The Role of Learning Style in University Students' Computer Attitudes: Implications Relative to the Effectiveness of Computer-Focused and Computer-Facilitated Instruction

By

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Approved by:

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Abstract of the Dissertation

The Role of Learning Style in University Students' Computer Attitudes: Implications Relative to the Effectiveness of Computer-Focused and Computer-Facilitated Instruction

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Claremont Graduate University: 2003

This research, conducted in an interdisciplinary approach and employing current education paradigms, models of learning theory, technology acceptance and attitude/technology interaction, investigated the manner in which students' learning styles affected their attitudes towards computer technology and the impact of those learning styles and attitudes on learning outcomes.

Analyses of data collected from four higher education institutions over a period of two-and-a-half years using a learning style inventory based on Gregorc's Style Delineator and a computer attitude scale adapted from Loyd and Gressard's Computer Attitude Scale indicate that a student's learning style (how information is gathered from the environment and how that information is processed and organized mentally) and attitudes toward computers may be, to some extent, a factor of gender and other conditions outside the student's control (e.g., fetal brain exposure to gonadal hormones). Certain technology-favoring learning styles were found more often in males while technology-averse learning styles were found more often in females. There were positive differences between overall GPA and students' GPA in computer-focused coursework (computer GPA exceeded overall GPA) in specific learning style groupings. Data also indicate that students tended to select academic majors

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and instruction delivery methods that complemented their learning styles and computer attitudes.

Implications for the future implementation of computers in schools and technology training, especially for females, are discussed and suggestions for future research are proposed.

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Dedication

This dissertation is dedicated to Dr. Ephraim P. Smith, Dr. Dorothy Heide and Dr. Michael C. Parker:

- To Ephraim, who opened the doors (thanks, Boss);
- To Dorothy, who dragged me kicking and screaming through the first one (I'm glad you convinced me to change my mind);
- And especially to my dear friend Mike, who opened my eyes to the possibilities and helped me find my way (I'd be lost without you).

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- The faculty, students, staff and administrators of –
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    - Scripps College, Claremont CA
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- Nettie Ott, my mother – for not letting me fall prey to the fate that might have been expected given my circumstances,
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Chapter 1 – Introduction and Statement of Purpose

In January 1996, then-President Bill Clinton called for a national partnership to ensure that every classroom be "connected to the information superhighway with computers, good software and well-trained teachers" (U.S. Dept. of Education, no page number available, 1996). As a result of the enthusiasm created by the funding initiatives that followed, computers and computer-based technology have become omnipresent in our educational institutions, from K-12 through the university. The faculty at all levels is employing computer-assisted or computer-facilitated instruction[1] to varying degrees in the classroom and often requires students to use computers outside of the classroom as well. Technology is being implemented in instructional facilities to such an extent that rooms are often classified as to their "smartness" or "intelligence" depending on the degree of computerization: i.e., super-smart or semi-intelligent classrooms. However, in our haste to connect every classroom, we may have put the cart before the horse.

It is no longer a question of *if* computer-facilitated instruction will be provided to current and future students; the technology is here and it will be used. Perhaps it would be better, instead, to ask if the technology will be *well* used. To what degree, how and under what circumstances should computer-based technology be employed in educational processes? Is computer-facilitated instruction appropriate and/or effective for students at all educational levels and of all abilities? What factors mediate the effectiveness of

[1] The terms "computer-facilitated," "computer-assisted," "computer-focused," "computer-based," and "technology-oriented," with respect to instruction, are used interchangeably in this document to avoid repetition and monotony.

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computer-facilitated instruction? Do some student groups (e.g., males) have a "natural" affinity for computers and, therefore, an advantage over others in computer-facilitated instruction?

Because differences between students in learning levels and comprehension are only partially explained by intelligence, background, and preparation (Berninger, 2001; Lawrence, 2000; Van Fleet & Antell, 2002), other variables must come into play. The research here reports on studies that attempted to answer the questions posed above with a specific focus on a potential variable: learning style. Are there differences in students' information acquisition and ordering processes (learning style) that influence the receptivity to computer-facilitated instruction and does that receptivity affect learning potential and educational outcomes? In an interdisciplinary approach, current models of learning theory, educational philosophies, technology acceptance/adoption and attitude/technology interaction are discussed and new models and theories are proposed. The research was conducted using both quantitative and qualitative methods of data collection and analyses. The project was based on a longitudinal case study employing surveys and questionnaires that were developed during preliminary exploratory studies. Finally, because students' achievement was measured during the course of their normal studies, portions of this project acted as a natural experiment[2].

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[2] A natural experiment can be described as one in which the variables or subjects of interest are studied or observed as they naturally occur, without manipulation or control by the researcher.

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Chapter 2 – Theoretical Bases for Research

Cognitive science, a widely embraced paradigm in the behavioral and social sciences, attempts to explain how organisms acquire, process and use information obtained from the environment (McGilly, 1994). Within the cognitive framework are a number of theories that explain how learning occurs. Included among these are the Jungian approach to the description and assessment of information acquisition and processing. Jungian typology (Sharp, 1987) is widely used in education and social science research where the focus is personality, cognition, attitudes or social interaction. Numerous validated theory-based instruments and a variety of methodologies based on Jungian typology are available and suitable for assessing and evaluating these mental processes and attitudes.

Within the various philosophical approaches to education, constructivism is currently the most widely embraced paradigm. The principal tenet of constructivism states that knowledge is "constructed" by an individual based on experiences, contexts, mental models and belief systems specific to that individual (Jonassen & Reeves, 1996). As such, knowledge is a personal possession – data and information can be stored and shared but knowledge cannot[3] (Rieber & Parmley, 1995). Knowledge comes about as a result of the cognitive processes that occur within an individual and the knowledge cannot be separated from its contexts and processes.

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[3] This is the generally accepted viewpoint of constructivist educators and researchers. However, it is not necessarily in agreement with viewpoints held by researchers and educators under other paradigms.

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In information technology/information science, a number of models have been proposed to explain how technology is diffused through an organization (Moore & Benbasat, 1991), how individuals accept and use technology (e.g., Davis, Bagozzi, & Warshaw, 1989; Mathieson, 1991) and how attitudes affect or interact with intentions to use technology (Compeau & Higgins, 1995). This research examined two of these models for applicability to the current questions.

The interdisciplinary research to be detailed in this dissertation was conducted according to the principles and guidelines espoused by the theories and paradigms described above.

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Chapter 3 – Significant Prior Research

3.1 - History of Computers in Higher Education

In the early 1960s and through the mid-1970s, computers in the academy were used primarily for administrative functions or by professors to conduct research and to exchange information with their professional colleagues (Roth & Tesolowski, 1986). In the late 1970s, following the introduction of microcomputers, public schools began using them principally as drill and practice tools (Berg & Bramble, 1983). There was little educational software and what did exist was primitive by today's standards.

Between 1980 and the mid-1990s, higher education spent in excess of $20 billion on computer-based technology (Jones & Paolucci, 1999). Computers have now transformed education to the extent that faculty are sometimes referred to as “instruction facilitators” rather than “teachers” and rooms where instruction facilitation occurs are no longer called classrooms but instead are known as “learner-centered environments” (Shute & Psotka, 1996). On the transformation of higher education by computing technology, one researcher recently stated, “Our community demanded graduates who could work in teams, communicate electronically, solve open-ended problems and think critically. We were convinced that four years of passive lecture reception did not build these skills” (Deden, pg. 58, 1998).

3.2 – Constructivism and Computers

Within constructivism, computers are among the resources used to create learning environments. These environments are referred to as

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"microworlds" in which students "live" the ideas, not just study them (Rieber & Parmley, 1995). Students are encouraged to explore and experience phenomena in these microworlds that may not be possible under other conditions (Hannafin, Hannafin, Hooper, Rieber, & Kini, 1996). Constructivist educators also use computer-based technology to assist students with visualization (Adams et al., 1996), to transform students from "learners" into "knowers" (Laszlo & Castro, 1995), and to involve students in the global economy and electronic world-wide learning communities (Trilling & Hood, 1999).

3.3 – Learning/Cognitive Styles

Numerous researchers have commented on the differences in how students learn and the significance of those differences with respect to educational achievement. One recent study confirmed that learning style appeared to affect student performance in classes where computers were either the delivery method or the topic of instruction (Rasmussen & Davidson Shivers, 1998). McLellan (1996) found that students' learning styles significantly influenced the effectiveness of instructional strategy and Tomei (1997) confirmed that a teaching style incompatible with a student's learning style led to either boredom or frustration on the part of the student. The Jones and Paolucci project (1999) recommended the identification of learning style as a precursor to technology-based instruction.

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3.4 – Attitudes and Computers

There is no shortage of published data to support the argument that attitudes toward computers play a role in the likelihood of their adoption and effectiveness of their use in the classroom. Many models have been proposed to demonstrate the role of attitudes in computer acceptance and use (e.g., Ajzen, 1989; Compeau & Higgins, 1995; Davis et al., 1989; Igbaria & Parasuraman, 1989; Karahanna, Straub, & Chervany, 1999). In one of the earliest and most cited studies, Marcoulides (1988) found that computer anxiety was an important predictor of achievement in computer-based or computer-facilitated instruction. Mahar, Henderson, and Deane (1997) found that not only did computer anxiety increase computer avoidance but it also resulted in performance deficits in computer tasks. Most of the models of computer adoption, computer diffusion, technology acceptance and computer-related behaviors emphasize attitudes as a significant component (Compeau, Higgins, & Huff, 1999).

3.5 – Effectiveness of Computer-Facilitated Instruction

Findings on the effectiveness of computer-assisted education are generally positive but there have been some skeptics. For example, Ely (1991) claimed that there had been minimal impact in higher education in the United States on learning achievement, instructional styles or curriculum reform but that claim was made more than a decade ago. Further, most of the academic computer use in higher education at that time was relegated to very specific courses with needs for intensive number crunching, like statistics classes (Goggin, Finkenbert, & Morrow, 1997).

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Recent research speaks more favorably about computers in education. Hayes (1997) reported that most educators he surveyed expressed positive feelings about the effects of technology in their schools. In a technology integration study conducted at seven institutions in one geographical area, the researchers found that students appeared to be more engaged in learning, asked more questions and worked in teams more cooperatively when using facilities with computer technology (Wiburg, Montoya, & Sandin, 1999). Liao's meta-analysis of 36 studies on the use of multi-media technology in instruction (1998) found positive effects of technology when compared to traditional lecture-based instruction. Draude and Brace's (1999) study revealed strong positive correlations between the number of courses taken in technology-enhanced classrooms and student learning. The students also acknowledged technology's appeal. Most recently, Kuh and Vesper (2001) found that the use of computers during college contributed to the development of other skills and increased competencies believed to be important to success outside the academy (i.e., quantitative and analytical skills, understanding technological developments, functioning as a team member, and awareness of differing philosophies).

3.6 – Weaknesses/Deficiencies in Previous Research

To date, there has been a fair amount of research conducted relative to the relationships between students' learning styles and outcomes in computer-focused or computer-facilitated coursework (e.g., Chamillard & Karolick, 1999; Chou & Wang, 2000; Kraus, Reed, & Fitzgerald, 2001; Oughton & Reed, 1999). In the four recent studies just cited, two found differences in computer-related

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achievement as a function of learning style and two did not. This researcher suspects the instrument used in those studies, and in most of the research on computer-facilitated instruction and learning styles, is the cause of the contradictory findings. The Kolb Learning Style Inventory (LSI) has been the tool most often employed to assess and evaluate learning style and has been repeatedly criticized for its psychometric properties (Loo, 1996). Loo's specific comments referenced 1) Kolb's assertion that individuals progress through the learning styles in a specific pattern whereas others assert that learning styles are relatively stable characteristics and 2) in the instances where learning style changes did occur, they did not occur in the pattern Kolb specified. Other criticisms include difficulty understanding the theoretical grounds (Hopkins, 1993), theoretical inconsistencies (Hopkins, 1993), misapplication of statistical procedures (Ruble & Stout, 1994), the use of ipsative scoring (Ruble & Stout, 1994), the lack of congruence between scale scores and theoretical constructs (Ruble & Stout, 1994), and lack of construct validity (Cornwell & Manfredo, 1994; Cornwell, Manfredo, & Dunlap, 1991; Geiger, Boyle, & Pinto, 1992, 1993)[4].

Further, there is little published research exploring the possible relationships between learning styles, computer-related attitudes, educational outcomes, and whether or not any possible relationships are consistent and comparable across various student groups (e.g., males and females). This research carries out such an investigation using a learning style inventory

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[4] Although this researcher believes these criticisms of the LSI make it an unsuitable instrument for assessing learning styles in the context of this type of research, there are those who do not share this opinion. For example, one study (Bostrom, Olfman, & Sein, 1990) used the LSI because of its relevance to information science applications and team learning processes.

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based on the Gregorc Style Delineator (Gregorc, 1982). (See discussion in section "Survey Instruments" below.)

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Chapter 4 - Research Propositions, Approaches and Methodologies

4.1 – Exploratory Studies

Although this investigator suspected there were relationships between learning styles, computer attitudes and educational outcomes, previous research did not provide much in the way of sufficiently specific data to formulate detailed theories or propositions beyond the initial supposition. In order to learn if there were relationships of a magnitude great enough to justify a comprehensive long-term study, it was determined that several smaller exploratory studies would be appropriate.

Inasmuch as this investigator is employed at a large public university as a mid-level academic manager and adjunct faculty member, access to student subjects was not problematic. Further, the university was in the process of planning for a major infrastructure and classroom technology upgrade (expected to take 12-18 months to complete) so it would be possible to conduct several technology-related exploratory studies as well as a longer-term research project with pre- and post-implementation data.

Contact was made with the appropriate university officials to obtain permission to conduct the short- and long-term research. The university's Institutional Review Board was given information about the proposed research and the project was approved.

4.1.1 – Propositions

The following propositions guided all of the research described in the preliminary studies and the dissertation projects:

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Proposition 1: There is a relationship between how a student acquires and processes information (learning style) and the student's attitudes toward the use of computer technology in the classroom.

Proposition 2: There is a relationship between a student's computer attitudes and the student's achievement in courses where the subject or tool of instruction is computers.

Proposition 3: There are differences in the ways males and females acquire and process information (learning style); as such, there will be gender differences in computer attitudes as a function of learning styles.

4.1.2 – Study 1

In September 2000, this investigator met with the director of the subject university's Social Science Research Center (SSRC)[5] to develop a student survey with an academic technology focus. The survey was designed to seek student opinions about 1) the existing campus computing facilities, 2) the extent to which their instructors used technology in the classrooms, and 3) other computer-related topics. The students were also asked to provide certain demographic information not obtainable from the Registrar. (The final telephone polling script is included as Appendix 1.)

A random sampling of students was obtained from the Registrar's office with one selection qualification. The students in the sample had to meet one of the following conditions: 1) be currently enrolled in a course held in one of the five classrooms that already had been provided with upgraded technology, 2) be enrolled in a course held in one of three rooms that had been previously

[5] The SSRC is a subsidiary of the university's non-profit foundation and conducts telephone polling for the university and the community at large.

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described as instructionally inadequate (poor ventilation, bad lighting, ambient noise, etc.) or 3) be enrolled in a course held in one of 20 other rooms throughout the campus that had been identified as typical lecture facilities. A sample size of approximately 2,000 was requested from a student population of approximately 27,000. The sampling procedures followed by the Registrar's office netted a listing of students meeting one of the specified criteria in proportion to the full student-body enrollment (i.e., if 15 percent of the student body were enrolled in the already upgraded rooms, approximately 15 percent of the sample also took courses in those rooms). Duplicates were removed, maintaining the correct criteria proportions, so that the final sample was narrowed to approximately 1,500. All grade levels and academic majors were represented so that the demographics of the final sample closely resembled the demographics of the entire student population. It was determined that any assumptions made based on the sample responses could be generalized to the university's full student population.

Calls were made by the SSRC to all the students in the final sample during October and November 2000, approximately 75 days prior to the commencement of the classroom technology upgrade referred to earlier. The pollers were instructed to make up to four telephone contacts before classifying the student as "unreachable"; approximately 460 students were classified as such. Eight students declined to participate. Completed surveys were obtained from 1,026 students within the 30-day polling period. The demographics of the 1,026 respondents were similar to the initial sample and to the general student population at this university. The survey data were accumulated in a telephone-surveying software package and were later converted to an SPSS data

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file. This investigator received the SPSS file in December 2000. Data analyses were undertaken in February and March 2001.

4.1.3 – Study 2

At the beginning of the Spring 2001 semester, during the first week of February, 20 professors (known to be amenable to use of their students as research subjects) in a variety of disciplines were contacted and permission was requested to survey their students on an assortment of issues related to instructional technology and classroom computers. Sixteen of the 20 responded in the affirmative. A one-page survey (Appendix 2) was developed to seek student opinions about classroom computers, to obtain information about students' level of computer proficiency and to seek volunteers for additional pilot studies. Approximately 850 surveys were distributed (one course section from each volunteering professor was selected to receive the survey) and 750 were returned. From those 750, surveys completed by students who had already participated in the SSRC polling were removed, yielding 718 usable surveys. Although the students' opinions were informative in matters relative to the technology upgrade project (some results are provided in a later section of this document), the primary purpose of this survey was to identify those who would be willing to participate in the development of assessment instruments for subsequent studies.

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4.2 – Results of Exploratory Studies

4.2.1 – Study 1

Responses relevant to the proposed long-term research are detailed in Tables A1 through A5 (Appendix 3). In summary, 1) 85% of the students whose instructors availed themselves of the technology in the classrooms that had already been upgraded felt that their learning was enhanced with the technology use, 2) less than half of those taking classes in rooms not yet upgraded felt that instructor computer use would enhance their learning, 3) nearly 95% of the students had access to a computer at home, 4) almost 24% rated themselves as being totally inexperienced to slightly experienced with respect to computer use, and 5) gender differences were evident with respect to presumption of learning enhancement and self-rated computer expertise (males tended to expect greater learning enhancement with computers and also rated their expertise higher than did females).

