and exams. There will be NO exceptions made for late work or failure to complete assignments. Follow your provided class schedule concerning when each exam will be available.
7. If you miss any *Access* exercise window timetable, you will receive a grade of zero for that exam. For instance, Access 1 and 2 are due September 26th. After that date, no grades will be accepted.
8. As this is a distance class, you may work from anywhere at anytime on any PC machine that has the *SAM 2003* software installed. The training and tests will NOT open on a machine without the software installed.

`

APPENDIX C

SAMPLE GUIDE-SHEETS FOR TREATMENT GROUP

Guide Sheet for Access 1 Pathway

Welcome to your first *SAM 2003 Access* assignment. In this pathway, there are seven exercises where the following objectives will be covered:

1. Launching *Access*.
2. Creating a new *Access* database.
3. Using the Assistance area of *Microsoft Help* to find out information on the keywords.
4. Closing the *Microsoft Access* application.
5. Converting a database file from *Access* 2000 file format to *Access* 2002 - 2003 file format.
6. Using undo and redo.
7. Working with *Smart Tags*.

The *Microsoft Access* 1 exercise is designed to accommodate the novice through expert learner. No matter what your current skill level, these exercises will enable you to learn the material efficiently and easily. Remember, each pathway consists of a pretest (labeled "A"), a training exercise (labeled "Training"), and a graded posttest (labeled "B"). Remember, if you don't know how to do something on Test "A," just skip it, and you will be trained on it later. Please refer to your *General Introduction and Instruction Sheet* for specific information about how to proceed through the assignments.

Remember, when you have finished test "A," hit the "refresh" button in the top right corner of your *SAM* assignment page, and the training will open. This will be labeled as "training." Again, you will be trained only on items you missed in test "A," and the training is not graded. You may go through the training as often as you like. **In order to advance to the final "B" exam, you must complete the "Apply" section of the training.** You may take the "B" exam up to six times. Please note all due dates as they are firm.

As a reminder, you may check your progress at any time by going to the reports section in *SAM*. Also, you may further demonstrate your competency of the material by creating an extra credit *Access* database. Simply follow the directions on the extra credit handout.

In addition, I encourage you to post questions, comments, complaints and suggestions to the threaded discussion in *WebCT* (each assignment has its own discussion) or post your comments on our class blog at http://_____
I am particularly interested in your comments regarding how to improve the materials.

Good Luck!

Sincerely,
Jason Huett

Guide Sheet for Access 2 Pathway

Congratulations on finishing your first pathway. You are now ready for *Access 2.* In this pathway, there are twelve exercises where the following objectives will be covered:

1. Create databases using the *Database Wizard*
2. Edit records from a table using a datasheet
3. Edit records from a table using a form
4. Delete records from a table using a datasheet
5. Work with the *Task Pane*
6. Open *Access* objects in the appropriate views
7. Open a query
8. Open a form
9. Use navigation controls to move among records in a table
10. Use navigation controls to move among records in a form
11. Format a table or query datasheet for display
12. Apply a cell effect

Each pathway consists of a pretest (labeled "A"), a training exercise (labeled "Training"), and a graded posttest (labeled "B"). Remember if you don't know how to do something on Test "A," just skip it, and you will be trained on it later. Please refer to your *General Introduction and Instruction Sheet* for specific information about how to proceed through the assignments.

Remember, when you have finished test "A," hit the "refresh" button in the top right corner of your *SAM* assignment page, and the training will open. This will be labeled as "training." Again, you will be trained only on items you missed in test "A," and the training is not graded. You may go through the training as often as you like. **In order to advance to the final "B" exam, you must complete the "Apply" section of the training.** You may take the "B" exam up to six times. Please note all due dates as they are firm.

As a reminder, you may work at your own pace and work through the differing assignments in any order. However, the materials are generally sequenced for easy to more difficult so you may find it advantageous to start with number one and proceed in order. There are no "trick" or excessively difficult questions. If you run into problems, try and be patient and work through them.

Good Luck!

Sincerely,

Jason Huett

Guide Sheet for Access 3 Pathway

Two down and six to go! You are now ready for *Access 3*. In this pathway, there are eleven exercises where the following objectives will be covered:

1. Creating a table using the *Table Wizard*
2. Creating one or more tables in *Design View*
3. Defining text fields
4. Defining number and currency fields
5. Specifying the *Primary Key*
6. Switching between form view and datasheet view
7. Using the *Input Mask Wizard*
8. Adding a lookup field to a table using the *Lookup Wizard*
9. Changing the data type
10. Modifying field properties for one or more tables in *Table Design View*
11. Changing the format property of a field in *Table Design View*

Each pathway consists of a pretest (labeled "A"), a training exercise (labeled "Training"), and a graded posttest (labeled "B"). Remember if you don't know how to do something on Test "A," just skip it, and you will be trained on it later. Please refer to your *General Introduction and Instruction Sheet* for specific information about how to proceed through the assignments.

Remember, when you have finished test "A," hit the "refresh" button in the top right corner of your *SAM* assignment page and, the training will open. This will be labeled as "training." Again, you will be trained only on items you missed in test "A" and the training is not graded. You may go through the training as often as you like. **In order to advance to the final "B" exam, you must complete the "Apply" section of the training.** You may take the "B" exam up to six times. Only your HIGHEST grade will count. However, it is always a good idea to do your best on the first attempt to save yourself some time. As you can see, you can practice as much as you like and make as many mistakes as is necessary to learn the materials. Your success depends on you, and you will be successful!

Please note all due dates as they are firm.