Since learning style data were not collected at this point, a decision was made to use the academic major as a proxy with the following justification: 1) both personality type and learning style can be assessed by the same instruments; for example, the Myers-Briggs Type Inventory (MBTI) (Myers & McCaulley, 1985) (e.g., Cooper & Miller, 1991; Dewar & Whittington, 2000; McCaulley, 1990), and 2) by the time a student reaches college age, a relationship between personality and academic/vocational pursuits has already been established, as evidenced by the use of personality instruments in academic and vocational counseling (e.g., Antony, 1998; Costa, 1995; Hogan & Hogan, 1995; McCutcheon, Schmidt, & Bolden, 1991; Wallace & Walker, 1988).

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Based on personal observations during eight years in higher education, this researcher believed that students generally achieve higher levels of success in academic majors that are compatible with their interests, skills and strengths. It has also been observed that certain academic programs emphasize instruction about and use of computers to a greater degree than other academic programs. Therefore, it was supposed that students with favorable attitudes toward computers would be more likely to select academic majors that focused on computing technology than those students with unfavorable attitudes toward computers. At the institution where this research was conducted, the programs with emphasis on computer-focused or computer-facilitated instruction are all of the majors within the business school (except economics which, for this study, is classified as a social science) and computer science.

To approximate learning styles, students were grouped into clusters according to their academic major. Cluster one was comprised of the students in the business school (except those studying economics) and computer science students. Students in all other academic majors were grouped into cluster two.

There were significant differences between the two clusters with respect to the students' perception of expected potential benefits with classroom computer use (Table A6, Appendix 3). The students in cluster one were much more likely to expect a benefit as a result of the use of classroom computers. This finding supports Proposition 1 to the extent that academic major can be used as a proxy for learning style and with respect to the specific attitude defined, that is, expected potential benefits.

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When the clusters were examined in terms of the ratio of male-to-female enrollment, it was clear that the academic interests of males and females were different. Although females comprised approximately 61% of the student population, only 43% of the students in the cluster one majors were female whereas 68% of the cluster two students were female. To the extent that academic major is indicative of learning style and assuming that students enrolled in majors reflective of their interests, Proposition 3 is supported[6].

4.2.2 – Study 2

As stated earlier, the primary purpose for this study was to identify volunteers for future research projects. However, there were some questions asked that were relevant to the proposed long-term project. Summary of relevant questions/responses – 1) more than 90% of the students believed that computers were useful in the classroom, 2) 95% were comfortable using computers, 3) 62% believed that classroom computers enhanced learning, 4) 96% had access to a computer in the home, 5) there were significant gender differences with respect to comfort level when using computers and perception of enhanced learning with computers, and 6) there were many significant relationships between attitudes, gender and the likelihood of favorable outcomes[7]. Appendix 4 (Tables A7 through A12) provides response frequencies, t-tests and correlation details.

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[6] Data collection to determine the support (or lack of) for Proposition 2 didn't occur until later studies.

[7] Interesting note – the ESL (English as a second language) students were much more likely to hold favorable attitudes about academic technology than were native English-speaking students.

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To further test Proposition 1, the students in this study were regrouped after the initial analysis into the two clusters detailed in the Study 1 results section. No computer science students participated in Study 2 so cluster one consisted of business students only (except those in economics). Cluster two was composed of students in economics, biology, math, psychology, speech, criminal justice, geography and anthropology. Student t-tests revealed significant differences between the two clusters with respect to attitudes about computers in the classroom. Table A13, detailing the t-test results, is included in Appendix 4.

Propositions 1 and 3 were again supported with respect to the questions related to usefulness and benefits of computers in the classroom according to academic major as a proxy for learning style. There were no significant differences between the two clusters in terms of the students' level of comfort when using computers.

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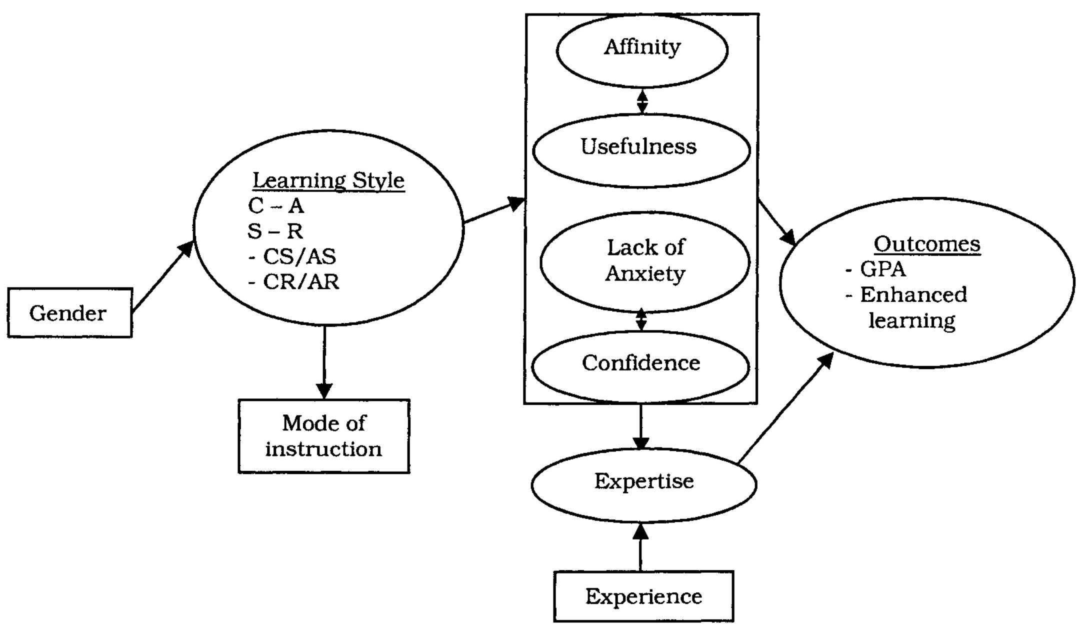
Chapter 5 – Dissertation Projects

5.1 – Research Model

As mentioned above, there have been many models developed to explain the processes involved in technology adoption and use, particularly with respect to the role played by attitudes. Among the most well known and widely researched are the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975), the Theory of Planned Behavior (TPB) (Ajzen, 1985) and the Technology Acceptance Model (TAM) (Davis et al., 1989). With these models in mind (shown in Figures A1 and A2), along with the findings from the two exploratory studies, the model for this dissertation research is shown in Figure 1 below.

Figure 1 – Research Model



The assumptions behind this model are that: 1) gender is the determining factor with respect to learning style; 2) learning style will play a role in the instructional mode selected by the student; 3) computer attitudes are based on the student's learning style; 4) both computer confidence and

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experience with computers are factors in the student's self-rated level of computer expertise; and, 5) both attitudes and expertise will influence outcomes as measured by the difference between the GPA in computer coursework and the overall GPA and also by the student's perception of enhanced learning.

5.2 – Study 1

The first dissertation study focused on the identification of learning styles, attitudes and learning outcomes by direct means rather than through academic major as a proxy. The subjects were students who had already participated in the earlier research. The study analyzed the presumed relationships (see Figure 1 above) between 1) gender and learning style; 2) learning style and computer attitudes; 3) learning style and instructional mode; 4) computer attitudes, experience and self-described level of expertise; and, 5) learning style, attitudes, expertise and outcomes (as measured by GPA and self-reported learning enhancement). All of the information necessary to analyze these relationships was obtained through the surveying described below and from data provided by the Registrar's office. The 1,026 participants of exploratory Study 1 (conducted in October/November 2000) were sent a survey by mail in April and May 2001. This mail survey included questionnaires used to determine students' computer attitudes and learning style.

5.3 – Survey instruments

There are a tremendous number of instruments designed and available to assess characteristics of learning, personality and attitude. Thus, it was

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necessary to determine which of those instruments would be best suited for this project. Due to the typically low return rate of surveys of this nature[8], this researcher felt that response rates might be increased if the instruments were succinct and personally relevant to the participants since, aside from offering incentives, brevity (Green & Hutchinson, 1996) and personalization (Boser & Clark, 1996) have been found to be among the most effective ways to increase participation. To that end, one of the conditions for consideration of an instrument for use in the mail survey would be that it either be "short and sweet" or be in a format compatible with length modification (reduction of number of questions without affecting reliability and validity) or personalization (modification of words or phrases to make the instrument more personally relevant to the participant).

A number of computer attitude surveys and questionnaires have been designed to measure anxiety about, confidence in, affinity for, intention to use and perceived usefulness of computers. Gardner, Discenza and Dukes (1993) evaluated and compared four different computer attitude scales and indicated that although they were all statistically similar, the Computer Attitude Scale (CAS) (Loyd & Gressard, 1984; Loyd & Loyd, 1985) was one of two recommended for research purposes[9] because of the instrument's anxiety, confidence and affinity subscales. In its full form the CAS, reported to be the most extensively tested and used computer attitude measurement tool (Woodrow, 1991), consists of 30 statements using a Likert-type scale to

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[8] Mail surveys are expected to have response rates between 11 and 50 percent (Cole, Palmer & Schwanz, 1997). Response rates between 20 and 30 percent are generally considered acceptable for this type of study.
[9] The other recommended computer attitude survey was the 1987 BELCAT (Blomberg-Erickson-Lowery Computer Attitude Task).

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measure affinity, anxiety and confidence. To meet the brevity requirement, the CAS was shortened from the original 30 items covering computer affinity, anxiety and confidence to 17 items: six affinity, five anxiety and six confidence statements. Some of the verbiage was also updated to reflect changes in technology as well as to make the statements more relevant to contemporary students. The selection of the statements to be included was based on item combinations yielding the highest Cronbach's alphas when the full instrument was administered to student volunteers recruited from exploratory Study 2 (reliability coefficients ranged between .80 and .93 for the various item groupings). In addition, since many of the models of technology adoption consider perceived usefulness as a relevant attitude, five usefulness questions were developed and included (reliability coefficients ranging between .53 and .70 during pilot studies). The modified Computer Attitude Scale is included as Appendix 5 and will be referred from this point forward as the Computer Attitude Survey 2 (CAS-2).

To evaluate learning style, it was necessary to identify the dimensions of cognitive processing that were relevant to this study. According to Bloom (1956), learning occurs in three overlapping domains:

- Cognitive – demonstrated by knowledge recall and intellectual skills – KNOWING
- Affective – demonstrated by behaviors reflective of attitudes and awareness (emotions, values, interest, etc.) – FEELING
- Psychomotor – demonstrated by physical skills and perceptual abilities (dexterity, coordination, etc.) – DOING

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One dimension of learning that spans all three domains is referred to as "style." The "learning style" identifiers describe how individuals acquire information and how it is processed, interpreted or acted upon once acquired[10]. Gregorc (1982) proposed a theory based on Jungian typology that explains learning style based on two bipolar dimensions: perception and ordering. He uses the term "perception" to describe the means by which information is grasped and defines two qualities of perception: concreteness and abstractness. Those who primarily employ their physical senses to acquire information are said to be "concrete" while those who use intuition or who can mentally manipulate formless concepts have strength in the "abstract" realm. Once information is acquired, it must then be processed and Gregorc refers to this as "ordering." Ordering is also a bi-polar dimension. The ordering abilities are "sequential" and "random." Those possessing sequential tendencies function best in situations where they can organize data in linear, step-by-step and methodical ways whereas those possessing random strengths are described as multi-tasking, non-linear thinkers who can manipulate data in non-sequential chunks.

Gregorc couples these two qualities to define four distinct learning styles: Abstract Sequential (AS), Abstract Random (AR), Concrete Sequential (CS) and Concrete Random (CR). He proposes that all learners have the ability to acquire and process data using all of these qualities but that each person has a preferred or natural style that is used most often. However, he also acknowledges that an individual can possess a "dominant" style that can inhibit

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[10] This study focuses on learning styles as opposed to learning strategies. According to the theories advanced by learning style scholars, "style" is believed to be a result of unconscious and involuntary mental processes whereas "strategy" is a conscious effort to employ specific techniques.

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processing abilities that rely on characteristics common to the non-dominant style.

Gregorc (1982) developed an instrument entitled the Gregorc Style Delineator (GSD) that measures the degrees to which adults employ these four qualities and identifies an individual's preferred learning style. The GSD has been widely used in education, often in combination with the Myers-Briggs Type Inventory (MBTI) (Myers & McCaulley, 1985) and the Kolb Learning Style Inventory (LSI) (Smith & Kolb, 1986). The Gregorc instrument was selected as the foundation for learning style identification in this study because of the targeted population (adults), the focus on mental processes similar to those used in computing operations (sequential and linear processing), the frequency of use in educational and dissertation research (e.g., Drysdale, Ross, & Schulz, 2001; Orr, Park, Thompson, & Thompson, 1999; Ross, 2000; Seidel & England, 1997; Stuber, 1997) and favorable opinions of users (Mental Measurements Yearbook, 1941 - present).

The GSD, in its original form, consists of 40 words within ten groupings that respondents are asked to rank from "1" to "4" as "least like me/most like me." The ranked responses are plotted on a matrix by the scorer in a predefined pattern to determine the favored (or natural) learning style. In order to maintain consistency of ranking with the CAS-2, the scoring values were reversed: the value of "1" was changed to "most like me" and "4" was indicative of "least like me." Further, the original GSD was developed for English-speaking populations and a modification was necessary to accommodate the large number of ESL (English as a Second Language) students at the university. To place the respondents on more equal footing, each word was contextualized

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in a sentence. For example, instead of ranking the word "objective," participants ranked the sentence "I make decisions from an objective, impartial point of view." ESL and native English-speaking volunteers recruited following exploratory Study 2 were used to develop sentences that represented the generally understood meanings of the original words. To meet the brevity requirement, the two sentences for each of the four learning styles that yielded the lowest Cronbach's alpha scores were omitted. As such, the final instrument consisted of 32 statements, instead of 40, grouped into eight sections of four statements each. The statement groupings are provided in Appendix 6. For purposes of identification, the Gregorc-based learning style assessment instrument developed for use in these studies will be referred to as the Information Acquisition and Ordering Inventory (IAOI).

The survey instruments were prepared in a packet that included a postage-paid return envelope. The return envelopes were coded so that the survey responses could be attributed to the specific students (a number on the inside of the envelope was cross-referenced to the students' university I.D. number). Three weeks following the original mailing, a second set of survey instruments was mailed to the students who had not responded to the first mailing.

5.4 – Studies 2 and 3

Assuming the propositions stated previously would be at least partially supported, further dissertation studies to be undertaken in a number of phases were designed under similar methodologies and with the same or similar surveys for administration to the following groups: 1) students enrolled in

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technology-based courses with non-traditional modes of instruction (interactive televised instruction, computer lab-based instruction and on-line web-based instruction) and 2) students taking courses in computer science (majors and non-majors taking computer science general education courses).

This researcher expected to find a greater number of students possessing the linear learning styles in the computer science major courses and the web-based courses than would be expected in a random sampling of the student population. These students were also expected to hold generally more favorable attitudes toward computers than students with non-linear learning styles.

The distribution of learning styles among the non-majors taking computer science general education courses was expected to be slightly skewed toward the linear processing learning styles but not to the same extent as computer science majors. Further, their attitudes toward computers were expected to be generally favorable.

With respect to computer lab-based instruction, a learning style distribution similar to the general student population was expected due to the fact that some lab-based coursework is required of all majors. The students participating in interactive televised instruction were expected to have a learning style distribution dissimilar to a random sample of the student body inasmuch as this method of instruction delivery is not strongly supported by student enrollment.

5.5 – Study 4

This study was another telephone survey of all the students that participated in the initial October/November 2000 project and who were still

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enrolled at the university. Since the university's classroom technology upgrade project was essentially completed by December 2001, the students were polled at that time to determine to what extent their instructors had been and were availing themselves of the new equipment. They were also asked questions from the first survey to compare pre- and post-implementation opinions about the benefits of computers in the classrooms.

Data from the Registrar were used to measure changes in students' GPAs and enrollment in computer-oriented or web-based courses. It was expected that students with linear learning styles and favorable attitudes towards the use of computers in the classroom would have received grades in those courses at or above their overall cumulative GPA and would have expressed a higher degree of satisfaction with the changes in classroom technology.

5.6 – Study 5

The final dissertation study determined if assumptions made from the research so far could be applied to students at other higher education institutions. Students at a consortium of private elite colleges on the west coast were administered questionnaires similar to those used at the public university. Learning styles as well as a variety of computer attitudes were identified.

In addition, questions were asked to determine other traits and characteristics common to students within specific learning style groupings. The questionnaire was administered either by paper-and-pencil in a manner similar to that at the state university or on-line via the Internet, according to the preference of the institution.

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Chapter 6 – Dissertation Research Results

6.1 – Study 1

The two survey instruments (IAOI and CAS-2) were mailed to the 1,026 respondents of the initial SSRC poll. The first mailing and a subsequent follow-up mailing resulted in 259 returned survey packets, yielding a response rate of 25.2%. Of the 259 packets, 232 contained scorable instruments. With respect to demographics, the 232 respondents were similar to the general student population (63% female, average age 24, ethnic groups, grade levels and majors proportionately represented) and, as such, it was determined that any assessments made from the resulting data could be generalized to the university's student population at large.

The IAOI was scored according to the procedures described earlier. The distribution of learning styles was as follows: Concrete Sequential (CS) – 31.5%; Abstract Sequential (AS) – 24.1%; Abstract Random (AR) – 22.0%; and, Concrete Random (CR) – 22.4%. As with the previously cited learning style research using the Gregorc instrument (the GSD), the CS learning style was most common[11]. However, the learning style distribution by gender did not follow the same pattern. By gender, the learning style distribution was much different in all styles other than CS. See Table 1 below.

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[11] There was no consistent distribution of learning styles other than the CS in the previously cited research.

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Table 1 – Preferred Learning Style Crosstabs

Preferred learning style (PREFSTY) * Gender Crosstabulation

		GENDER				Total
		Male	%	Female	%	
PREFSTY	cs	26	35.62%	47	64.38%	73
	as	26	46.43%	30	53.57%	56
	ar	10	19.61%	41	80.39%	51
	cr	24	46.15%	28	53.85%	52
Total		86	37.07%	146	62.93%	232

Females accounted for 64% of the CSs, which might be expected based on the proportion of females in the student population. Within both the AS and CR learning styles, the proportion of females was 54%. The AR learning style was overwhelmingly female at 80%.

When the respondents were grouped according to major into the same clusters as described in the pilot studies, gender differences were clear. Only 19% of the female respondents were enrolled in majors classified as cluster one (business, except economics, and computer science/engineering). Amongst the males, 57% were enrolled in cluster one programs. Further, regardless of cluster or major, males were predominantly sequential processors (61% sequential, 39% random). Females were more evenly distributed: 53% were sequential learners and 47% had the random learning styles.

As shown in Tables A14a and A14b (Appendix 7), there were no significant differences ($p < .05$) in the mean scores for affinity, confidence, anxiety or usefulness between males and females without categorization according to learning style. Within the learning style groupings, there were no significant computer attitude differences between males and females except in the AR grouping (Tables A15a and A15b, Appendix 7). Among Abstract Randoms, females expressed significantly higher anxiety than did males ($p = .045$).

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Between the groups, more differences were found for females than males with respect to learning styles and computer attitudes. For males, the following significant differences were found: between AS and AR, significant differences (p = .043) with respect to anxiety (Tables A16a and A16b, Appendix 7). For females, the significant differences were: between CS and CR, significant differences in affinity (p = .003), confidence (p = .033) and usefulness (p = .004) (Tables A17a and A17b, Appendix 7); and, between AS and CR, significant differences in affinity (p = .009) and usefulness (p = .048) (Tables A18a and A18b, Appendix 7). A summary table is shown below.

Table 2 – Significant differences between learning styles by gender re: computer attitudes

Significant differences between learning styles re: computer attitudes by gender

	Affinity	Confidence	Anxiety	Usefulness
Males				
			AS/AR *	
Females				
	CS/CR ** AS/CR **	CS/CR *		CS/CR ** AS/CR *

* < .05
** < .01

Because significant differences in computer attitudes based on both gender and learning style were evident, this researcher determined that a more detailed analysis of attitudes based on learning style would be appropriate.

As indicated earlier, Gregorc believed that some individuals had not only a preferred or natural learning style but also a dominant style. Those individuals with dominant styles should be less flexible with respect to their ability to employ multiple techniques when acquiring and processing information. As such, it seemed reasonable to assume that those individuals

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would also be less flexible with respect to the attitudes associated with that particular learning style[12].

As shown in Tables 3 and 4 below, the differences in computer attitudes between dominant style males and females were pronounced. For each of the four computer attitudes, gender had a significant main effect on each of the specific attitudes (Tables A19a-d, Appendix 7). No learning style main effect was present nor was there a learning style versus gender interaction.

Table 3 – Computer Attitudes For Dominant Learning Style Students

Group Statistics - Students Possessing a Dominant Style	Gender	N	Mean	SD	Std. Err.
Affinity	Male	29	1.391	0.514	0.095
	Female	47	1.819	0.652	0.095
Confidence	Male	29	1.649	0.539	0.100
	Female	47	2.110	0.657	0.096
Anxiety	Male	29	1.434	0.583	0.108
	Female	47	1.851	0.766	0.112
Usefulness	Male	29	1.214	0.350	0.065
	Female	47	1.668	0.578	0.084

Table 4 – Significant Differences for Dominant Style Students

Independent Samples Test	t-test for Equality of Means				
	t	df	Sig. (2-tailed)	Mean Diff	Std. Err Diff
Affinity	-3.006	74	**0.004**	-0.428	0.143
Confidence	-3.172	74	**0.002**	-0.461	0.145
Anxiety	-2.511	74	**0.014**	-0.417	0.166
Usefulness	-3.815	74	**0.000**	-0.454	0.119

[12] In this context, less flexible would mean that the opinion is more strongly held – i.e., the response to an attitude question would be "strongly like/dislike me" rather than "slightly like/dislike me."

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6.2 – Study 2

The motivation behind this study was to determine if students "self-selected" courses delivered via specific modes based on their learning style and, when relevant, computer attitudes.

At the university in which this research was conducted, instruction is typically offered in four different modes: lecture, lecture with computer lab, interactive television and on-line. During the summer of 2001, 225 students were surveyed to determine their learning style and computer attitudes and were also categorized according to the type of instruction delivery they received. All of the students taking an interactive TV course or a web-based course were asked to participate. Two lecture-only classes were also selected: one section of a class that was also offered via TV and one section of a class also offered on-line. The three lecture-with-lab classes were required courses in different departmental majors. Participant numbers were as follows: 57 in standard lecture, 70 in lecture with lab, 55 from interactive TV and 43 taking web-based courses.

As stated earlier, it was expected that learning styles in the lecture and lecture with lab would be distributed similarly to the general student population in the previous studies because all students take lecture and lecture with lab courses. This expectation was not supported. The numbers of CS and AR learners in the lecture classes were similar to the general student population. However, there were substantially more AS and substantially fewer CR learners. In the lecture/lab classes, the numbers of AS and AR learners were similar to what was expected but there were more CS learners and fewer CRs.

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It was believed that the distribution of learning styles in the interactive TV courses would be different from the general population because these courses tend to have fairly low enrollments and few sections are offered. This expectation was supported.

With respect to web-based courses, this researcher believed there would be a greater number of students having a linear/sequential learning style in these courses than would be seen in the general population. The data supported that belief. Nearly 63% of the students taking web-based courses possessed a sequential learning style. Within the general population, that percentage would be approximately 54-57%[13]. Table 5 below details the various instructional mode and learning style distributions.

Table 5 – Distribution of Learning Style by Instruction Mode

Preferred Learning Style by Instruction Mode Distribution

	Lecture		Lecture/Lab		Interactive TV		On-line course	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
CS	18	31.58	26	37.14	23	41.82	20	46.51
AS	19	33.33	15	21.43	6	10.91	7	16.28
AR	14	24.56	18	25.71	18	32.73	9	20.93
CR	6	10.53	11	15.71	8	14.55	7	16.28
Total	57	100	70	100	55	100	43	100

Comparing the computer attitudes of the students in the various instructional mode classifications with the general student population, the following was found: there were no significant differences between the lecture students and the general population; between the lecture/lab students and the general population, a difference approaching significance (p = .059) was found with respect to affinity and a significant difference was found in usefulness (p = .01) (Tables A20a and A20b, Appendix 8); there were significant differences

[13] The CS learning style occurs in approximately 31-34% of the population and the AS learning style occurs in approximately 20-23% of the population based on the data in this study.

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between the general population and the interactive TV students in both confidence (p = .030) and anxiety (p = .026) (Tables A21a and A21b, Appendix 8); and, between students in the web-based courses and the general population, differences were evident in affinity (p < .001), anxiety (p = .021) and usefulness (p = .040) (Tables A22a-c, Appendix 8).

When males were compared to females, without regard to instructional mode, there were significant differences in confidence (p = .019) and anxiety (p = .013) (Table A23, Appendix 8). When segregated into instructional mode categories, the following was found: within lecture, there was a significant difference in anxiety (p = .002); within lecture/lab, no significant differences; within interactive TV, no significant differences; and, within web-based, no significant differences (Table A24, Appendix 8).

Not surprisingly, students enrolled in the online courses had the most favorable attitudes toward computers; they liked them more, were more confident, less anxious and thought computers were more useful than the other groups. Also not surprising, the interactive TV students held the least favorable computer attitudes (Table A25, Appendix 8).

To determine which factor (gender, instructional mode or learning style) had the greatest impact on computer attitudes, a MANOVA was conducted (Tables A26a and A26b, Appendix 8). Learning style consistently had the strongest main effect on affinity, confidence and anxiety. There were no significant interactions.

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6.3 – Study 3

This project focused on a specific segment of the university population that might be expected to have attitudes and learning styles different from the rest of the university student population. Permission was requested and granted to administer the IAOI and the CAS-2 instruments to students taking computer science courses. Because the instruments were to be administered during class time and, in the interest of minimizing instructor inconvenience and instruction disruption, it was decided to eliminate questions related to demographics (other than gender) and the perceived usefulness of computers, since this researcher assumed that any student taking a computer science course would, by default, find computers useful (no computer science courses are mandatory and students taking them do so freely).

Sixteen computer science course sections were selected for surveying. Course selections were made to 1) minimize inconvenience to the instructors, 2) obtain responses from a cross-section of undergraduate and graduate students, 3) obtain responses from students who were taking general education computer science courses and from those who were majoring in computer science and, 4) minimize duplicate student responses.

The 16 course sections had a total student enrollment of 315. On the days the instruments were administered, 264 of the 315 students were present and completed both the IAOI and the CAS-2 (with usefulness questions removed).

Of the 264 students, 199 were male and 108 were non-computer science majors taking general education computer science courses. As expected, more

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of the 264 students possessed the linear/sequential learning styles than would be typical of the general student population (see Table 6 below).

Table 6 – Learning Style Frequencies of Computer Science Students

Learning Style Frequencies in Computer Science Students	Frequency	Percent	Valid Percent	Cumulative Percent
CS	82	31.06	31.06	31.06
AS	93	35.23	35.23	66.29
AR	49	18.56	18.56	84.85
CR	40	15.15	15.15	100.00
Total	264	100.00	100.00	

In excess of 66% of the students participating had either a CS or AS learning style (54-57% would be typical based on the previous projects). Chi-square tests revealed that the gender-based distribution of learning styles was significantly different from the learning style distribution of the general student population[14].

When the attitude scores of the students taking general education computer science courses were compared to the general student population, no significant differences were found for any of the attitudes measured. There were, however, significant differences between the general education computer science students and the students majoring in computer science with respect to affinity and confidence. See Table 7 below.

Table 7 – Differences in Attitudes of Computer Science Students

Group Statistics	CompSci major	N	Mean	SD	Std. Err Mean
Affinity	Major	156	1.505	0.489	0.039
	Non-major	108	1.640	0.606	0.058
Confidence	Major	156	1.640	0.600	0.048
	Non-major	108	1.897	0.738	0.071
Anxiety	Major	156	1.518	0.626	0.050
	Non-major	108	1.681	0.756	0.073

[14] Chi-square tests were conducted on all gender-based distributions of learning style compared to the general student population in all phases of this research. The gender-specific distribution of learning style was significantly different from what would be expected based on the general distribution in all instances.

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Table 7 - continued

t-test for equality of means		t	df	Sig. (2-tailed)	Mean Diff	Std. Err Diff
Affinity	Equal variances assumed	-2.000	262	**0.047**	-0.135	0.068
Confidence	Equal variances assumed	-3.107	262	**0.002**	-0.257	0.083
Anxiety	Equal variances assumed	-1.915	262	0.057	-0.164	0.085

Also, the students majoring in computer science were significantly more inclined to like computers ($p = .004$), were more confident ($p < .001$) and were less anxious ($p = .010$) than the full student population (see Table 8 below).

Table 8 – Differences in Computer Attitudes Between Computer Science Students and Full Student Population

One-Sample Test - CompSci Students vs. Full Student Population	t	df	Sig. (2-tailed)	Mean Diff
Affinity Test Value = 1.6194	-2.913	155	**0.004**	-0.114
	t	df	Sig. (2-tailed)	Mean Diff
Confidence Test Value = 1.8629	-4.638	155	**0.000**	-0.223
	t	df	Sig. (2-tailed)	Mean Diff
Anxiety Test Value = 1.6493	-2.620	155	**0.010**	-0.131

Within the computer science students, when males were compared to females, there were no significant differences on any of the computer attitudes[15]. However, across all three attitudes measured, females were more strongly positive (Table A27, Appendix 9).

[15] Power estimates of the tests based on N, SD and alpha exceeded .96. If there had been an effect, the sample size was large enough for it to have been detected. Further, power estimates were calculated in all instances where no significant differences were found between males and females. In some cases, the power estimate exceeded .99.

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Within the group of students taking general education computer science courses, females held significantly less positive attitudes towards the computer than did their male counterparts. See Table 9 below.

Table 9 – Computer Attitudes for Non-Computer Science Majors Taking Computer Science Courses

Group Statistics - Students taking General Ed. computer science courses

	Gender	N	Mean	SD	Std. Error
Affinity	Male	68	1.490	0.548	0.066
	Female	40	1.896	0.620	0.098
Confidence	Male	68	1.782	0.701	0.085
	Female	40	2.092	0.766	0.121
Anxiety	Male	68	1.574	0.692	0.084
	Female	40	1.865	0.832	0.132

t-test for Equality of Means

	t	df	Sig.	Mean Diff.	Std. Error
Affinity	-3.538	106	**0.001**	-0.406	0.115
Confidence	-2.143	106	**0.034**	-0.310	0.145
Anxiety	-1.960	106	**0.053**	-0.291	0.149

6.4 – Study 4

Over the course of approximately two-and-one-half years, learning style and computer attitude data were collected from a total of 721 students. Of those, longitudinal academic achievement data could be compiled on 491 (by way of student I.D. numbers). Further, many of these students were initially surveyed prior to and following the implementation of the massive academic technology upgrade project recently completed at the university. As a result, some pre- and post-implementation data were available with respect to students' perception of enhanced learning based on the use of technology in the classroom.

Across the 491 students, learning styles were distributed in a manner similar to the first study: 34.6% CS, 22.8% AS, 23% AR and 19.6% CR. Females accounted for 63% of the subjects and males for 37%. Males were

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more likely than females to have a higher computer-based course GPA[16] than cumulative GPA. The only GPA difference of statistical significance (p = .037) was that between the ARs and the CRs with respect to the difference between their cumulative GPAs and their computer GPAs (ARs had higher computer GPAs whereas CRs had lower computer GPAs). The computer GPAs of female AS learners and male AR learners exceeded their overall GPAs but not significantly. As such, Proposition 2 is not supported.

CSs liked computers the most (ARs the least), ASs were the most confident (ARs the least), ASs were the least anxious (ARs the most), and CSs expressed the strongest degree of perceived usefulness (CRs the least).

Although all of the computer attitudes were related to each other, the strongest relationships were between affinity and usefulness and between confidence and anxiety as shown in the ANOVA table below.

Table 10 – Relationships Between Computer Attitudes

Tests of Between-Subjects Effects
Dependent Variable: **Affinity**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model [a]	195.212	309	0.632	4.864	0.000
Intercept	599.157	1	599.157	4613.355	0.000
Confidence	6.770	27	0.251	1.931	0.007
Anxiety	5.752	16	0.359	2.768	0.001
Usefulness	11.319	10	1.132	**8.715**	**0.000**
Confidence * Anxiety	13.927	69	0.202	1.554	0.014
Confidence * Usefulness	11.315	59	0.192	1.477	0.031
Anxiety * Usefulness	5.349	31	0.173	1.329	0.135
Confidence * Anxiety * Usefulness	1.651	15	0.110	0.847	0.624
Error	19.092	147	0.130		
Total	1465.052	457			
Corrected Total	214.304	456			
a	R Squared = .911 (Adjusted R Squared = .724)				

[16] Hereafter referred to as computer GPA.

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Table 10 – Relationships Between Computer Attitudes (continued)

Tests of Between-Subjects Effects

Dependent Variable: **Confidence**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model [a]	217.528	289	0.753	5.44225	0.000
Intercept	774.300	1	774.300	5598.48	0.000
Anxiety	19.980	17	1.175	**8.498**	**0.000**
Usefulness	4.248	11	0.386	2.792	0.002
Affinity	9.457	26	0.364	2.630	0.000
Anxiety * Usefulness	8.864	32	0.277	2.003	0.003
Anxiety * Affinity	15.125	68	0.222	1.608	0.008
Usefulness * Affinity	10.490	47	0.223	1.614	0.015
Anxiety * Usefulness * Affinity	2.426	11	0.221	1.594	0.104
Error	23.097	167	0.138		
Total	1945.523	457			
Corrected Total	240.625	456			

a R Squared = .904 (Adjusted R Squared = .738)

On affinity, confidence and usefulness, learning style had a significant main effect. Gender had a significant main effect on confidence and anxiety. There were no significant gender and learning style interactions with respect to attitude (Table 11 below).

Table 11 – Relationships Between Attitudes and Gender

Tests of Between-Subjects Effects

Dependent Variable: **Affinity**

Source	Type III SS	df	MS	F	Sig.
Corrected Model	10.787	7	1.541	3.419	0.001
Intercept	1171.668	1	1171.668	2599.154	0.000
Gender	0.717	1	0.717	1.591	0.208
Pref. Style	5.923	3	1.974	4.380	**0.005**
Gender * PrefSty	2.909	3	0.970	2.151	0.093
Error	217.731	483	0.451		
Total	1557.216	491			
Corrected Total	228.518	490			

R Squared = .047 (Adjusted R Squared = .033)

Dependent Variable: **Anxiety**

Source	Type III SS	df	MS	F	Sig.
Corrected Model	7.509	7	1.073	1.889	0.069
Intercept	1178.012	1	1178.012	2074.509	0.000
Gender	2.787	1	2.787	4.909	**0.027**
Pref. Style	1.099	3	0.366	0.645	0.586
Gender * PrefSty	2.683	3	0.894	1.575	0.195
Error	274.272	483	0.568		
Total	1657.920	491			
Corrected Total	281.782	490			

R Squared = .027 (Adjusted R Squared = .013)

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Table 11 – Relationships Between Attitudes and Gender (continued)

Dependent Variable: **Confidence**

Source	Type III SS	df	MS	F	Sig.
Corrected Model	12.888	7	1.841	3.648	0.001
Intercept	1535.957	1	1535.957	3043.020	0.000
Gender	3.875	1	3.875	7.677	**0.006**
Pref. Style	6.124	3	2.041	4.044	**0.007**
Gender * PrefSty	0.307	3	0.102	0.203	0.894
Error	243.793	483	0.505		
Total	2035.459	491			
Corrected Total	256.681	490			

R Squared = .050 (Adjusted R Squared = .036)

Dependent Variable: **Usefulness**

Source	Type III SS	df	MS	F	Sig.
Corrected Model	4.696	7	0.671	2.454	0.018
Intercept	830.364	1	830.364	3037.823	0.000
Gender	0.771	1	0.771	2.821	0.094
Pref. Style	3.290	3	1.097	4.012	**0.008**
Gender * PrefSty	0.230	3	0.077	0.281	0.839
Error	122.731	449	0.273		
Total	1073.680	457			
Corrected Total	127.427	456			

R Squared = .037 (Adjusted R Squared = .022)

Between the learning style groups, there were significant differences for all computer attitudes except anxiety. The greatest discrepancies were between the CSs and ARs. CRs and ARs were most similar (Tables A28a-f, Appendix 10). Within each learning style grouping, significant gender differences with respect to computer attitudes were evident only in ARs (affinity and anxiety) (Table A29, Appendix 10).

A MANOVA was conducted to determine on which of the learning styles gender had the strongest effect. As shown in Table 12 below, the AS and AR learning styles were most affected by gender.