Good Luck!

Sincerely,

Jason Huett

APPENDIX D

EXAMPLES OF CONFIDENCE-ENHANCING EMAILS

Dear _____ Students,

It is my privilege to welcome you to the fall semester of _____. This letter serves to introduce myself and to offer you some advice and recommendations about the course and the assignments you will be completing for this class. I want you to enjoy and learn from this class, and I have no doubt that you will be successful!

First, let me give you a brief personal introduction. My name is Jason Huett. I have taught this online section of ____ for two years now. In addition, I have taught numerous university courses for the last 13 years. I am in the process of completing my Ph.D. in Educational Computing. If you would like to learn more about me, please feel free to access my personal Website at http://_____/

Second, I would like to offer some suggestions regarding how to proceed with the class.

1. Make sure you have logged into the correct *SAM 2003* section. Your section is _____
2. Make sure you read and follow all the directions on your assignment sheets for each pathway.
3. Remember, *SAM 2003* pathways are numbered from one to eight in a clear and easy to follow sequence. While the assignments are available for you to complete in any order, they are generally sequenced from simple to more difficult.
4. Pay attention to due dates. You have one due date for all eight *Access* pathways. Set a schedule for completion of the assignments, and stick to it. Please do not procrastinate.
5. Do as well as you can on the pretest but don't worry if you don't know all the answers. Feel free to skip any question you don't know how to do.
6. You can take the posttest up to six times if you desire. I will only count your highest grade.

In these assignments, you have complete control of your pacing, your sequencing, your place of study, and you can have multiple attempts at the graded portion of the pathway. You will be given feedback regarding your performance in terms of a percent grade (e.g. 84% correct) on each exam by *SAM 2003*. You can also access your progress report at any time by clicking on the reports button in *SAM 2003*.

Lastly, I also encourage you to submit any comments you have concerning these assignments and how they can be improved to the ___section of the discussion board in *WebCT*. I have also set up a blog (short for Web-log) where you can record your thoughts, comments, and ideas at http://_____ Give it a try!

Your success in this class depends entirely on you, and you will be successful!

If you ever need my help or have any questions, please do not hesitate to contact me via email at_____. If it is an emergency, I can be reached on my cell at ___
I look forward to working with you this semester.

Sincerely,

Jason Huett

Hello Again ____ Students,

I hope are doing great! I sent a letter out last week introducing myself and reminding you of what is expected in this class. If you are anything like me, you might have a tendency to procrastinate or have a tough time getting started. Don't worry—there is still time.

Ideally, by the end of this first week, you will have completed at least two of the *SAM 2003 Access* assignments. If not, I suggest you create a schedule for yourself to make sure you complete the remaining assignments by the scheduled due date of ____.

Periodically, I check the reports in *SAM 2003* just to see how you are doing. If you haven't completed an assignment yet, I look forward to seeing your successful completion in the near future. If you wish to successfully complete this course (as I am sure you do!), it is important to complete *SAM 2003* pathways in a timely manner.

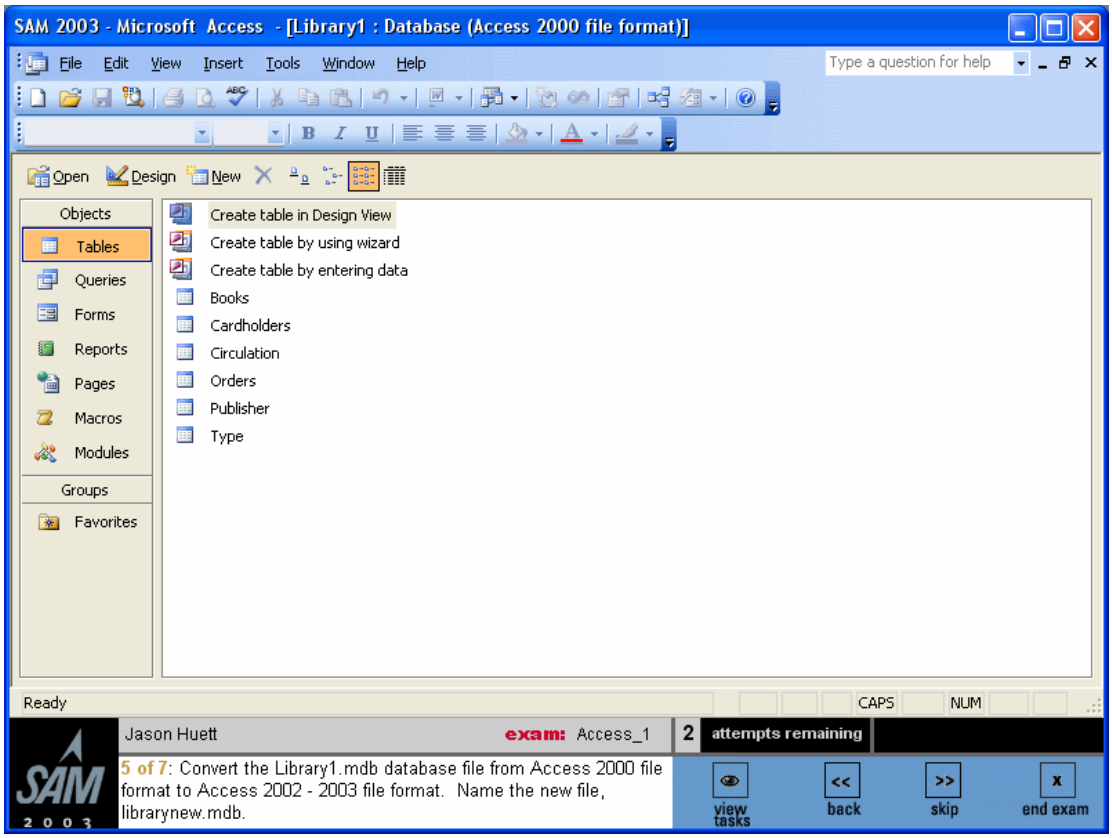
From some emails I have received, I note that some of you are experiencing confusion and/or difficulties with the *SAM 2003* software. You may feel a bit overwhelmed by the amount of information presented in the pathways. Fear not! You still have plenty of time. If you have yet to begin, try and complete at least 3 assignments per week. That will guarantee that you finish on time. Remember, you can also create a database in *Access* for extra credit if you desire. Simply follow the directions on the extra credit handout.