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Table 12 – Effects of Gender on Learning Style

Tests of Between-Subjects Effects

Source	DV	Type III SS	df	MS	F	Sig.
Corrected Model	CS	8.572	1	8.572	0.417	0.519
	AS [1]	122.566	1	122.566	7.263	0.007
	AR [1]	156.841	1	156.841	7.494	0.006
	CR	19.271	1	19.271	1.072	0.301
	A	2.888	1	2.888	0.187	0.665
	S	26.765	1	26.765	0.630	0.428
Intercept	CS	260902.096	1	260902.096	12693.911	0.000
	AS	273906.631	1	273906.631	16231.707	0.000
	AR	304668.841	1	304668.841	14557.510	0.000
	CR	301997.805	1	301997.805	16795.401	0.000
	A	1156567.637	1	1156567.637	75018.214	0.000
	S	1082743.530	1	1082743.530	25498.245	0.000
Gender	CS	8.572	1	8.572	0.417	0.519
	AS	122.566	1	122.566	7.263	**0.007**
	AR	156.841	1	156.841	7.494	**0.006**
	CR	19.271	1	19.271	1.072	0.301
	A	2.888	1	2.888	0.187	0.665
	S	26.765	1	26.765	0.630	0.428
Error	CS	10050.576	489	20.553		
	AS	8251.772	489	16.875		
	AR	10234.104	489	20.929		
	CR	8792.700	489	17.981		
	A	7538.990	489	15.417		
	S	20764.628	489	42.463		
Total	CS	290098.000	491			
	AS	306611.000	491			
	AR	334450.000	491			
	CR	335342.000	491			
	A	1251698.000	491			
	S	1189610.000	491			
Corrected Total	CS	10059.149	490			
	AS	8374.338	490			
	AR	10390.945	490			
	CR	8811.971	490			
	A	7541.878	490			
	S	20791.393	490			

[1] R Squared = .015 (Adjusted R Squared = .013)

There were 120 students for whom pre- and post-implementation attitudes were available. Although only one of the differences was significant, these students generally expressed a higher degree of computer liking and were more confident over time. Their perception of computer usefulness decreased over time (Table A30, Appendix 10). Concrete Randoms expressed a significant increase in computer liking (p = .033) over the course of the study (Table A31, Appendix 10).

Of the participants in the pre-implementation SSRC survey in Nov/Dec 2000 and the post-implementation survey during the summer of 2002, two

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specific questions were asked with respect to learning enhancement. The first question was for those students whose instructors used the classroom equipment; do you believe your learning is enhanced when your instructors make use of the technology in the classrooms? The second question was for students whose instructors did not use the available equipment; do you believe your learning would be enhanced if your instructors made use of the technology in the classroom? There was also a group of students whose instructors were not using technology at the time of the first survey but who were using it at the time of the second survey. They were also asked if they perceived learning enhancement when the classroom computers were used by their instructors. Sixty-four students had instructors who were using computers at the beginning and the end of the study. Of those, four students' perceptions improved, four declined and 56 remained the same. Of the 56 whose opinion remained unchanged, 53 already believed that instructor's use of classroom technology enhanced their (the student's) learning experiences. (Table 12 below presents a summary of all the pre- and post-implementation learning enhancement questions.)

Table 12 – Pre- and Post-implementation Responses to Learning Enhancement Inquiries

	Pre-implementation	**Post-implementation**	**Opinion Change**
Is your learning enhanced when faculty use the computer (or would it be if the computer were used)?			
Condition 1 - classroom computer used before and after			
Yes	57	57	+4
No	7	7	-4
Condition 2 - classroom computer not used before but used after			
Yes	n/a	123	
No	n/a	13	
Condition 3 - classroom computer not used			
Yes	81	133	+89
No	79	27	-18

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There were 160 students whose instructors did not use the classroom technology either at the beginning or the end of the project. Of the 160 students, 89 expressed an increase in their perception of probable learning enhancement if their instructors would avail themselves of the classroom computers. Eighteen students expressed a lower degree of expected learning enhancement if the classroom technology were used. Of the remaining 71 with unchanged opinions, 41 expressed the same degree of positive expectation at the beginning and end of the project. Thirty students expected little or no technology-based learning enhancement at both the beginning and end of the project.

There were 136 students whose instructors did not use (or have access to) technology at the beginning of the project but who were using it at the end of the project. Of those 136, all but 13 said their learning was enhanced when their instructors used the new classroom computer equipment.

Of those who participated in both the pre- and post-implementation surveys, learning style information was available for only 90. Of those 90, eight expressed a reduced expectation (or actual reduction) of learning enhancement as a result of faculty use of classroom technology. Six of those eight were sequential/linear learners. However, of those who believed their learning had been enhanced following the completion of the project, there appeared to be little difference between the sequential and non-sequential learners and, as such, Proposition 2 is again not supported.

During the initial Nov/Dec 2000 polling, the participants were asked to state the number of years they had been using computers and their self-rated level of computer expertise. There was a significant correlation between years

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of experience and self-rated expertise (r = .093, p = .002) but there were no significant correlations between experience/expertise and learning styles. There was one area in which significance was achieved with respect to attitudes – the more highly rated the level of expertise, the higher the confidence rating (r = -.208, p = .001)[17]. See Table 13 below.

Table 13 – Correlations Between Experience, Expertise and Attitudes

	Correlations		1	2
1	Rate general computer skills	Pearson Correlation	1	
		Sig. (2-tailed)	.	
		N	1025	
2	Years you've been using computers	Pearson Correlation	0.093466	1
		Sig. (2-tailed)	**0.00281**	.
		N	1020	1021
3	Affinity	Pearson Correlation	-0.11466	-0.05994
		Sig. (2-tailed)	0.08203	0.365531
		N	231	230
4	Confidence	Pearson Correlation	-0.20836	-0.11665
		Sig. (2-tailed)	**0.00145**	0.077476
		N	231	230
5	Anxiety	Pearson Correlation	-0.09573	-0.07873
		Sig. (2-tailed)	0.146964	0.234296
		N	231	230
6	Usefulness	Pearson Correlation	-0.12852	-0.04679
		Sig. (2-tailed)	0.051083	0.480155
		N	231	230

With respect to the research model, regression analyses revealed no significant predictors of either achievement or perceived learning enhancement. However, the degree to which an individual was an Abstract Sequential was a significant predictor of the liking of computers (F = 8.164, R = .185, p = .005) (Table A32, Appendix 10), gender was a significant predictor of the degree of anxiety (F = 6.706, R = .275, p = .011) (Table A33, Appendix 10) and the degree to which an individual was a sequential processor was a significant predictor of the perceived degree of computer usefulness (F = 8.576, R = .190, p = .004) (Table A34, Appendix 10).

[17] The correlation is negative because expertise was rated as a higher number equaling a greater level of expertise whereas the attitudes were rated as a lower number being more representative of the similarity to the respondent.

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One additional statistical test was conducted on the data from the 491 students for whom both learning style and computer attitudes were known. The two sequential learning styles were combined into one group and the two random learning styles were combined into a second in order to compare the differences in computer attitudes between linear/sequential processors and non-linear/random processors. There were significant differences between the two styles for all attitudes evaluated. The results are shown in Table 14 below.

Table 14 – Attitudes Differences in Sequential vs. Random Processors

Group Statistics

	Style	N	Mean	SD	Std. Err.
Affinity	Sequential	282	1.543	0.606	0.036
	Random	209	1.782	0.755	0.052
Confidence	Sequential	282	1.808	0.672	0.040
	Random	209	2.032	0.772	0.053
Anxiety	Sequential	282	1.616	0.722	0.043
	Random	209	1.752	0.800	0.055
Usefulness	Sequential	263	1.379	0.470	0.029
	Random	194	1.521	0.590	0.042

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
Affinity	-3.893	489	**0.000**	-0.239	0.061
Confidence	-3.427	489	**0.001**	-0.224	0.065
Anxiety	-1.968	489	**0.050**	-0.136	0.069
Usefulness	-2.859	455	**0.004**	-0.142	0.050

6.5 – Study 5

This project was undertaken for two primary reasons: 1) to determine if the results from the previous four projects could be generalized to university students outside a specific institution and 2) to determine if there were other characteristics not previously explored that were indicative of learning styles and computer attitudes.

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An agreement was reached with three small elite private colleges in Southern California allowing this researcher to solicit participation from their students in this project. The first of the institutions was a women's liberal arts college, the second was a coed liberal arts institution and the third was a coed college for science and engineering students.

The instrument used to evaluate computer attitudes was modified in order to encourage student participation and to allow for the inclusion of additional inquiries. Only two questions for each of the four computer attitudes – affinity, confidence, anxiety and usefulness – were included. An additional 22 statements were developed to determine if there were characteristics common to sequential or random processors that might assist in the identification of students with an interest in pursuing coursework or a career in computer-oriented areas and were formulated based on personal observations of this researcher. The students were asked to indicate their degree of agreement with each of the statements, with 1 indicating a strong agreement and 4 indicating a strong disagreement. The 30 questions are detailed in Appendix 11. (The additional 22 non-computer-attitude questions asked sought to determine characteristics such as sociability, preference for numbers or letters, mechanical aptitude, artistic inclination and to confirm or deny attitudes anecdotally held to be true of those with an interest in computers.) The learning style questions (IAOI) were included on the reverse side of the form.

For the two liberal arts colleges, the survey instruments, a letter of explanation and a postage-paid return envelope were placed in the students' mail boxes several days prior to the beginning of the Fall 2002 semester. The science and engineering college allowed only electronic distribution so the

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explanatory letter and survey instruments were placed on-line. An e-mail message was sent via a college listserv to all of the students in that college asking them to participate in the study and provided a URL for the instruments.

Since the composition of the institutions' student bodies were specific to the type of institution, the following results were expected based on findings from the previous studies; 1) there would be a greater number of ARs in the women's college than would be typical of the state university, 2) the distribution of learning styles in the coed liberal arts institution would be similar to the state university and 3) there would be more students (as a proportion of the population) having the AS learning style in the science and engineering college than was evident at the state university. Computer attitudes at these institutions were expected to correlate with the learning styles in a pattern similar to the state university. The expectations for responses to the 22 new questions were that students who expressed favorable computer attitudes and who possessed the sequential learning styles would be more mechanical, less artistic, less sociable and more number-oriented than their non-sequential counterparts.

From the women's college, there were 180 responses, 165 of which were scorable. From the coed institution, there were 57 responses, 44 of which could be scored. The science and engineering college yielded 31 scorable surveys out of 42 completed.

Of the 240 combined responses, 24.2% were CS, 18.7% were AS, 31.7% were AR and 25.4% were CR. On a college-by-college basis, the following was found: 1) 34% of the respondents from the women's college were identified as ARs, a higher percentage than would be expected in a coed institution

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(supposition supported), 2) the responses from the coed college were 70% female and the learning style that occurred most frequently was AR (supposition partially supported[18]) and 3) the learning style that occurred most often in the student respondents from the science and engineering college was AS (at 54.8%), much higher than would be expected from a typical coed institution (supposition supported).

Also as expected, the students having the AS learning style and those from the science and engineering college had the most favorable computer attitudes (Table A35, Appendix 12)[19]. When both of the sequential learning styles and both random learning styles were combined, the differences were even more pronounced. Student t-tests and ANOVAs reflecting the differences between the genders, learning styles and colleges are also included in Tables A36 through A39, Appendix 12. These results provide support against an argument that might be made regarding responses being culturally or socially biased[20].

With respect to the 22 statements seeking information on traits and characteristics that may be associated with favorable computer attitudes, some interesting patterns emerged. A correlation matrix was created to determine which, if any, of the 22 statements generated a consistent response pattern among students with the linear/sequential processing styles. Of the 22

[18] Since the respondents in this group were overwhelmingly female, it was not possible to determine if the learning styles of males were similar in distribution to the population of the larger public university. However, the learning style distribution among the female respondents was as expected.
[19] Because affinity and usefulness were closely related (as indicated in a previous section), as were confidence and anxiety, the attitudes were combined in this analysis.
[20] Although the students from the large public university are of lower socio-economic status and are generally less academically gifted than the students from the elite private universities, both groups responded similarly to all the inquiries. This finding would argue against an assertion that learning styles and the resultant attitudes are socially or culturally influenced.

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statements, 11 were identified as clearly distinguishing linear processors from random processors ($p < .05$). A factor analysis (Varimax rotation, factor loading > .5, Eigenvalue > 1) narrowed the questions to nine loading on only one factor and revealed three principal components. Component one might be described as a curiosity about how things work or perhaps an inclination to "tinker." Component two appears to be an orientation toward either numbers or letters. Component three consists of characteristics that relate to structure or rule-following[21]. See Table 15 below for specifics.

Table 15 – Factors Associated with Favorable Computer Attitudes

Rotated Component Matrix – Factor Analysis

	Component		
	1	2	3
can take apart and reassemble things	**0.748**		
uncomfortable w/ electricity and mechanical things	**-0.718**		
could not learn to program	**-0.718**		
could assemble a computer	**0.688**		
better with word problems		**-0.894**	
like math and physics		**0.677**	
am artistic			**-0.711**
learn more w/ computers in class			**0.697**
could handle discipline and structure of military			**0.560**

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 4 iterations.

[21] Artistic inclination is listing in the "rule-following" category because artists are encouraged to be creative and to explore outside traditional boundaries.

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Chapter 7 – Summary and Conclusions

The various propositions and suppositions detailed throughout this dissertation were generally supported (see Table 16 below for summary). The data indicate that a student's affinity for, anxiety about, confidence in and opinion regarding the usefulness of computers appears to be associated with the methods and mental processes the student uses to gather and organize information. Those who mentally organize and process data in a linear or sequential manner expressed more favorable attitudes toward computers and tended to do better in coursework where computers were either the topic or tool of instruction.

Table 16 – Summary of Propositions and Suppositions

Propositions and suppositions	Outcome
1 – There is a relationship between learning style and computer attitudes	Supported
2 – There is a relationship between computer attitudes and achievement	Not supported
3 – There will be gender differences in learning style and computer attitudes	Supported
4 - There will be more students possessing the linear learning styles in computer science and web-based courses than would be expected in the full student population	Supported
5 - Students with linear learning styles will have more favorable computer attitudes	Supported
6 - Students having linear learning styles will express more favorable attitudes regarding changes in classroom technology	Not supported
7 - Learning style and computer attitude relationships will be similar from institution to institution	Supported

Gender differences were apparent with respect to two specific learning style groupings – Abstract Sequentials (overwhelmingly male) and Abstract Randoms (disproportionately female) – but within the learning style groupings themselves, males and females were remarkably similar to each other in their computer attitudes. With respect to specialized instructional modes and technology-oriented curricula, students also tended to select the mode and

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curriculum most compatible with their learning style and associated computer attitudes. Within the computer-based or computer-focused courses, majors and delivery modes, there were more students with the sequential learning style than would be expected, other things being equal. With respect to the generalizability of findings based on data from the large public institution to other types and sizes of institution and student bodies, the suppositions put forth appear reasonable. Student responses from the small, elite, private institutions were similar to those from the public university. There were few significant differences between computer GPA and overall GPA but that may be a result of the number of influences on a student's GPA that are unrelated to learning style. Finally, there appear to be characteristics common to linear learners with respect to a number of attitudes and preferences and this will be discussed below.

With respect to the research model (shown earlier), gender was a significant predictor of the degree to which a student would be an Abstract Sequential or Abstract Random processor (Abstract Sequentials were more often males, Abstract Randoms were more often females). Although students appeared to select some instructional modes based on learning style and computer attitudes, the research population was atypical to such an extent that this researcher does not believe the findings from this particular study are generalizable to the student population at large[22]. As previously noted, learning style was a significant predictor of attitudes and confidence was a significant predictor of self-assessed level of expertise. Although there were positive

[22] Following the summer semester during which the "instructional mode" research was conducted, the University implemented year-round instruction. As a result, students enrolling in the summer semester are more typical of the student body at large than they were during the period of this specific study.

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correlations between favorable attitudes towards computers and students' GPA in computer-related courses, none of the correlations were significant. There were no significant correlations between learning style, computer attitudes and expectation of learning enhancement when computers were used in the classroom. Based on the findings, a new model has been developed and will be addressed in the discussion section of this dissertation.

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Chapter 8 – Limitations

As with most studies focusing on the behavior of humans, making predictions or generalizing observations from one situation to another is, to a certain degree, risky. Humans, more so than other animals, are self-aware and can exercise control over even instinctive actions. Further, typing or classifying people according to their behavior, traits or observable characteristics fails to consider individuality. For those who dispute the validity of measures based on personality, this researcher acknowledges that there are limitations and qualifications to the assumptions. The results stated in this paper are valid only to the extent that what was being evaluated was, in fact, learning style although substantial evidence of facial validity has been presented in this dissertation that the IAOI did assess what can be described as information acquisition and ordering processes or learning style as it is often referred to in these writings.

Caution should be used when generalizing any of the results from dissertation Study 2 (focus on instructional modes) to the student population at large. When this portion of the research was conducted, students participating in summer instruction were not typical of the regular semester student population. Summer students at this university have typically been either 1) extremely motivated students who took extra summer classes in order to graduate more quickly or 2) students who did poorly during a regular semester and took summer courses in order to repeat a class and offset an unsatisfactory grade. Subsequent to this project, the university implemented year-round state-supported instruction and the summer semester is now considered to be a

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regular semester with student populations more similar to those in the fall and spring semesters.

As noted earlier, what appears to be typical of students who participated in this research may not be typical of all students or of the population at large. Finally, as with all research, what looks to be "true" or "real" today may be revealed as "false" or "illusory" tomorrow. Studies in cutting-edge fields present new and often contradictory data with great frequency. Keeping these caveats in mind, actions based on the findings detailed in this dissertation should be undertaken with careful consideration and current research should always be consulted.

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Chapter 9 – Implications for Practitioners

As stated in the introduction, higher education is spending billions of dollars to upgrade instructional technology and to install computers on campuses. This researcher believes that the findings from these studies could assist administrators and faculty members within higher education develop more informed expectations regarding the degree to which students can benefit from technology being installed and the likelihood of similar benefits being realized across all groups within the student population. For example, if a college or university were considering the implementation of a requirement that all students take a web-based course as a condition of graduation, this research shows that a specific group of students, namely the female Abstract Random learners, would be ill-served by being directed to use an instructional tool not well-suited to their learning style. Perhaps, then, the goal of this massive national investment in computers and computing infrastructure should be to make the technology available and more user-friendly to those who can and will benefit from its use but not to mandate or require its use by all students, regardless of its suitability to their learning ability.