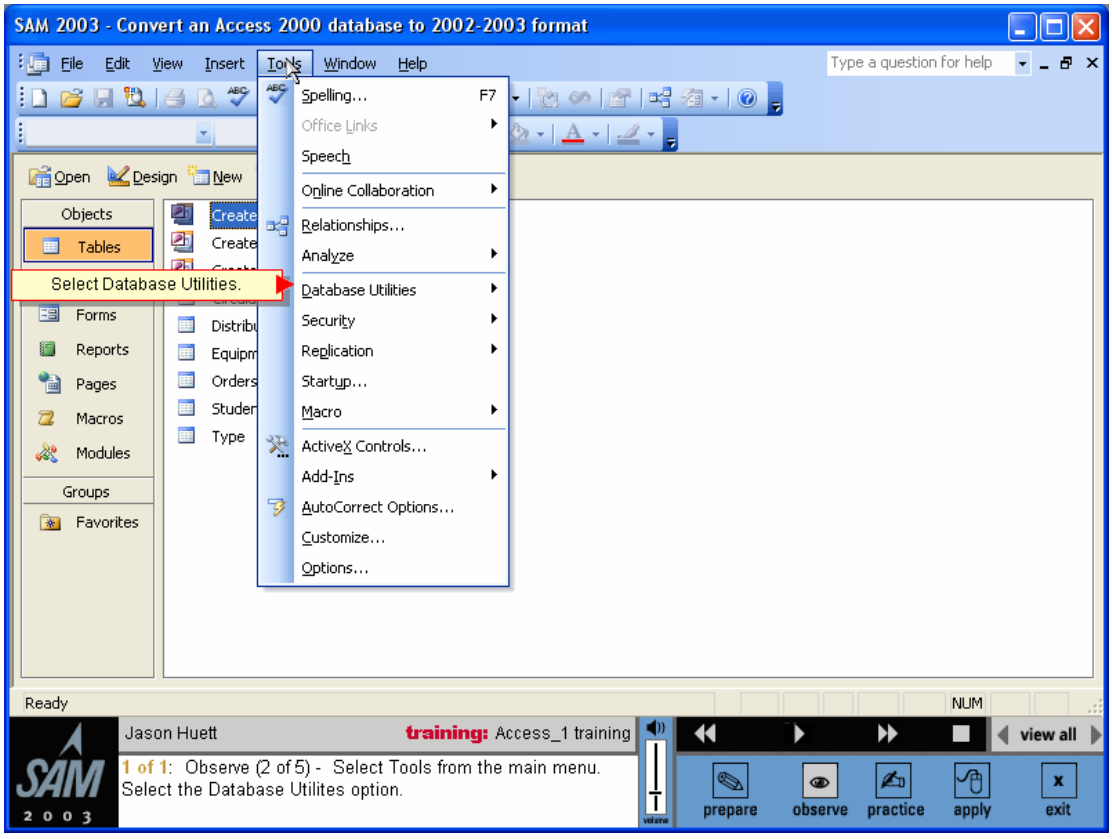
I am very sure you will be successful. If you ever need my help or have any questions or concerns, please do not hesitate to contact me via email at_____. If it is an emergency, I can be reached on my cell at___
Good Luck!
Jason Huett

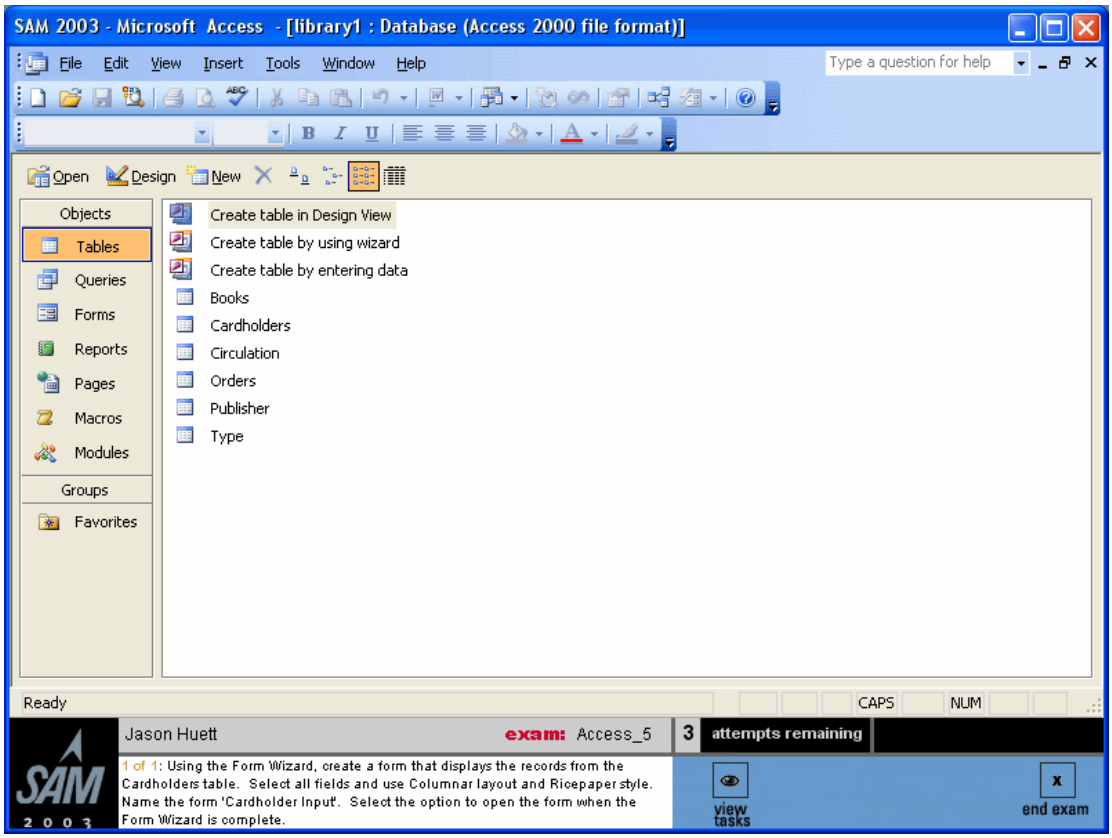
APPENDIX E

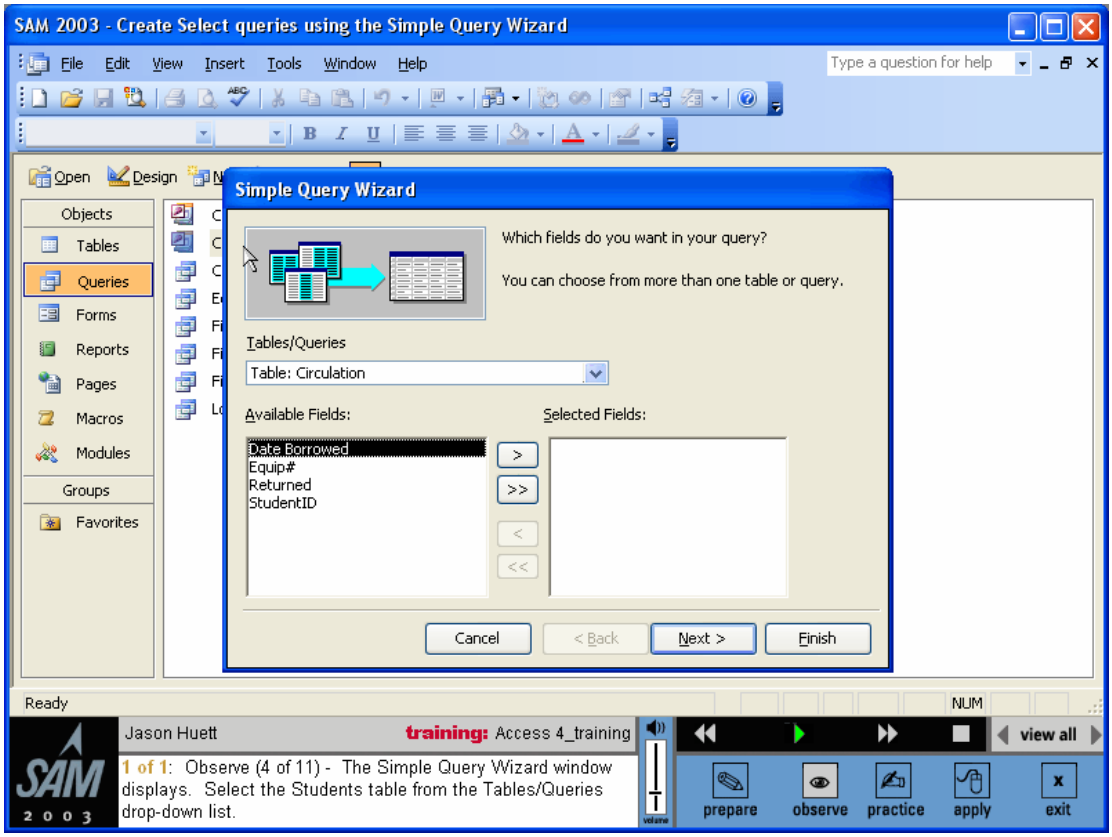
SAMPLE SCREEN-SHOTS OF SAM 2003

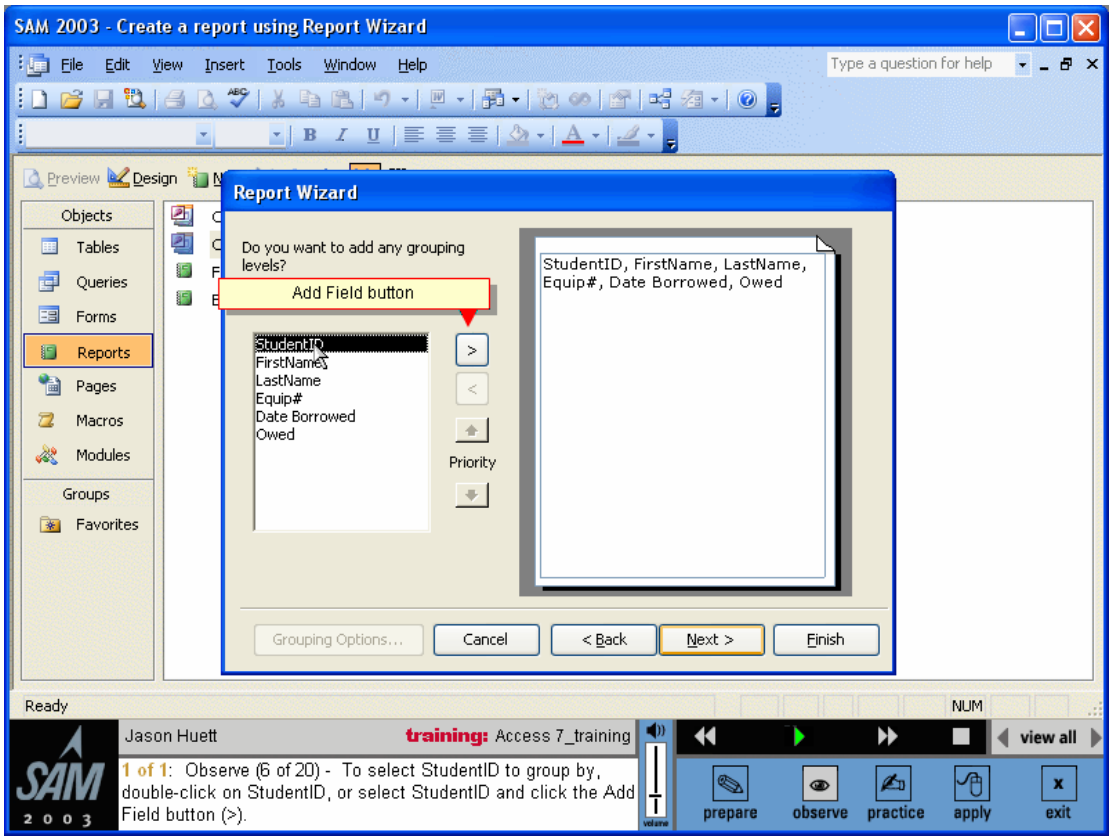
(REPRODUCED WITH PERMISSION FROM THOMSON COURSE TECHNOLOGY)

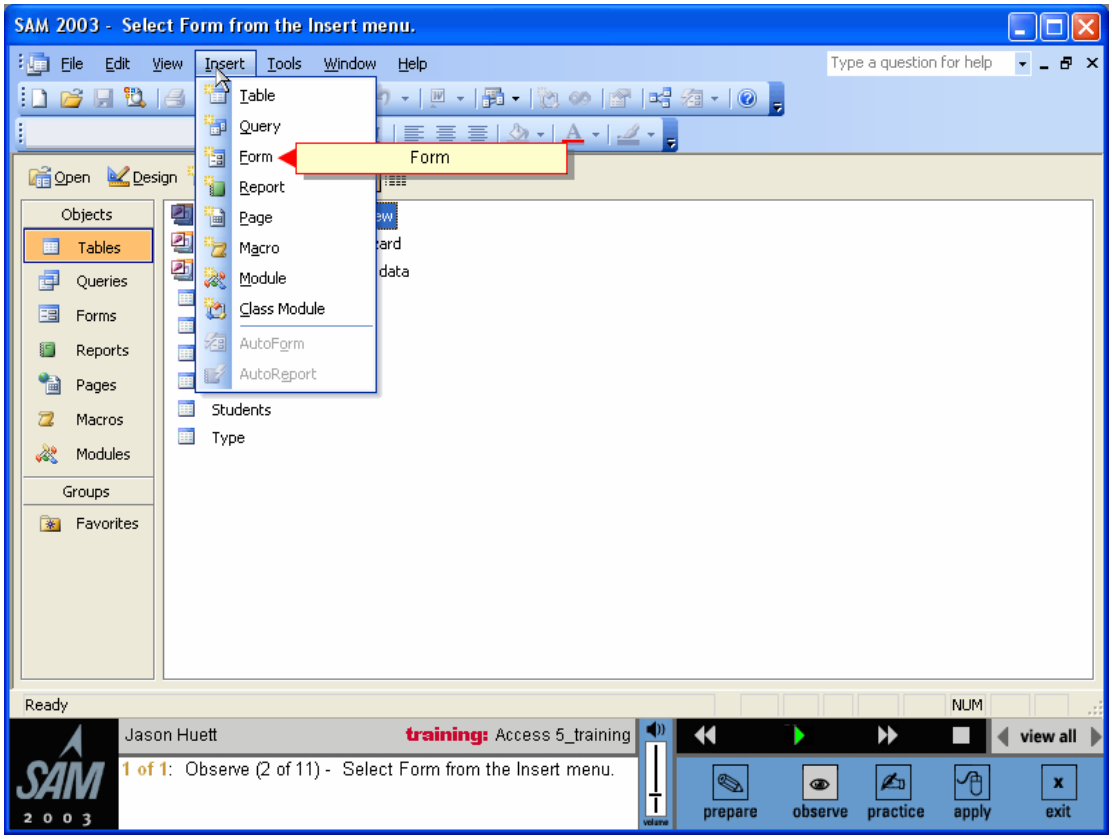

SAM 2003 - Microsoft Access - [Library1 : Database (Access 2000 file format)]
File Edit View Insert Tools Window Help
Type a question for help
Open Design New
Objects
Tables
Queries
Forms
Reports
Pages
Macros
Modules
Groups
Favorites
Create table in Design View
Create table by using wizard
Create table by entering data
Books
Cardholders
Circulation
Orders
Publisher
Type
Ready
CAPS NUM
Jason Huett
exam: Access_1
2 attempts remaining
5 of 7: Convert the Library1.mdb database file from Access 2000 file format to Access 2002 - 2003 file format. Name the new file, librarynew.mdb.
view tasks
back
skip
end exam