Within the California State University (CSU) system (the largest public university system in the world), considerable effort and expense is being devoted to the development of academic technology master plans at the individual campuses and within the system-wide governing office itself. These plans will determine the direction of funding and deployment of instructional technology within the system, at the campuses and for hundreds of thousands of California students for the foreseeable future. Since this researcher currently

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serves on one of the committees charged with the development of these master plans, the findings from this dissertation have been used to inform these plans and policies, both system-wide and at the campus at which this research was conducted. The dissertation findings may serve to guide the expenditure of time and money in directions that will provide the greatest benefit to the CSU academic community and its constituents. An example of the application of these findings is that a proposal has been made to the CSU system that the system fund installation of multi-media presentation equipment (computers, data projectors, control switches, etc.) in heavily used classrooms at each campus so that instructors can avail themselves of the technology favored by the students as a supplement to lectures (during the initial telephone survey, students indicated that their learning was enhanced when the instructor provided multi-media visual/audio reinforcement to the standard lecture).

Finally, since the early 1990s, both academic journals (e.g., Cohoon, 2001; Frenkel, 1990; Teague, 1997) and the popular press (e.g., DeBare, 1996; Mayfield, 2001a, 2001b) have commented on the lack of trained personnel, especially women, in the fields of computer science and information technology. This researcher believes it has been demonstrated to a sufficiently convincing degree that certain individuals avoid instruction by and interaction with computing technology[23] as a result of mental processes or characteristics determined by factors outside of the individuals' control (gender or genetics, for example). As such, some funding might be more appropriately directed toward early identification of those most likely to benefit from technology-assisted or

[23] Student having the learning styles that are typically associated with negative computer attitudes tend to enroll less frequently in the academic majors that have a high degree of reliance on computer-based or computer-focused instruction than the students having the computer-favoring learning styles.

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technology-focused instruction. In conjunction with that effort, if the technology-favoring students can be identified, so can those who are inclined to be technology-averse. By introducing these students to technology early in non-threatening ways, the aversion and anxiety that are manifested later may be reduced. Further, efforts currently being made in high schools and higher education to steer "under-represented groups" (e.g., women) into technology-intensive fields are misguided. By the time a student has reached the age where academic- and career-oriented decisions are being made, the likelihood of changing that student's interests are slim. As stated previously, perhaps those efforts would be better directed, instead, to the elementary schools in an attempt to learn ways in which to make technology less intimidating and frightening to those who have a natural aversion to it.

Another possibility would be to parse the computer science field into subfields with particular emphasis on separating the "linear" areas (e.g., programming or software engineering) from the "non-linear" areas (e.g., multi-media concepts, computer graphics). As computer science programs are currently structured, there are few options for the student who may be exceedingly talented in the non-linear subfields but who also has great difficulty with the standard "techie" areas like programming and algorithms.

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Chapter 10 – Discussion

There is a clear relationship between gender, how information is mentally organized and the attitudes resulting from those mental processes. It is less clear is why this should be so. Speculation as to the reason for the relationship follows.

Prior to the "women's movement" of the mid- to late-1960s, discussions about differences between "male" brains and "female" brains were common and not particularly controversial. However, once the women's movement tied those differences to disparate and discriminatory treatment of women in the workplace, discussions of the biological, physiological and psychological differences between males and females became politicized. One could not say that "women think differently than men" without being accused of chauvinism or sexism. Thankfully, the dialog in recent years has become less emotional. Pointing out the differences between men and women, particularly with respect to biological and physiological functions, no longer generates the extreme reactions once commonplace.

Within the last 10-12 years, much has been published about the effects of sex chromosomes and gonadal hormones on brain physiology and function. Physiological differences in the brains of males and females have been found with respect to the functioning of the hippocampus (Ibanez, Gu, & Simerly, 2001; Pruessner, Collins, Pruessner, & Evans, 2001; Shors, Chua, & Falduto, 2001; Smith, Jones, & Wilson, 2002; Wright et al., 1999), the cerebrum and cerebral blood flow (Kritzer, 1998; Ragland, Coleman, Gur, Glahn, & Cur, 2000), proportions of gray matter, white matter and cerebral-spinal fluid (Gur et

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al., 1999), the hypothalamus (Mong, Glaser, & McCarthy, 1999), cortical organization and EEGs (Volf & Razumnikova, 1999), neural patterns and neural networks (Gron, Wunderlich, Spitzer, Tomczak, & Reipe, 2000; Pogun, 2001), and the shape of the corpus callosum and the transmission of information across it (Allen, Richey, Chai, & Gorski, 1991; Nowicka & Fersten, 2001). All of these structures play a role in how information is received, transmitted across, processed and organized in the brain.

Gonadal hormones (estrogen and testosterone, primarily) also affect male and female brains differently. Estrogen has been shown to have an impact on cognitive and motor skills (Collaer, Geffner, Kaufman, Buckingham, & Hines, 2002), memory (Leranth et al., 2000; Markowska, 1999), and cognitive aging (Markowska & Savonenko, 2002). Testosterone affects spatial ability (Postma et al., 2000; Silverman, Kastuk, Choi, & Phillips, 1999), verbal fluency (Wolf et al., 2000), how stress impacts learning (Shors & Miesegaes, 2002), vocal learning (Korsia & Bottjer, 1991) and a variety of other cognitive functions (Raber, Bongers, LeFevour, Buttini, & Mucke, 2002; Wolf & Kirschbaum, 2002). While estrogen has the greatest effect on female brains, testosterone's role is noticeable in both sexes. Testosterone's effects are also more or less impactful depending on the developmental period during which the subject is exposed to the hormone.

Additional gender-based brain differences observable by fMRI (functional magnetic resonance imaging) scans and other methods included manifestations of learning disabilities and behavioral problems (Biederman et al., 2002), strength and location of emotional memories (Canli, Desmond, Zhao, & Gabrieli, 2002), object recognition (Barbarotto, Laiacona, Macchi, & Capitani,

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2002), and problem solving strategies (Gallagher et al., 2000). Two recent texts (Halpern, 2000; Kimura, 1999) also go into great detail about the physiological and cognitive differences between male and female brains. Brain physiology and functioning are affected at different times depending on the type of intervention; hormones (testosterone, especially) have the greatest effect on brain structure during fetal development and during old age whereas neural pathway development is most susceptible to outside influence between the ages of three and eight (in human children).

So what does all of this have to do with learning style, attitudes and the use of computers in the classroom? Because there are physiology-based differences in the ways males and females acquire and process information AND because the preferences and attitudes that result from the acquired and processed information are not easily modifiable, if at all, this researcher believes there is no "one-size-fits-all" methodology to implementing and using computer technology in the classroom[24]. Specifics follow.

First, students' expectation of educational benefits seemed not to depend on learning style or attitudes toward computers. Even those who expressed anxiety when having to interact with computers on a one-to-one basis either expected to receive or had already benefited from enhanced learning when their instructors used computers in the classroom. Responses to open-ended questions during the telephone surveying indicated that students appreciated

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[24] There is a large body of literature addressing Aptitude-Treatment Interaction (ATI), a concept stating that the effectiveness of instructional strategies (treatments) depends on the abilities (aptitudes) of those receiving the instruction (Cronbach & Snow, 1977; Snow, 1989). Much of the research in this area focuses on matching low-conceptual learners with instructor-centered teachers and high-conceptual learners with student-centered instructors (e.g., Dawson, 1992). This dissertation focuses, instead, on what this researcher believes to be the bases for differences in learning ability/aptitude.

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the visual reinforcement provided by the computers during lectures and were more attentive during instruction when multi-media accompanied a lecture. To put computers and presentation equipment in classrooms, at least to the extent of having it available at an instructor workstation, seems to be a good use of technology-earmarked dollars. Deployment of computers to this extent in all schools, K-12 and higher education, would be appropriate and beneficial.

Second, offering instruction via a variety of modes, including computer-assisted delivery and web-based coursework, seems appropriate given the number of distinctly different learning styles and associated attitudes/preferences. On campuses where physical facility availability does not meet the demand, providing a wider selection of quality web-based coursework directed toward the linear/sequential learner may reduce the demand for classrooms, particularly in coursework common to the fields that tend to be attractive to linear/sequential learners. One note of caution: mandating that students take courses delivered by way of computers would be ill-serving those who are naturally averse to interacting with technology in a learning environment. As explained in a previous section of this dissertation, plans to use technology to deliver instruction in order to reduce the demand on physical facilities should be carefully considered. Not all students are likely to benefit from computer-delivered coursework.

Finally, if, in fact, there is a need to increase the number of women majoring in computer science or technology-intensive fields, the time to identify those most likely to be interested and successful in those fields is during childhood, not high school or college. According to the data mentioned in a previous section of this dissertation, significant post-childhood changes in

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mental processes, such as learning and cognition, normally occur only when the brain suffers trauma or following hormonal declines that usually take place during old age. By the time a child reaches eight years old, how that child acquires and processes information and the preferences derived from that information are, to a great extent, not malleable. However, since the neural networks that are developed during learning are not well formed until the age of eight (and possibly even into puberty), any interventions or attempts to modify learning styles and resultant attitudes should occur in the primary grades. As such, it seems appropriate to direct the greatest amount of resources and time with respect to development of future "technologists" and "computer scientists" toward elementary and pre-schools.

With respect to the models developed by others and noted in this dissertation (Figures A1 and A2), this researcher believes they omit critical information regarding the formation of technology and computer attitudes. Neither of them considers gender or learning style as a factor in the formation of attitudes and this research has shown both to be of significance in attitude formation[25]. Further, the relationships among the attitudes shown in Figure A2 were found to be different in the current research. Even students who did not like computers, who were anxious when using them and who expressed a low level of confidence in their own computer skills agreed that computers were useful. However, the perception of usefulness had little to do with the desire to use computers. Students with the linear learning styles enrolled more often in courses of study that offered computer-based and computer-focused curricula

[25] Although gender may be a consideration in the research based on the models, the models themselves do not list gender as a factor.

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and tended to perform better academically than those students having the learning styles more closely associated with computer aversion.

As a result of this research, a new model (theory) has been developed to explain the relationships found between gender, learning style (ordering processes), attitudes and outcomes in an educational setting. The new model is shown in the following section and is referred to as the Technology Attitude Theory. It is explained at greater length below.

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Chapter 11 – Suggestions for Future Research

If the time to realize the greatest benefit from technology training, both for the individual and society at large, is during childhood, perhaps greater efforts should be undertaken to identify those most likely to have a natural interest in technology or at least be "pliable" enough to be receptive to technology-based or technology-focused instruction. It was clear that those who favor computers generally acquire and process information differently than those who are technology averse. Furthermore, there are clear attitude and preference patterns unrelated to technology that are indicative of the learning styles most closely associated with an affinity for technological instruction. If assessment devices and methods could be developed to identify the linear/sequential learners of both sexes prior to kindergarten or shortly thereafter, then perhaps computer technology could be utilized in the primary grades in a manner that would encourage those with a "natural" technology bent to pursue technology-related educational and career paths. Most of the non-computer-related preferences that identified linear/sequential learners fell into three categories or orientations: 1) having a preference for numbers vs. letters (follows the research mentioned earlier with respect to verbal and spatial areas of the brain), 2) the degree to which following the rules or adhering to policy was appealing or not appealing (free thinkers and artists vs. regimented and orderly thinkers, as an example) and 3) an interest in tinkering or figuring out how things work.

Based on these observations plus the findings from the computer attitude and learning style questions, this researcher believes it would be

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possible to design relatively simple and non-invasive ways to determine if a child is likely to have a natural linear processing style, perhaps by the use of flash cards with symbols or shapes, observing what type of toy a child chooses to play with when presented with specific alternatives, how a child arranges blocks and so on. This researcher has already initiated contact with faculty members in the child development and elementary education divisions of a large public university in order to begin the planning for additional studies in these areas along the lines mentioned.

Further, additional research would be appropriate to determine methods to reduce the intimidation factor of technology for those having the learning styles that tend to be technology averse. Based on the data collected in this study, those individuals are inclined to have more of a social orientation, feel comfortable thinking "outside the lines," are more fluid in terms of time and space and tend to perceive themselves as having artistic tendencies[26]. Although this researcher has few ideas presently with respect to how to make technology more "social," perhaps thinking along the lines of the makers of the Apple MacIntosh computers may be of some benefit. Anecdotal evidence indicates that females prefer the colorful packaging and the less-"boxy" shape of the Mac computers. They also find the Mac's user interface friendlier than that typically found on IBM-based personal computers. Graphic artists also prefer to use Mac-based software and this research indicates that those with "artistic"

[26] Some personal observations by this researcher based on the analysis of more than 2,000 learning style surveys: Concrete Sequential (CS) learners tended to be cynical or perhaps just skeptical about technology and the world in general; Abstract Sequentials (AS) were not overly concerned about social convention and tended to be introspective and focused; Abstract Randoms (AR) were the most artistically inclined and were often intimated by technology; and, Concrete Random learners (CR) were the most social and most open-minded with respect to possible benefits from technology.

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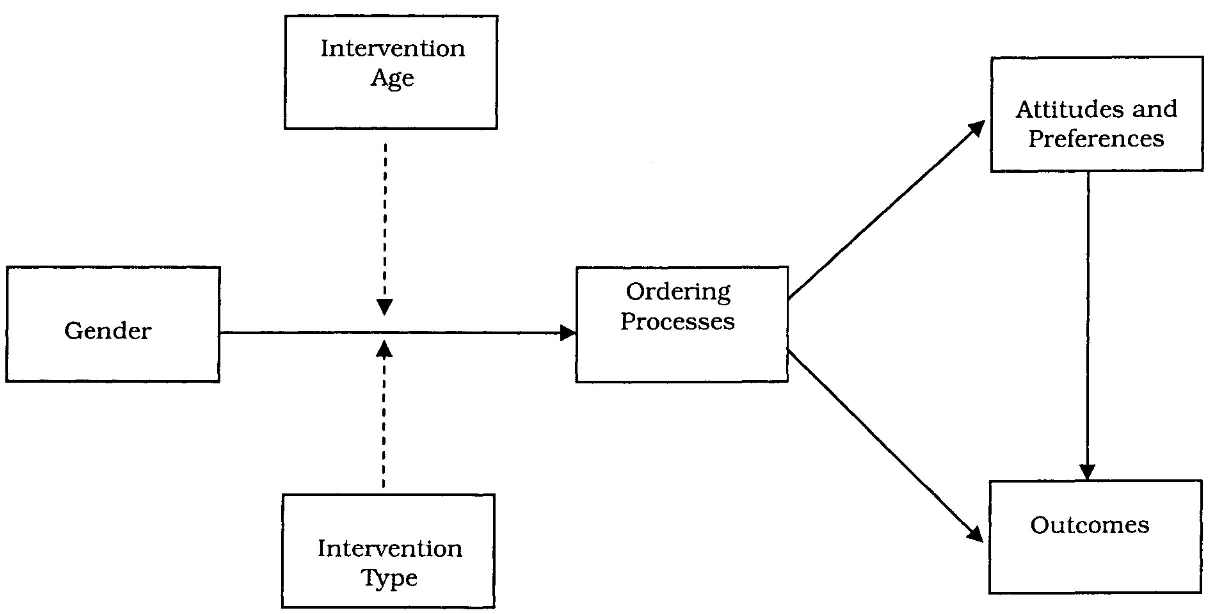
inclinations are more likely to have the learning style and associated attitudes that tend to be technology-averse.

Lastly, a new theoretical model has been developed based on the findings from this research. This model reflects the following beliefs of the researcher that: 1) gender[27] is the primary determinant of ordering processes/learning styles; 2) interventions can modify those biologically-determined processes (interventions include changes in brain chemistry, exposure to gonadal hormones, brain injury or training); 3) the type and timing of interventions affect the likelihood of modification to the ordering processes; 4) the ordering processes, to a large extent, determine the technology-related attitudes, and 5) both the ordering processes and related attitudes influence outcomes.

Figure 2 – Technology Attitude Theory/Model



The most ambiguous component of this theory or model relates to the identification and measurement of outcomes. In the research described in this

[27] In this context, gender also refers to the biological and physiological differences in brain structure and brain hormones that result from being "male" or "female."

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dissertation, outcomes were defined as grade point average (GPA) in computer-based or computer-focused coursework, the difference between overall GPA and computer GPA, and student expectation of enhanced learning as a result of classroom computer use. Because there are many factors that come into play with respect to GPA (grading style of instructor, type of course, student motivation, etc.), GPA may not be the best, or even a good, outcome measure in research of this nature. Expectation of enhanced learning was not a discriminating variable since a majority of all the students responded affirmatively, without regard to learning style. If the question had been phrased in such a manner that expectation of enhanced learning related to the student's use of computers rather than the instructor's use of computers, the findings may have been different but that is a matter for future research. The challenge with respect to use of this model will be to define a discriminating variable to measure success or lack of success with respect to the other variables. Future research undertaken by the present researcher will be conducted using this model as the guideline.

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Chapter 12 – Concluding Remarks

Over the course of the past two-and-a-half years while conducting the research for this dissertation, this researcher has learned much about the uses (and occasional misuses) of instructional technology, how the brain works, and human nature. To invoke the old adage about “leading a horse to water” is appropriate here, albeit in a slightly modified version. You can give students access to great instructional technology but you can’t make them use it and even if you could, should you? In our haste to install and employ the latest and greatest technology in the academy, we may have dragged that horse to the water, shoved his head in, and tried to force him to drink without realizing that not only wasn’t he thirsty but also that water wasn’t good for him.

Further, while this project has focused solely on how students learn, an equally important component of the learning process was not addressed at all: that is, how faculty teach. As our biological, physiological, and hormonal characteristics affect how we receive, arrange and interpret information, so do they also have ramifications on how we disseminate information. To discuss learning styles without delving into teaching styles, too, is not well-serving the education community. That, however, is another project for someone else.

What strikes most deeply as this researcher reflects on what has been learned here is that although humans appear to be exceedingly complex creatures, it would not be surprising to learn in the years ahead that homo sapiens are more simple than previously believed. Thinking about people as either “sequential” or “random” processors makes a great deal of sense and may

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have implications in other fields[28]. Using the mental health field as an example, it seems logical and quite reasonable to believe that science will learn that obsessive-compulsive disorder (OCD) is a malfunction in the area of the brain charged with sequential processing (and probably occurs more often in those who manifest a learning style that emphasizes sequential processing), that schizophrenia is a random processing glitch occurring most often in those whose learning style leans toward random and that bi-polar disorder occurs more often in people who move easily or often from random to sequential processing.

This researcher fully expects that studies likely to be undertaken in the future will reveal that the male Abstract Random processors who have an affinity for computers possess brains very much like female Abstract Sequential learners, both in structure and perhaps even hormonally. It is not unreasonable to anticipate reading some day that whether we are random or sequential processors, whether we enjoy working with or are fearful when using computers, whether we learn better with our ears or hands is no more within our control than the color of our eyes or the "X-ness" and "Y-ness" of our chromosomes.

This researcher would truly love to conduct research that seeks to answer, not just speculate about, the questions that have been posed about how we learn, how we acquire and organize information, why some of us like Macs but do not like PCs, and why some of us are really interested in the practical applications of computers but indifferent about programming. Sadly, that inquiry will likely be undertaken in a field outside this researcher's current

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[28] Of course, this is only speculation but this is the section of the dissertation in which the researcher is given that leeway.

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expertise: namely, neuroscience. Fortunately, access to the publications in that field is not problematic and this researcher intends to take full advantage of that access.

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Appendix 1 - CSUF Classroom Technology Student Survey 2000
Final Telephone Survey Instrument: 10-18-00

SHELLO Hello, this is ________________, calling from the Social Science Research Center at California State University, Fullerton. Have I reached [READ RESPONDENT'S PHONE NUMBER]?

SCONTACT May I please speak with [STUDENT'S NAME]?

1. YES [SKIPTO INTRO]
2. NO

CALLBAK1 Can you suggest a better time to call back to reach [CSUF STUDENT]?

INTRO We are conducting a short survey for the Vice President for Academic Affairs.
We're interested in obtaining student opinion regarding your access to computers on the CSUF campus, as well as your personal access to a computer. Your input will be used by researchers on campus to evaluate technology. You are free to decline to answer any survey question and your responses will remain confidential.

I should also mention that this call may be monitored by my supervisor for quality control purposes only.

Is it all right to ask you these questions now?

1. YES [SKIPTO OFAGE]
2. NO

CALLBAK2 When can we call you back?

OFAGE May I first verify that you are 18 years or older?

1. YES
2. NO [DISCONTINUE CALL]

TRANS1 The first questions I'd like to ask you concern the computer technology available in some of the classrooms on campus.

Q1 May I please verify that you are currently taking a course in [ROOM NUMBER]?
1. YES [SKIPTO Q2]
2. NO [CONTINUE]
7. DK/NR [CONTINUE]

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9. REFUSED [CONTINUE]

Q1A Admissions and Records indicates that you take a class in [ROOM NUMBER].

Please think for a minute about that classroom.
It is: [PROVIDE DESCRIPTION]

INTERVIEWER: DESCRIBE THE LOCATION OF THE CLASSROOM.

Q2 What is the name of the class you attend in [ROOM NUMBER]?
1. Specify
7. DK/NR
9. REFUSED

Q3 How much do you agree with the following statement: In that class, the instructor's spoken English is clear and understandable?
1. Strongly agree
2. Somewhat agree
3. Somewhat disagree
4. Strongly disagree
7. DK/NR
9. REFUSED

Q4 Does that classroom have a computer installed at the front of the room?
1. YES [CONTINUE]
2. NO [SKIPTO Q6]
7. DK/NR
9. REFUSED

Q5 Does the instructor use the computer?
1. YES [SKIPTO Q8]
2. NO [CONTINUE]
7. DK/NR
9. REFUSED

Q6 Does the instructor ever bring a computer into the room, either a laptop or a computer wheeled in on a cart?
1. YES [CONTINUE]
2. NO [IF Q4 = NO OR Q5 = NO, SKIPTO Q13]
7. DK/NR
9. REFUSED

Q7 How often does the instructor bring a computer into the class?
1. Every class meeting
2. Every two to three class meetings, or
3. Less than that
7. DK/NR
9. REFUSED

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Q8 Does the instructor use the computer for...?
1. Access to the Internet
2. Software or programs installed on the computer, or
3. Both
7. DK/NR
9. REFUSED

Q9 Please rate the instructor's apparent level of comfort with the computer.
1. Very uncomfortable
2. Somewhat uncomfortable
3. Somewhat comfortable
4. Very comfortable
7. DK/NR
9. REFUSED

Q10 Does the instructor allow or require students to make presentations with the computer?
1. YES
2. NO
7. DK/NR
9. REFUSED

Q11 Comparing the lessons when the instructor uses the computer to lessons without use of the computer, how much do you agree with the following statement? The instructor's use of the computer makes him or her a "better" instructor.
1. Strongly agree
2. Somewhat agree
3. Somewhat disagree
4. Strongly disagree
7. DK/NR
9. REFUSED

Q12 Do you feel your learning experience is enhanced by the instructor's use of the computer?
1. YES (Please specify) [ALL SKIPTO Q14]
2. NO (Please specify) [ALL SKIPTO Q14]
7. DK/NR [ALL SKIPTO Q14]
9. REFUSED [ALL SKIPTO Q14]

Q13 How much do you agree with the following statement. I feel my learning experience would be enhanced if the instructor used a computer in the classroom? Do you...
1. Strongly agree
2. Agree
3. Disagree
4. Strongly disagree
7. DK/NR
9. REFUSED

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Q14 Does the instructor use either WebCT or Blackboard as one of the teaching tools?

1. YES
2. NO
7. DK/NR
9. REFUSED

Q15 Does the instructor require you to complete homework or assignments using computers?
[IF YES, ASK RESPONDENT TO SPECIFY IF IT'S FOR RESEARCH, FOR WORD PROCESSING, FOR GRAPHICS, ETC.)

1. YES
2. NO
7. DK/NR
9. REFUSED

Q16 How knowledgeable does the instructor seem to be about computers and/or software? Would you say...

1. Very knowledgeable
2. Somewhat knowledgeable
3. Not very knowledgeable
4. Not at all knowledgeable
7. DK/NR
9. REFUSED

TRANS2 These next few questions concern your personal access to a computer.

Q17 Do you presently own, or have access to a computer at home?

1. YES
2. NO [SKIPTO Q28]
7. DK/NR
9. REFUSED

Q18 How many computers, either laptop or desktop, do you own?

NUMBER> [IF 1, SKIPTO Q21]
7. DK/NR
9. REFUSED

[REPEAT Q19 AND Q20 FOR EACH COMPUTER THEY HAVE]
Q19 Is your first [SECOND, THIRD, ETC] computer a PC or a Mac?

1. PC
2. MAC
7. DK/NR
9. REFUSED

Q20 Is that computer a laptop or a desktop?

1. LAPTOP [IF AT LEAST ONE IS A LAPTOP, SKIPTO Q23]

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2. DESKTOP [IF ALL ARE DESKTOP, SKIPTO Q27]
7. DK/NR
9. REFUSED

Q21 Is it a PC or a Mac?
1. PC
2. MAC
7. DK/NR
9. REFUSED

Q22 Is it a laptop or a desktop?
1. LAPTOP [CONTINUE]
2. DESKTOP [SKIPTO Q27]
7. DK/NR
9. REFUSED

Q23 How important is it for you to be able to use your laptop to connect to the campus network while on campus?
1. Very important
2. Somewhat important
3. Not very important
4. Not at all important
7. DK/NR
9. REFUSED

Q24 Does your laptop have a network card?
1. YES
2. NO
7. DK/NR
9. REFUSED

Q25 A wireless network card provides an Internet connection without a cable connection. What price would you be willing to pay for a "wireless" network card?
1. $100 or less
2. $101 to $175
3. $176 to $250
4. More than $250
7. DK/NR
9. REFUSED

Q26 Do you use your laptop for classroom presentations?
1. YES [ALL SKIPTO Q28]
2. NO [ALL SKIPTO Q28]
7. DK/NR [ALL SKIPTO Q28]
9. REFUSED [ALL SKIPTO Q28]

Q27 To what extent would having access to a laptop computer enhance your learning experience?
1. To a great extent

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2. Somewhat
3. Not really
4. Not at all
7. DK/NR
9. REFUSED

Q28 How strongly would you favor an increase in student fees to cover the cost of issuing a laptop computer to each student? Would you say that you...
1. Strongly favor [IF Q17 =2, SKIPTO Q33]
2. Somewhat favor
3. Somewhat oppose
4. Strongly oppose an increase in student fees to cover the cost of issuing a laptop computer.
7. DK/NR
9. REFUSED

Q29 Do you have Internet access at home?
1. YES
2. NO [SKIPTO Q31]
7. DK/NR [SKIPTO Q31]
9. REFUSED [SKIPTO Q31]

Q30 Is your connection at home through...
1. Titan Access (through CSUF)
2. Other dial-up service (standard modem service)
3. Cable modem
4. DSL
5. Other
7. DK/NR
9. REFUSED

Q31 Do you have Microsoft Office installed on any of your computers?
1. YES
2. NO [SKIPTO Q33]
7. DK/NR [SKIPTO Q33]
9. REFUSED [SKIPTO Q33]

Q32 Was Microsoft Office...
1. Pre-installed on the computer
2. Purchased by yourself at a retail store
3. Rented through the CSU bookstore rental program
4. Copied from someone you know, or
5. Other (Please specify)
7. DK/NR
9. REFUSED

Q33 How would you rate your general computer skills? Would you say that you...
1. Have no experience
2. Are a beginner

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3. Are slightly experienced
4. Moderately experienced
5. Very experienced, or
6. An expert
7. DK/NR
9. REFUSED

Q34 For how many years have you been using computers?
YEARS>
96. LESS THAN ONE YEAR
97. DON'T USE COMPUTERS
98. DK/NR
99. REFUSED

Q35 Do you have at least one e-mail account?
1. YES [CONTINUE]
2. NO [SKIPTO TRANS3]
7. DK/NR
9. REFUSED

Q36 How many separate email accounts do you have that you access regularly? Regularly means that you access the account at least once a week.
NUMBER OF ACCOUNTS>
98. DK/NR
99. REFUSED

Q37 How often do you access the e-mail account that you consider to be your primary email address?
1. More than once a day
2. Once a day
3. Once every few days
4. Once a week
5. Fewer than one time per week
7. DK/NR
9. REFUSED

Q38 Is your primary e-mail account...
1. Provided by CSUF
2. Provided by an Internet dial-up provider, like AOL or Earthlink
3. Free e-mail (Yahoo, Hotmail, etc.)
4. Other (Please specify)
7. DK/NR
9. REFUSED

Q39 Do you access your e-mail most from:
1. CSUF
2. Home
3. Work
4. A friend's house, or
5. Other (Please specify)

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7. DK/NR
9. REFUSED

Q40 How often do you communicate with your professor(s) using email?
IF ANSWER IS 1, 2, OR 3: ASK "Exactly how many times per month do you mean by that?"

1. Regularly (Please specify)
2. Often (Please specify)
3. Every once in while (Please specify)
4. Never
7. DK/NR
9. REFUSED

TRANS3 There are several places on campus where you have access to computers. Please answer the next several questions thinking only about the open computer lab located in the library basement.

Q41 First, do you use the computers in the library basement?

1. YES
2. NO [SKIPTO TRANS4]
7. DK/NR
9. REFUSED

Q42 On average, how many times in one week do you use these computers?
DAYS OUT OF SEVEN>
98. DK/NR
99. REFUSED

Q43 On average, how long do you spend using the computers during each visit?
HOURS>
97. LESS THAN ONE HOUR
98. DK/NR
99. REFUSED

Q44 Please tell me which of the following you use these computers for.
[READ EACH OPTION AND SELECT ALL THAT APPLY]

1. Research
2. E-mail
3. Web surfing
4. Word or Excel
5. Printing
6. Other (Please specify)
7. DK/NR
9. REFUSED

Q45 How often do you use them on a Friday afternoon, Saturday or Sunday? Would you say you use them...

1. Weekly
2. Monthly

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3. Once or twice a semester
4. Less than once a semester
7. DK/NR
9. REFUSED

Q46 Do you ever have to wait longer than 5 minutes for access to a computer in the library basement?

1. YES
2. NO [SKIPTO TRANS4]
7. DK/NR
9. REFUSED

Q47 What is the average amount of time you usually wait before a computer is available?

INTERVIEWER: YOU MUST SPECIFY HOURS, MINUTES SECONDS (USE 00)
TIME>HH:MM

98. DK/NR
99. REFUSED

TRANS4 Now, please answer the following questions thinking only about the computers in the library on the first floor and above, omitting the computer lab in the basement of the library.

Q48 Do you use the computers in the library, again not including the computers in the basement?

1. YES
2. NO [SKIPTO Q55]
7. DK/NR
9. REFUSED

Q49 On average, how many times in one week do you use these computers?
DAYS OUT OF SEVEN>

98. DK/NR
99. REFUSED

Q50 On average, how long do you spend using the computers during each visit?
HOURS>

97. LESS THAN ONE HOUR
98. DK/NR
99. REFUSED

Q51 Please tell me which of the following you use these computers for?
[READ EACH OPTION AND SELECT ALL THAT APPLY]

1. Research
2. E-mail
3. Web surfing
4. Word or Excel
5. Printing

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6. Other (Please specify)
7. DK/NR
9. REFUSED

Q52 How often do you use them on a Friday afternoon, Saturday or Sunday? Would you say you use the computers in the library, not counting the ones in the basement...
1. Weekly
2. Monthly
3. Once or twice a semester
4. Less than once a semester
7. DK/NR
9. REFUSED

Q53 Do you ever have to wait longer than 5 minutes for access to a computer in the library, not counting the basement?
1. YES
2. NO [SKIPTO Q55]
7. DK/NR
9. REFUSED

Q54 What is the average amount of time you usually wait before a computer is available?
INTERVIEWER: YOU MUST SPECIFY HOURS, MINUTES AND SECONDS (USE 00) TIME>HH:MM
98. DK/NR
99. REFUSED

Q55 Overall, how would you rate the availability of computers on campus? Please use a scale from 1 to 5, where 1 is equal to "You always have to wait a long time for one" and 5 is "There is always one available when I need it"
1. ALWAYS HAVE TO WAIT
2.
3.
4.
5. ALWAYS ONE AVAILABLE
6. DON'T USE COMPUTERS ON CAMPUS
7. DK/NR
9. REFUSED

Q56 Do you have any other comments or suggestions you'd like to make about the open computer labs, student computers, or the computers in the classrooms?

OPN

Q57 We have just a few more questions for demographic purposes only – first, Did you transfer from a junior college or community college in California?
1. YES
2. NO

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7. DK/NR
9. REFUSED

Q58 Is English your first language?
1. YES
2. NO (Please specify first language)
7. DK/NR
9. REFUSED

Q59 Were you born in the United States?
1. YES [SKIPTO Q61]
2. NO (Please specify where student was born)
7. DK/NR
9. REFUSED

Q60 How long have you been in the United States?
YEARS
98. DK/NR
99. REFUSED

Q61 Are you the first in your immediate family to enroll in college?
1. YES
2. NO
7. DK/NR
9. REFUSED

Q62 Which of the following best characterizes your school schedule?
1. Mornings, before noon
2. Afternoons, between 12 and 5:15
3. Evenings, after 5:15, or
4. Do you have classes during all of these time periods?
7. DON'T KNOW
9. REFUSED

Q63 Do you take classes only Monday through Friday, only on Saturday, or both?
1. MONDAY THROUGH FRIDAY ONLY
2. SATURDAY ONLY
3. BOTH
7. DON'T KNOW
9. REFUSED

Q64 How many hours in a typical week do you work for wages?
HOURS>
97. NOT EMPLOYED FOR WAGES [SKIPTO CONCLUDE]
98. DON'T KNOW
99. REFUSED

Q65 Briefly what is your job description?

OPN

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Q66 And what field are you employed in?

OPN

Q67 Do you use a computer in your work?

1. YES
2. NO
7. DK/NR
9. REFUSED

CONCLUDE That concludes our survey. I'd like to thank you very much for your time and cooperation.

CMDI: Gender
Age
Number of units
Ethnicity
Fresh/Soph/Jr/Sr/Grad or Post-bacc/Teaching credential
Major or Concentration
GPA

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Appendix 2 – CSUF Classroom Survey

Room #: ____________________

Class: ____________________ (ex. Fin 320, Psyc 100)

Last 4 numbers of Student ID: ____________

Gender: Male ____ Female ____ **Age:** ______

Is English Your First Language?: Yes ______ No ______

I would like to participate in additional research related to computers on campus: Yes ____ No ____

	Strongly Agree	Slightly Agree	No Opinion	Slightly Disagree	Strongly Disagree
1) Computers are useful in the classroom.	____	____	____	____	____
2) CSUF should install a computer in every classroom for the <u>instructor</u>.	____	____	____	____	____
3) CSUF should install a computer at every classroom workstation for the <u>students</u>.	____	____	____	____	____
4) CSUF has an adequate number of computer labs for students.	____	____	____	____	____
5) I am comfortable using computers.	____	____	____	____	____
6) I learn more when computers are used in class.	____	____	____	____	____
7) A course on how to use computers should be a requirement for graduation.	____	____	____	____	____
8) I know how to use the Internet to do research for class projects.	____	____	____	____	____
9) I know how to use PowerPoint.	____	____	____	____	____
10) I know how to use word processing software (Word, WordPerfect).	____	____	____	____	____
11) I know how to use spreadsheet software (Excel, Lotus).	____	____	____	____	____
12) I own a computer or have access to one at home.	____	____	____	____	____
13) I have an e-mail account that I use at least once per week.	____	____	____	____	____
14) The instructors used computers in my high school classrooms.	____	____	____	____	____

Thank you for your participation.