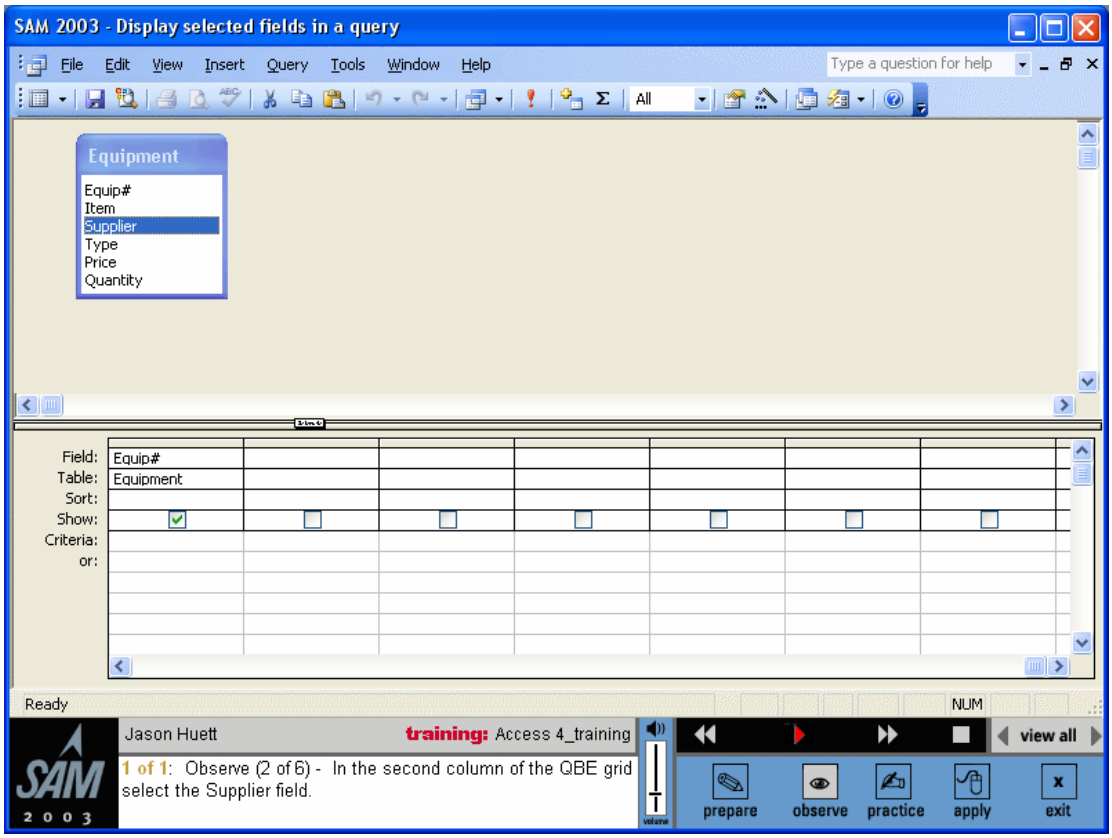

SAM 2003 - Convert an Access 2000 database to 2002-2003 format
File Edit View Insert Tools Window Help
Type a question for help
Spelling... F7
Office Links
Speech
Online Collaboration
Relationships...
Analyze
Database Utilities
Security
Replication
Startup...
Macro
ActiveX Controls...
Add-Ins
AutoCorrect Options...
Customize...
Options...
Select Database Utilities.
Open Design New
Objects
Tables
Forms
Reports
Pages
Macros
Modules
Groups
Favorites
Type
Ready
NUM
Jason Huett
training: Access_1 training
view all
1 of 1: Observe (2 of 5) - Select Tools from the main menu. Select the Database Utilites option.
prepare
observe
practice
apply
exit