Appendix 3 – Exploratory Study 1 Tables

Table A1 - Classrooms with upgraded instructional technology

Feel learning experience is enhanced when instructor uses classroom computers

		Frequency	Percent	Valid Percent	Cum. Percent
Valid	Yes (Please specify)	264	25.731	85.437	85.437
	No (Please specify)	45	4.386	14.563	100.000
	Total	309	30.117	100.000	

Table A2 - Classrooms without upgraded instructional technology

Feel my learning experience would be enhanced if instructor used classroom computers

		Frequency	Percent	Valid Percent	Cum. Percent
Valid	Strongly agree	79	7.700	11.952	11.952
	Agree	248	24.172	37.519	49.470
	Disagree	209	20.370	31.619	81.089
	Strongly disagree	125	12.183	18.911	100.000
	Total	661	64.425	100.000	

Table A3 - Student access to computers

Own or have access to computer at home

		Frequency	Percent	Valid Percent	Cum. Percent
Valid	Yes	970	94.542	94.634	94.634
	No	55	5.361	5.366	100.000
	Total	1025	99.903	100.000	
Missing	REFUSED	1	0.097		
Total		1026	100.000		

Table A4 - Student self-evaluation of computer expertise

Rate general computer skills

		Frequency	Percent	Valid Percent	Cum. Percent
Valid	Have no experience	3	0.292	0.293	0.293
	Are a beginner	58	5.653	5.659	5.951
	Are slightly experienced	181	17.641	17.659	23.610
	Moderately experienced	479	46.686	46.732	70.341
	Very experienced	261	25.439	25.463	95.805
	An expert	43	4.191	4.195	100.000
	Total	1025	99.903	100.000	
	No response/don't know	1	0.097		
Total		1026	100.000		

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Appendix 3 – Exploratory Study 1 Tables (continued)

Table A5 - t-Tests for Gender Differences

		t	df	Sig. (2-tailed)	Std. Error
Feel learning experience is enhanced	Equal variances assumed	-1.242	307	0.215	0.041
Feel my learning exper. would be enhanced	Equal variances assumed	-2.175	659	**0.030**	0.073
Own or have access to computer at home	Equal variances assumed	-0.121	1023	0.904	0.014
Rate general computer skills	Equal variances assumed	5.690	1023	**0.000**	0.058
Years you've been using computers	Equal variances assumed	0.581	1019	0.561	0.399

	Gender	N	Mean	Std. Dev.	Std. Error
Feel learning experience is enhanced	Male	122	1.115	0.320	0.029
	Female	187	1.166	0.373	0.027
Feel my learning exper. would be enhanced	Male	274	2.482	0.915	0.055
	Female	387	2.641	0.934	0.048
Own or have access to computer at home	Male	418	1.053	0.224	0.011
	Female	607	1.054	0.227	0.009
Rate general computer skills	Male	417	4.235	0.962	0.047
	Female	608	3.906	0.870	0.035
Years you've been using computers	Male	414	7.833	7.563	0.372
	Female	607	7.601	5.194	0.211

Table A6 – Cluster differences
t-test for Equality of Means

	t	df	Sig. (2-tailed)	Mean Diff	Std. Error
Equal variances assumed	-4.919	659	**0.000**	-0.389	0.079

Group Statistics

	Cluster	N	Mean	Std. Dev	Std. Error
Feel my learning exper. would be enhanced	1	186	2.296	0.885	0.065
	2	475	2.684	0.924	0.042

A lower mean score indicates a greater degree of agreement with the statement.

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Appendix 4 – Exploratory Study 2 Tables

Table A7 - Computers are useful in the classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	4	0.557	0.558	0.558
	Slightly Disagree	9	1.253	1.255	1.813
	No Opinion	48	6.685	6.695	8.508
	Slightly Agree	212	29.526	29.568	38.075
	Strongly Agree	444	61.838	61.925	100.000
	Total	717	99.861	100.000	
Missing	No response	1	0.139		
Total		718	100.000		

Table A8 - I am comfortable using computers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	3	0.418	0.420	0.420
	Slightly Disagree	18	2.507	2.521	2.941
	No Opinion	13	1.811	1.821	4.762
	Slightly Agree	212	29.526	29.692	34.454
	Strongly Agree	468	65.181	65.546	100.000
	Total	714	99.443	100.000	
Missing	No response	4	0.557		
Total		718	100.000		

Table A9 - I learn more when computers are used in class

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	15	2.089	2.098	2.098
	Slightly Disagree	59	8.217	8.252	10.350
	No Opinion	193	26.880	26.993	37.343
	Slightly Agree	219	30.501	30.629	67.972
	Strongly Agree	229	31.894	32.028	100.000
	Total	715	99.582	100.000	
Missing	No response	3	0.418		
Total		718	100.000		

Table A10 - I own or have access to a computer at home

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	6	0.836	0.837	0.837
	Slightly Disagree	12	1.671	1.674	2.510
	No Opinion	8	1.114	1.116	3.626
	Slightly Agree	66	9.192	9.205	12.831
	Strongly Agree	625	87.047	87.169	100.000
	Total	717	99.861	100.000	
Missing	No response	1	0.139		
Total		718	100.000		

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Appendix 4 – Exploratory Study 2 Tables (continued)

Table A11 – t-tests for Gender Differences		t	df	Sig. (2-tailed)	Std. Error
Computers are useful in the classroom	Equal variances assumed	1.637	709	0.102	0.055
I am comfortable using computers	Equal variances assumed	2.819	706	**0.005**	0.052
I learn more when computers are used in class	Equal variances assumed	1.983	707	**0.048**	0.078
I own or have access to a computer at home	Equal variances assumed	-0.384	709	0.701	0.047

Group Statistics	Gender	N	Mean	Std. Dev.	Std. Error
Computers are useful in the classroom	Male	343	4.554	0.766	0.041
	Female	368	4.465	0.688	0.036
I am comfortable using computers	Male	340	4.647	0.633	0.034
	Female	368	4.500	0.746	0.039
I learn more when computers are used in class	Male	342	3.904	0.995	0.054
	Female	367	3.749	1.070	0.056
I own or have access to a computer at home	Male	342	4.792	0.668	0.036
	Female	369	4.810	0.573	0.030

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Appendix 4 – Exploratory Study 2 Tables (continued)

	Table 12 - Correlations	1	2	3	4	5	6	7	8	9
1	Computers are useful in the classroom	1								
		717								
2	I am comfortable using computers	0.255	1							
		0.000	.							
		713	714							
3	I learn more when computers are used in class	0.474	0.274	1						
		0.000	**0.000**	.						
		714	711	715						
4	A computer literacy course should be required for graduation	0.255	0.086	0.318	1					
		0.000	**0.022**	**0.000**	.					
		710	707	708	711					
5	I own or have access to a computer at home	0.107	0.209	0.119	0.086	1				
		0.004	**0.000**	**0.001**	**0.022**	.				
		716	713	714	710	717				
6	My high school instructors used computers in the classrooms	0.125	0.100	0.191	0.070	0.024	1			
		0.001	**0.008**	**0.000**	0.062	0.526	.			
		714	711	712	708	714	715			
7	Gender	-0.061	-0.105	-0.074	-0.020	0.014	-0.013	1		
		0.102	**0.005**	**0.048**	0.602	0.701	0.738	.		
		711	708	709	705	711	709	712		
8	Is English your first language	0.022	-0.095	0.121	0.080	-0.089	0.009	0.059	1	
		0.554	**0.012**	**0.001**	**0.035**	**0.018**	0.810	0.122	.	
		698	695	696	692	698	696	696	699	
9	Your age	0.067	-0.034	0.019	0.153	-0.036	-0.255	0.054	0.142	1
		0.084	0.385	0.625	**0.000**	0.353	**0.000**	0.165	**0.000**	.
		670	666	667	665	669	667	670	657	670

	Table A13 - Group Statistics	Cluster	N	Mean	Std. Dev	Std. Error
1	Computers are useful in the classroom	1	364	4.676	0.602	0.032
		2	353	4.340	0.800	0.043
2	I am comfortable using computers	1	365	4.559	0.730	0.038
		2	349	4.590	0.657	0.035
3	I learn more when computers are used in class	1	364	4.104	0.930	0.049
		2	351	3.530	1.066	0.057

T-test for Equality of Means	t	df	Sig. (2-tailed)	Mean Diff	Std. Error
1 - Equal variances assumed	6.364	715	**0.000**	0.336	0.053
2 - Equal variances assumed	-0.602	712	0.547	-0.031	0.052
3 - Equal variances assumed	7.688	713	**0.000**	0.574	0.075

In this study, higher scores represented stronger agreement with the statement.
Cluster 1 consisted of business and computer science students. All other students were in cluster 2.

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Appendix 5 – Computer Attitude Survey 2 (CAS-2)

Please answer the questions below by putting a check mark on the line that most agrees with your opinion. Mark only one answer per question and answer all questions (on both sides of the paper).

		Strongly Agree	Slightly Agree	No Opinion	Slightly Disagree	Strongly Disagree
1.	I like working with computers.	___	___	___	___	___
2.	I use computers as often as possible.	___	___	___	___	___
3.	I avoid using computers whenever I can.	___	___	___	___	___
4.	I think working with computers is enjoyable and stimulating.	___	___	___	___	___
5.	I'm no good with computers.	___	___	___	___	___
6.	Generally, I would feel OK about trying to solve a problem using a computer.	___	___	___	___	___
7.	I'm not the type to do well with computers.	___	___	___	___	___
8.	I am sure I could learn a programming language.	___	___	___	___	___
9.	I think using computers is hard.	___	___	___	___	___
10.	I have a lot of self-confidence when it comes to working with computers.	___	___	___	___	___
11.	Computers do not scare me at all.	___	___	___	___	___
12.	Working with a computer makes me very nervous.	___	___	___	___	___
13.	Computers make me feel uncomfortable.	___	___	___	___	___
14.	Learning about computers is a waste of time.	___	___	___	___	___
15.	I'll need to know about computers for my future work.	___	___	___	___	___
16.	Learning about computers is worthwhile.	___	___	___	___	___
17.	I expect to have little use for computers in my daily life.	___	___	___	___	___

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		Strongly Agree	Slightly Agree	No Opinion	Slightly Disagree	Strongly Disagree
18.	Working with computers will not be important in my future career.	______	______	______	______	______
19.	Anything a computer can do, I can do just as well some other way.	______	______	______	______	______
20.	Knowing how to work with computers will increase my job opportunities.	______	______	______	______	______
21.	I will use computers in many ways in my life.	______	______	______	______	______
22.	I like learning with a computer.	______	______	______	______	______
23.	Having computers in the classrooms would be fun for me.	______	______	______	______	______
23.	I would feel at ease in a computer class.	______	______	______	______	______
24.	Computers make me feel uneasy and confused.	______	______	______	______	______

Thank you for your assistance with this research.

Appendix 6 – Information Acquisition and Ordering Inventory (IAOI)

In each and every grouping, please rank the statements as they describe you, with **"1" being "most like me" and "4" being "least like me."** There are no right or wrong answers and no one will see your responses other than the researcher. **Please make sure each group of statements has rankings of 1, 2, 3 and 4 (see example below)** and that all eight groupings are completed.

Example:
Q. __2__ I like cold pizza for breakfast.
__1__ I like cereal or eggs for breakfast.
__3__ I can eat just about anything for breakfast.
__4__ I'm not much of a breakfast eater.

1. _____ I make decisions from an objective, impartial point of view.
_____ I would like others to describe me as a person who does high quality work.
_____ I can tell if someone's upset with me without them saying so.
_____ I might enjoy being a physician, lawyer or inventor.

2. _____ I'm a researcher. I carefully research a project before completing it.
_____ I think of myself as lively and fun-loving.
_____ I always have a back-up plan in case the first one doesn't succeed.
_____ I'm very attentive to detail.

3. _____ I would like others to describe me as a fair, non-judgmental person.
_____ I like to approach situations from a different perspective than most people take.
_____ I would be uncomfortable working at a cluttered desk.
_____ I might enjoy being a chemist, mathematician or engineer.

4. _____ I make decisions based on my gut feeling or intuition.
_____ I think of myself as practical and pragmatic.
_____ I like taking things apart to see how they work.
_____ I'm colorful. I prefer red or yellow to beige and gray.

5. _____ I would like others to describe me as a solid, reliable person.
_____ If I'm not sure how a word is spelled, I look it up in the dictionary.
_____ I'm very aware of what's going on around me.
_____ I think of myself as being perceptive and able to "read between the lines."

6. _____ I make decisions only after complete and careful evaluation.
_____ I'm a spontaneous person and like to do things on the spur of the moment.
_____ I'm a risk-taker. I enjoy new challenges.
_____ I'm a realistic person. I understand what is possible and what isn't.

7. _____ When someone else talks about their pain, I can almost feel it with them.
_____ I would like others to describe me as an insightful person.
_____ My motto is "a place for everything and everything in its place."
_____ I like discovering new ways of doing things.

8. _____ I think I'm a creative person.
_____ I'm a perfectionist. I want my work to be completely error-free.
_____ I think of myself as rational and logical.
_____ I might enjoy being an artist, sculptor or writer.

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Appendix 7 – Dissertation Study 1 Tables

Table A14a
Group Statistics

	Gender	N	Mean	SD	Std. Err.
Affinity	Male	86	1.680	0.796	0.086
	Female	146	1.744	0.689	0.057
Confidence	Male	86	1.771	0.639	0.069
	Female	146	1.942	0.788	0.065
Anxiety	Male	86	1.612	0.797	0.086
	Female	146	1.703	0.775	0.064
Usefulness	Male	86	1.421	0.580	0.063
	Female	146	1.541	0.556	0.046

Table A14b
Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig. (2-tailed)	Mean Diff	Std. Err Diff
Affinity	-0.645	230	0.520	-0.064	0.099
Confidence	-1.703	230	0.090	-0.170	0.100
Anxiety	-0.856	230	0.393	-0.091	0.106
Usefulness	-1.564	230	0.119	-0.120	0.077

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Appendix 7 – Dissertation Study 1 Tables (continued)

Table A15a
Group Statistics – Learning style **AR**

	Gender	N	Mean	SD	Std. Err.
Affinity	Male	10	1.517	0.426	0.135
	Female	41	1.772	0.689	0.108
Confidence	Male	10	1.567	0.466	0.147
	Female	41	2.073	0.890	0.139
Anxiety	Male	10	1.140	0.313	0.099
	Female	41	1.688	0.823	0.129
Usefulness	Male	10	1.620	0.824	0.261
	Female	41	1.566	0.551	0.086

Table A15b
Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig. (2-tailed)	Mean Diff	Std. Err Diff
Affinity	-1.118	49	0.269	-0.256	0.229
Confidence	-1.734	49	0.089	-0.507	0.292
Anxiety	-2.054	49	**0.045**	-0.548	0.267
Usefulness	0.251	49	0.803	0.054	0.215

Table A16a
Group Statistics - **Males**

	Pref. Style	N	Mean	SD	Std. Err.
Affinity	as	26	1.705	0.765	0.150
	ar	10	1.517	0.426	0.135
Confidence	as	26	1.628	0.574	0.113
	ar	10	1.567	0.466	0.147
Anxiety	as	26	1.677	0.780	0.153
	ar	10	1.140	0.313	0.099
Usefulness	as	26	1.492	0.555	0.109
	ar	10	1.620	0.824	0.261

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Appendix 7 – Dissertation Study 1 Tables (continued)

Table A16b
Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig. (2-tailed)	Mean Diff	Std. Err Diff
Affinity	0.732	34	0.469	0.188	0.257
Confidence	0.302	34	0.764	0.062	0.204
Anxiety	2.098	34	**0.043**	0.537	0.256
Usefulness	-0.538	34	0.594	-0.128	0.237

Table A17a
Group Statistics -
Females

	Pref. Style	N	Mean	SD	Std. Err.
Affinity	cs	47	1.599	0.578	0.084
	cr	28	2.107	0.860	0.162
Confidence	cs	47	1.766	0.622	0.091
	cr	28	2.137	0.846	0.160
Anxiety	cs	47	1.638	0.778	0.113
	cr	28	1.886	0.769	0.145
Usefulness	cs	47	1.387	0.523	0.076
	cr	28	1.800	0.671	0.127

Table A17b
Independent Samples
Test

	t-test for Equality of Means				
	t	df	Sig. (2-tailed)	Mean Diff	Std. Err Diff
Affinity	-3.058	73	**0.003**	-0.508	0.166
Confidence	-2.178	73	**0.033**	-0.371	0.170
Anxiety	-1.339	73	0.185	-0.247	0.185
Usefulness	-2.969	73	**0.004**	-0.413	0.139

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Appendix 7 – Dissertation Study 1 Tables (continued)

Table A18a
Group Statistics -
Females

	Pref. Style	N	Mean	SD	Std. Err.
Affinity	as	30	1.594	0.563	0.103
	cr	28	2.107	0.860	0.162
Confidence	as	30	1.856	0.781	0.143
	cr	28	2.137	0.846	0.160
Anxiety	as	30	1.653	0.720	0.131
	cr	28	1.886	0.769	0.145
Usefulness	as	30	1.507	0.413	0.075
	cr	28	1.800	0.671	0.127

Table A18b
Independent Samples
Test

	t-test for Equality of Means				
	t	df	Sig. (2-tailed)	Mean Diff	Std. Err Diff
Affinity	-2.704	56	**0.009**	-0.513	0.190
Confidence	-1.316	56	0.193	-0.281	0.214
Anxiety	-1.189	56	0.240	-0.232	0.195
Usefulness	-2.020	56	**0.048**	-0.293	0.145

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Table A19a
Tests of Between-Subjects Effects

Dependent Variable: **Affinity**

Source	Type III SS	df	MS	F	Sig.
Corrected Model	5.509	7	0.787	2.164	0.048
Intercept	140.886	1	140.886	387.364	0.000
DOMSTY	1.146	3	0.382	1.050	0.376
GENDER	3.896	1	3.896	10.712	**0.002**
DOMSTY * GENDER	1.061	3	0.354	0.973	0.411
Error	24.732	68	0.364		
Total	238.583	76			
Corrected Total	30.241	75			

R Squared = .182 (Adjusted R Squared = .098)

Table A19b
Tests of Between-Subjects Effects

Dependent Variable: **Confidence**

Source	Type III SS	df	MS	F	Sig.
Corrected Model	4.228	7	0.604	1.491	0.185
Intercept	192.229	1	192.229	474.404	0.000
DOMSTY	0.096	3	0.032	0.079	0.971
GENDER	3.254	1	3.254	8.031	**0.006**
DOMSTY * GENDER	0.282	3	0.094	0.232	0.874
Error	27.554	68	0.405		
Total	316.111	76			
Corrected Total	31.782	75			

R Squared = .133 (Adjusted R Squared = .044)