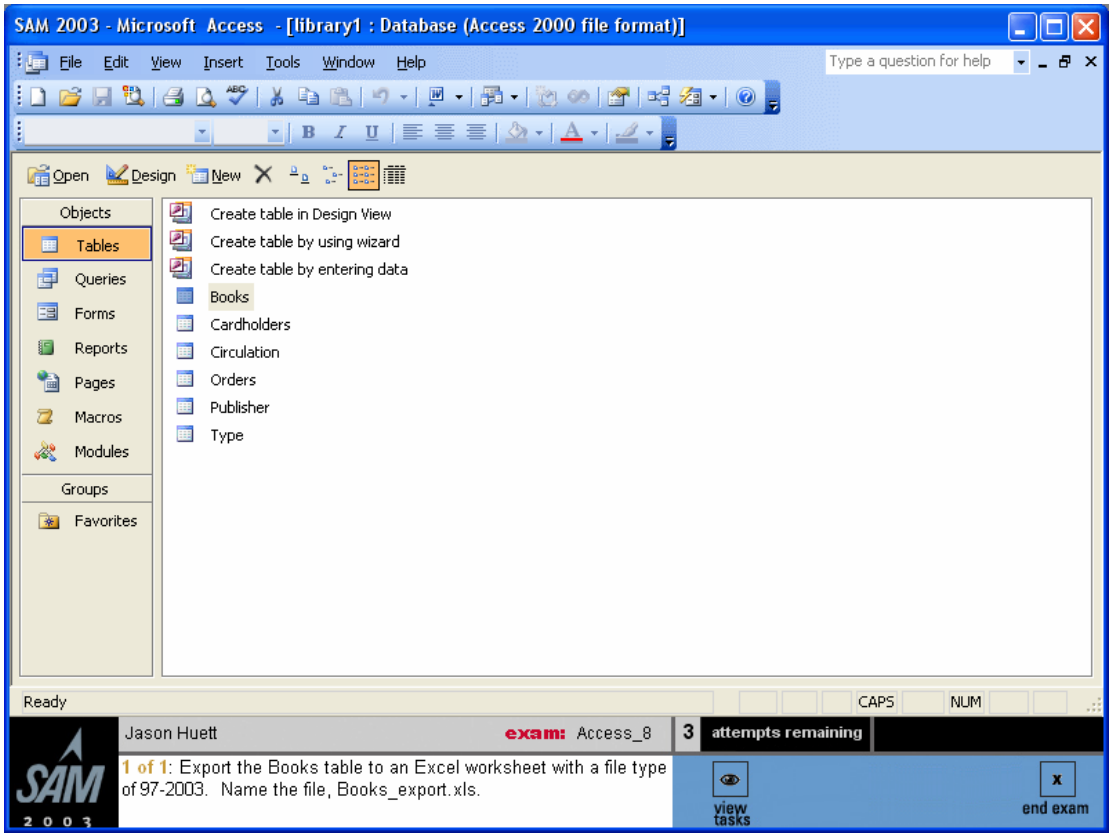

SAM 2003 - Microsoft Access - [library1 : Database (Access 2000 file format)]
File Edit View Insert Tools Window Help
Type a question for help
Open Design New
Objects
Tables
Queries
Forms
Reports
Pages
Macros
Modules
Groups
Favorites
Create table in Design View
Create table by using wizard
Create table by entering data
Books
Cardholders
Circulation
Orders
Publisher
Type
Ready
CAPS NUM
Jason Huett
exam: Access_5
3 attempts remaining
1 of 1: Using the Form Wizard, create a form that displays the records from the Cardholders table. Select all fields and use Columnar layout and Ricepaper style. Name the form 'Cardholder Input'. Select the option to open the form when the Form Wizard is complete.
view tasks
end exam


SAM 2003 - Create Select queries using the Simple Query Wizard
File Edit View Insert Tools Window Help
Type a question for help
Open Design
Objects
Tables
Queries
Forms
Reports
Pages
Macros
Modules
Groups
Favorites
Simple Query Wizard
Which fields do you want in your query?
You can choose from more than one table or query.
Tables/Queries
Table: Circulation
Available Fields:
Date Borrowed
Equip#
Returned
StudentID
Selected Fields:
Cancel
< Back
Next >
Finish
Ready
NUM
Jason Huett
training: Access 4_training
1 of 1: Observe (4 of 11) - The Simple Query Wizard window displays. Select the Students table from the Tables/Queries drop-down list.
view all
prepare
observe
practice
apply
exit


SAM 2003 - Create a report using Report Wizard
File Edit View Insert Tools Window Help
Type a question for help
Preview Design
Objects
Tables
Queries
Forms
Reports
Pages
Macros
Modules
Groups
Favorites
Report Wizard
Do you want to add any grouping levels?
Add Field button
StudentID
FirstName
LastName
Equip#
Date Borrowed
Owed
Priority
StudentID, FirstName, LastName, Equip#, Date Borrowed, Owed
Grouping Options...
Cancel
< Back
Next >
Finish
Ready
NUM
Jason Huett
training: Access 7_training
1 of 1: Observe (6 of 20) - To select StudentID to group by, double-click on StudentID, or select StudentID and click the Add Field button (>).
SAM 2003
view all
prepare
observe
practice
apply
exit


SAM 2003 - Select Form from the Insert menu.
File Edit View Insert Tools Window Help
Type a question for help
Table
Query
Form
Report
Page
Macro
Module
Class Module
AutoForm
AutoReport
Form
Open Design
Objects
Tables
Queries
Forms
Reports
Pages
Macros
Modules
Groups
Favorites
Students
Type
Ready
NUM
Jason Huett
training: Access 5_training
1 of 1: Observe (2 of 11) - Select Form from the Insert menu.
SAM 2003
view all
prepare
observe
practice
apply
exit


SAM 2003 - Display selected fields in a query
File Edit View Insert Query Tools Window Help
Type a question for help
Equipment
Equip#
Item
Supplier
Type
Price
Quantity
Field: Equip#
Table: Equipment
Sort:
Show:
Criteria:
or:
Ready
NUM
Jason Huett
training: Access 4_training
1 of 1: Observe (2 of 6) - In the second column of the QBE grid select the Supplier field.
view all
prepare
observe
practice
apply
exit


SAM 2003 - Microsoft Access - [library1 : Database (Access 2000 file format)]
File Edit View Insert Tools Window Help
Type a question for help
Open Design New
Objects
Tables
Queries
Forms
Reports
Pages
Macros
Modules
Groups
Favorites
Create table in Design View
Create table by using wizard
Create table by entering data
Books
Cardholders
Circulation
Orders
Publisher
Type
Ready
CAPS
NUM
Jason Huett
exam: Access_8
3
attempts remaining
1 of 1: Export the Books table to an Excel worksheet with a file type of 97-2003. Name the file, Books_export.xls.
view tasks
end exam

APPENDIX F

SAMPLING OF CONFIDENCE ITEMS FROM CIS AND IMMS SURVEYS

(REPRODUCED WITH PERMISSION FROM JOHN KELLER)

CIS

I feel confident that I will do well in this course.

You have to be lucky to get good grades in this course.

Whether or not I succeed in this course is up to me.

The subject matter of this course is just too difficult for me.

It is difficult to predict what grade the instructor will give my assignments.

As I am taking this class, I believe that I can succeed if I try hard enough.

IMMS

When I first looked at the *Access* lessons, I had the impression that they would be easy for me.

This material was more difficult to understand than I would like for it to be.

After reading the introductory information, I felt confident that I knew what I was supposed to learn from the *Access* lessons.

Many of the *Access* lessons had so much information that it was hard to pick out and remember the important points.

As I worked on the *Access* lessons, I was confident that I could learn the content.

The exercises in the *Access* lessons were too difficult.

APPENDIX G

BREAKDOWN OF INDIVIDUAL POSTTEST MEASURES

Table 24

Descriptive Statistics for Posttest Measures

	Section	*N*	Mean	Std. Dev	Skewness	Kurtosis
Access 1	Treatment	34	97.94	5.033	-2.086	2.496
	Control	38	92.92	11.379	-1.905	3.654
	Total	72	95.29	9.253	-2.449	6.891
Access 2	Treatment	35	99.09	2.582	-2.535	4.689
	Control	38	95.39	6.708	-1.064	-.482
	Total	73	97.16	5.452	-1.776	1.880
Access 3	Treatment	33	90.67	19.635	-3.640	14.983
	Control	34	77.18	19.275	-2.311	7.145
	Total	67	83.82	20.466	-2.428	7.222
Access 4	Treatment	34	80.59	24.527	-1.889	3.513
	Control	34	68.03	21.843	-.802	.037
	Total	68	74.31	23.902	-1.180	.958
Access 5	Treatment	33	93.94	12.547	-2.018	3.594
	Control	35	86.43	16.430	-.822	-.323
	Total	68	90.07	15.049	-1.256	.595
Access 6	Treatment	33	91.52	15.011	-1.963	3.081
	Control	37	78.08	15.435	-.175	-.887
	Total	70	84.41	16.566	-.750	-.618
Access 7	Treatment	33	96.21	9.103	-2.038	2.287
	Control	35	87.86	12.677	-.060	-2.121
	Total	68	91.91	11.783	-.772	-1.448
Access 8	Treatment	33	85.61	20.257	-1.662	2.697
	Control	35	67.14	33.084	-.670	-.666
	Total	68	76.10	29.114	-1.139	.398
Average	Treatment	30	93.40	5.43189	-.702	.002
	Control	26	86.10	7.38568	-.865	1.730
	Total	56	90.0	7.33922	-.896	1.354

Table 25

Posttest Performance

	Section	*N*	Mean	Std. Dev	Std. Error Mean
Access 1	Treatment	34	97.94	5.033	.863
	Control	38	92.92	11.379	1.846
Access 2	Treatment	35	99.09	2.582	.437
	Control	38	95.39	6.708	1.088
Access 3	Treatment	33	90.67	19.635	3.418
	Control	34	77.18	19.275	3.306
Access 4	Treatment	34	80.59	24.527	4.206
	Control	34	68.03	21.843	3.746
Access 5	Treatment	33	93.94	12.547	2.184
	Control	35	86.43	16.430	2.777
Access 6	Treatment	33	91.52	15.011	2.613
	Control	37	78.08	15.435	2.538
Access 7	Treatment	33	96.21	9.103	1.585
	Control	35	87.86	12.677	2.143
Access 8	Treatment	33	85.61	20.257	3.613
	Control	35	67.14	33.084	5.592
Average	Treatment	30	93.40	5.43189	.99172
	Control	26	86.10	7.38568	1.4484

Table 26

Results of Independent Samples t-*Test*

Posttest	Equal Variances Assumed per Levene's?	*t*	*df*	*p*	Mean Difference	Std. Error Difference
Access1	N	2.464	52.153	.017	5.020	2.038
Access2	N	3.148	48.498	.003	3.691	1.173
Access3	Y	2.838	65	.006	13.490	4.755
Access4	Y	2.230	66	.029	12.559	5.633
Access5	N	2.126	65.133	.037	7.511	3.533
Access6	Y	3.688	68	<.001	13.434	3.648
Access7	N	3.135	61.736	.003	8.355	2.665
Access8	N	2.773	57.642	.007	18.463	6.658
Average	Y	4.252	54	<.001	7.3044	1.718

Note. Where equal variances are not assumed, the appropriate numbers from the t-test results have been used.

Table 27

Effect Size and Approximate Power

Posttest	Mean Difference	Pooled Estimate of Pop. Standard Dev.	*p*	Effect Size (*d*)	Approx. Power (*p*=.05)	Approx. Power (*p*=.01)
Access1	5.020	9.253	.017	.54	.74	.48
Access2	3.691	5.452	.003	.68	.88	.70
Access3	13.490	20.466	.006	.66	.85	.65
Access4	12.559	23.902	.029	.53	.73	.40
Access5	7.511	15.049	.037	.50	.66	.37
Access6	13.434	16.566	<.001	.81	.95	.81
Access7	8.355	11.783	.003	.71	.89	.69
Access8	18.463	29.114	.007	.63	.82	.55
Average	7.3044	7.3392	<.001	1	.98	.91

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