Table A19c
Tests of Between-Subjects Effects

Dependent Variable: **Anxiety**

Source	Type III SS	df	MS	F	Sig.
Corrected Model	5.851	7	0.836	1.682	0.128
Intercept	139.486	1	139.486	280.751	0.000
DOMSTY	2.641	3	0.880	1.772	0.161
GENDER	3.814	1	3.814	7.677	**0.007**
DOMSTY * GENDER	0.206	3	0.069	0.138	0.937
Error	33.785	68	0.497		
Total	257.240	76			
Corrected Total	39.635	75			

R Squared = .148 (Adjusted R Squared = .060)

DOMSTY = Dominant Learning Style

Table A19d
Tests of Between-Subjects Effects

Dependent Variable: **Usefulness**

Source	Type III SS	df	MS	F	Sig.
Corrected Model	4.707	7	0.672	2.568	0.021
Intercept	113.511	1	113.511	433.383	0.000
DOMSTY	0.556	3	0.185	0.708	0.551
GENDER	3.150	1	3.150	12.026	**0.001**
DOMSTY * GENDER	0.439	3	0.146	0.559	0.644
Error	17.810	68	0.262		
Total	192.320	76			
Corrected Total	22.518	75			

R Squared = .209 (Adjusted R Squared = .128)

Appendix 8 – Dissertation Study 2 Tables

Table A20a
One-Sample Statistics - **Lecture/lab mode**

	N	Mean	SD	Std. Err.
Affinity	70	1.529	0.530	0.063

Test Value = 1.65 (population mean)

	t	df	Sig.	Mean Diff.
Affinity	-1.917	69	**0.059**	-0.121

Table A20b
One-Sample Statistics - **Lecture/lab mode**

	N	Mean	SD	Std. Err.
Usefulness	70	1.303	0.436	0.052

Test Value = 1.44 (population mean)

	t	df	Sig.	Mean Diff.
Usefulness	-2.633	69	**0.010**	-0.137

Table A21a
One-Sample Statistics - **Interactive TV**

	N	Mean	SD	Std. Err.
Confidence	55	2.170	0.796	0.107

Test Value = 1.93 (population mean)

	t	df	Sig.	Mean Diff.
Confidence	2.232	54	**0.030**	0.240

Table A21b
One-Sample Statistics - **Interactive TV**

	N	Mean	SD	Std. Err.
Anxiety	55	1.956	0.861	0.116

Test Value = 1.69 (population mean)

	t	df	Sig.	Mean Diff.
Anxiety	2.294	54	**0.026**	0.266

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Appendix 8 – Dissertation Study 2 Tables (continued)

Table A22a
One-Sample Statistics – **Web-based**

	N	Mean	SD	Std. Err.
Affinity	43	1.360	0.403	0.061

Test Value = 1.69 (population mean)

	t	df	Sig.	Mean Diff.
Affinity	-4.708	42	**0.000**	-0.290

Table A22b
One-Sample Statistics – **Web-based**

	N	Mean	SD	Std. Err.
Anxiety	43	1.465	0.617	0.094

Test Value = 1.69 (population mean)

	t	df	Sig.	Mean Diff.
Anxiety	-2.391	42	**0.021**	-0.225

Table A22c
One-Sample Statistics – **Web-based**

	N	Mean	SD	Std. Err.
Usefulness	43	1.293	0.454	0.069

Test Value = 1.69 (population mean)

	t	df	Sig.	Mean Diff.
Usefulness	-2.122	42	**0.040**	-0.147

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Appendix 8 – Dissertation Study 2 Tables (continued)

Table A23
Group Statistics - **Instructional Modes Combined**

	Gender	N	Mean	SD	Std. Err.
Affinity	Male	79	1.513	0.548	0.062
	Female	146	1.626	0.671	0.056
Confidence	Male	79	1.835	0.671	0.075
	Female	146	2.067	0.720	0.060
Anxiety	Male	79	1.539	0.628	0.071
	Female	146	1.799	0.792	0.066
Usefulness	Male	79	1.370	0.470	0.053
	Female	146	1.385	0.487	0.040

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Error
Affinity	-1.282	223	0.201	-0.113	0.088
Confidence	-2.362	223	**0.019**	-0.232	0.098
Anxiety	-2.515	223	**0.013**	-0.259	0.103
Usefulness	-0.228	223	0.820	-0.015	0.067

Table A24
Group Statistics - **Lecture Mode**

	Gender	N	Mean	SD	Std. Err.
Affinity	Male	22	1.561	0.567	0.121
	Female	35	1.610	0.556	0.094
Confidence	Male	22	1.886	0.538	0.115
	Female	35	2.167	0.647	0.109
Anxiety	Male	22	1.345	0.419	0.089
	Female	35	1.960	0.811	0.137
Usefulness	Male	22	1.382	0.482	0.103
	Female	35	1.509	0.479	0.081

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Error
Affinity	-0.321	55	0.749	-0.049	0.152
Confidence	-1.696	55	0.096	-0.280	0.165
Anxiety	-3.280	55	**0.002**	-0.615	0.187
Usefulness	-0.971	55	0.336	-0.127	0.131

Table A25
Descriptive Statistics - **Lecture**

	N	Min	Max	Mean	SD
Affinity	57	1	2.833	1.591	0.556
Confidence	57	1	3.500	2.058	0.618
Anxiety	57	1	4.600	1.723	0.746
Usefulness	57	1	2.600	1.460	0.480

Descriptive Statistics - **TV**

	N	Min	Max	Mean	SD
Affinity	55	1	5.000	1.830	0.862
Confidence	55	1	3.833	2.170	0.796
Anxiety	55	1	4.800	1.956	0.861
Usefulness	55	1	3.200	1.462	0.536

Descriptive Statistics - **Lecture/Lab**

	N	Min	Max	Mean	SD
Affinity	70	1	2.833	1.529	0.530
Confidence	70	1	3.500	1.900	0.699
Anxiety	70	1	3.800	1.649	0.677
Usefulness	70	1	2.600	1.303	0.436

Descriptive Statistics - **Online**

	N	Min	Max	Mean	SD
Affinity	43	1	2.667	1.360	0.403
Confidence	43	1	3.333	1.795	0.680
Anxiety	43	1	3.400	1.465	0.617
Usefulness	43	1	2.600	1.293	0.454

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Appendix 8 – Dissertation Study 2 Tables (continued)

Table A26a
Multivariate Tests

Effect		Value	F	Proposition df	Error df	Sig.
Intercept	Pillai's Trace	0.897	411.920	4	190	0.000
	Wilks' Lambda	0.103	411.920	4	190	0.000
	Hotelling's Trace	8.672	411.920	4	190	0.000
	Roy's Largest Root	8.672	411.920	4	190	0.000
Gender	Pillai's Trace	0.024	1.177	4	190	0.322
	Wilks' Lambda	0.976	1.177	4	190	0.322
	Hotelling's Trace	0.025	1.177	4	190	0.322
	Roy's Largest Root	0.025	1.177	4	190	0.322
Instruction Mode	Pillai's Trace	0.078	1.280	12	576	0.226
	Wilks' Lambda	0.923	1.282	12	503	0.225
	Hotelling's Trace	0.082	1.281	12	566	0.225
	Roy's Largest Root	0.055	2.660	4	192	**0.034**
Preferred Learning Style	Pillai's Trace	0.115	1.917	12	576	**0.030**
	Wilks' Lambda	0.887	1.940	12	503	**0.028**
	Hotelling's Trace	0.124	1.957	12	566	**0.026**
	Roy's Largest Root	0.098	4.697	4	192	**0.001**
Gender * Inst. Mode	Pillai's Trace	0.040	0.649	12	576	0.800
	Wilks' Lambda	0.960	0.649	12	503	0.800
	Hotelling's Trace	0.041	0.649	12	566	0.800
	Roy's Largest Root	0.035	1.696	4	192	0.152
Gender * Preferred Style	Pillai's Trace	0.075	1.237	12	576	0.253
	Wilks' Lambda	0.926	1.237	12	503	0.254
	Hotelling's Trace	0.079	1.235	12	566	0.255
	Roy's Largest Root	0.052	2.488	4	192	**0.045**
Inst. Mode * Preferred Style	Pillai's Trace	0.159	0.888	36	772	0.660
	Wilks' Lambda	0.850	0.880	36	714	0.672
	Hotelling's Trace	0.167	0.872	36	754	0.685
	Roy's Largest Root	0.064	1.379	9	193	0.200
Gender * Mode * Style	Pillai's Trace	0.168	0.942	36	772	0.569
	Wilks' Lambda	0.841	0.936	36	714	0.578
	Hotelling's Trace	0.178	0.931	36	754	0.586
	Roy's Largest Root	0.081	1.745	9	193	0.081

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Appendix 8 – Dissertation Study 2 Tables (continued)

Table A26b
Tests of Between-Subjects Effects

Source	Dep. Var.	Type III SS	df	MS	F	Sig.
Corrected Model	Affinity	17.790	31	0.574	1.548	0.041
	Confidence	21.823	31	0.704	1.490	0.056
	Anxiety	26.587	31	0.858	1.681	0.019
	Usefulness	7.068	31	0.228	0.988	0.492
Intercept	Affinity	340.792	1	340.792	919.276	0.000
	Confidence	524.284	1	524.284	1109.990	0.000
	Anxiety	389.386	1	389.386	763.346	0.000
	Usefulness	264.913	1	264.913	1147.459	0.000
Gender	Affinity	0.332	1	0.332	0.894	0.345
	Confidence	1.875	1	1.875	3.970	**0.048**
	Anxiety	1.545	1	1.545	3.028	0.083
	Usefulness	0.001	1	0.001	0.003	0.955
Instruction Mode	Affinity	3.653	3	1.218	3.284	**0.022**
	Confidence	2.720	3	0.907	1.919	0.128
	Anxiety	2.832	3	0.944	1.850	0.139
	Usefulness	0.661	3	0.220	0.955	0.415
Preferred Learning Style	Affinity	3.158	3	1.053	2.840	**0.039**
	Confidence	8.498	3	2.833	5.997	**0.001**
	Anxiety	4.647	3	1.549	3.037	**0.030**
	Usefulness	0.341	3	0.114	0.493	0.688
Gender * Inst. Mode	Affinity	0.343	3	0.114	0.309	0.819
	Confidence	0.178	3	0.059	0.125	0.945
	Anxiety	1.157	3	0.386	0.756	0.520
	Usefulness	0.142	3	0.047	0.205	0.893
Gender * Preferred Style	Affinity	2.226	3	0.742	2.002	0.115
	Confidence	0.144	3	0.048	0.102	0.959
	Anxiety	1.324	3	0.441	0.865	0.460
	Usefulness	0.398	3	0.133	0.574	0.633
Inst. Mode * Preferred Style	Affinity	3.726	9	0.414	1.117	0.353
	Confidence	3.226	9	0.358	0.759	0.655
	Anxiety	2.367	9	0.263	0.516	0.862
	Usefulness	1.648	9	0.183	0.793	0.623
Gender * Mode * Style	Affinity	2.165	9	0.241	0.649	0.754
	Confidence	3.904	9	0.434	0.918	0.510
	Anxiety	4.714	9	0.524	1.027	0.420
	Usefulness	2.320	9	0.258	1.116	0.353
Error	Affinity	71.548	193	0.371		
	Confidence	91.160	193	0.472		
	Anxiety	98.450	193	0.510		
	Usefulness	44.558	193	0.231		
Total	Affinity	655.250	225			
	Confidence	1000.361	225			
	Anxiety	781.080	225			
	Usefulness	479.840	225			
Corrected Total	Affinity	89.339	224			
	Confidence	112.983	224			
	Anxiety	125.037	224			
	Usefulness	51.626	224			

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Appendix 9 – Dissertation Study 3 Tables

Table A27
Group Statistics - Students majoring in Computer Science

	Gender	N	Mean	SD	Std. Error
Affinity	Male	131	1.514	0.488	0.043
	Female	25	1.460	0.501	0.100
Confidence	Male	131	1.646	0.620	0.054
	Female	25	1.607	0.495	0.099
Anxiety	Male	131	1.524	0.635	0.055
	Female	25	1.488	0.592	0.118

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Appendix 10 – Dissertation Study 4 Tables

Table A28a
Group Statistics

	Pref. Style	N	Mean	SD	Std. Err.
Affinity	cs	170	1.517	0.613	0.047
	as	112	1.583	0.595	0.056
Confidence	cs	170	1.842	0.685	0.053
	as	112	1.756	0.651	0.061
Anxiety	cs	170	1.621	0.763	0.059
	as	112	1.609	0.658	0.062
Usefulness	cs	160	1.319	0.464	0.037
	as	103	1.472	0.467	0.046

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
Affinity	-0.902	280	0.368	-0.067	0.074
Confidence	1.053	280	0.293	0.086	0.082
Anxiety	0.139	280	0.889	0.012	0.088
Usefulness	-2.605	261	**0.010**	-0.153	0.059

Table A28b
Group Statistics

	Pref. Style	N	Mean	SD	Std. Err.
Affinity	cs	170	1.517	0.613	0.047
	ar	113	1.758	0.629	0.059
Confidence	cs	170	1.842	0.685	0.053
	ar	113	2.131	0.768	0.072
Anxiety	cs	170	1.621	0.763	0.059
	ar	113	1.777	0.778	0.073
Usefulness	cs	160	1.319	0.464	0.037
	ar	110	1.505	0.555	0.053

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
Affinity	-3.212	281	**0.001**	-0.241	0.075
Confidence	-3.311	281	**0.001**	-0.289	0.087
Anxiety	-1.670	281	0.096	-0.156	0.093
Usefulness	-2.996	268	**0.003**	-0.187	0.062

Table A28c
Group Statistics

	Pref. Style	N	Mean	SD	Std. Err.
Affinity	cs	170	1.517	0.613	0.047
	cr	96	1.811	0.883	0.090
Confidence	cs	170	1.842	0.685	0.053
	cr	96	1.915	0.763	0.078
Anxiety	cs	170	1.621	0.763	0.059
	cr	96	1.723	0.828	0.085
Usefulness	cs	160	1.319	0.464	0.037
	cr	84	1.540	0.636	0.069

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
Affinity	-3.190	264	**0.002**	-0.294	0.092
Confidence	-0.799	264	0.425	-0.073	0.091
Anxiety	-1.013	264	0.312	-0.102	0.100
Usefulness	-3.108	242	**0.002**	-0.222	0.071

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Appendix 10 – Dissertation Study 4 Tables (continued)

Table A28d
Group Statistics

	Pref. Style	N	Mean	SD	Std. Err.
Affinity	as	112	1.583	0.595	0.056
	cr	96	1.811	0.883	0.090
Confidence	as	112	1.756	0.651	0.061
	cr	96	1.915	0.763	0.078
Anxiety	as	112	1.609	0.658	0.062
	cr	96	1.723	0.828	0.085
Usefulness	as	103	1.472	0.467	0.046
	cr	84	1.540	0.636	0.069

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
Affinity	-2.205	206	**0.029**	-0.228	0.103
Confidence	-1.622	206	0.106	-0.159	0.098
Anxiety	-1.105	206	0.270	-0.114	0.103
Usefulness	-0.850	185	0.396	-0.069	0.081

Table A28e
Group Statistics

	Pref. Style	N	Mean	SD	Std. Err.
Affinity	as	112	1.583	0.595	0.056
	ar	113	1.758	0.629	0.059
Confidence	as	112	1.756	0.651	0.061
	ar	113	2.131	0.768	0.072
Anxiety	as	112	1.609	0.658	0.062
	ar	113	1.777	0.778	0.073
Usefulness	as	103	1.472	0.467	0.046
	ar	110	1.505	0.555	0.053

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
Affinity	-2.144	223	**0.033**	-0.175	0.082
Confidence	-3.952	223	**0.000**	-0.375	0.095
Anxiety	-1.748	223	0.082	-0.168	0.096
Usefulness	-0.477	211	0.634	-0.034	0.071

Table A28f
Group Statistics

	Pref. Style	N	Mean	SD	Std. Err.
Affinity	ar	113	1.758	0.629	0.059
	cr	96	1.811	0.883	0.090
Confidence	ar	113	2.131	0.768	0.072
	cr	96	1.915	0.763	0.078
Anxiety	ar	113	1.777	0.778	0.073
	cr	96	1.723	0.828	0.085
Usefulness	ar	110	1.505	0.555	0.053
	cr	84	1.540	0.636	0.069

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
Affinity	-0.501	207	0.617	-0.053	0.105
Confidence	2.034	207	**0.043**	0.216	0.106
Anxiety	0.486	207	0.627	0.054	0.111
Usefulness	-0.409	192	0.683	-0.035	0.086

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Appendix 10 – Dissertation Study 4 Tables (continued)

Table A29
Group Statistics - Prefsty AR

	Gender	N	Mean	SD	Std. Err.
Affinity	male	33	1.571	0.480	0.084
	female	80	1.836	0.668	0.075
Confidence	male	33	1.950	0.602	0.105
	female	80	2.206	0.818	0.092
Anxiety	male	33	1.461	0.499	0.087
	female	80	1.908	0.836	0.093
Usefulness	male	32	1.425	0.556	0.098
	female	78	1.538	0.555	0.063

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
Affinity	-2.066	111	**0.041**	-0.265	0.128
Confidence	-1.625	111	0.107	-0.256	0.158
Anxiety	-2.864	111	**0.005**	-0.447	0.156
Usefulness	-0.974	108	0.332	-0.113	0.117

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Appendix 10 – Dissertation Study 4 Tables (continued)

Table A30
Paired Samples Statistics - all learning styles

		Mean	N	SD	Std. Err.
Pair 1	Affinity - pre	1.682	120	0.691	0.063
	Affinity - post	1.575	120	0.614	0.056
Pair 2	Confidence - pre	1.783	120	0.709	0.065
	Confidence - post	1.703	120	0.842	0.077
Pair 3	Usefulness - pre	1.483	120	0.559	0.051
	Usefulness - post	1.625	120	0.789	0.072

Table A31
Paired Samples Statistics - Prefsty CR

		Mean	N	SD	Std. Err.
Pair 1	Affinity - pre	1.901	27	0.853	0.164
	Affinity - post	1.519	27	0.483	0.093
Pair 2	Confidence - pre	1.920	27	0.718	0.138
	Confidence - post	1.667	27	0.901	0.173
Pair 3	Usefulness - pre	1.689	27	0.676	0.130
	Usefulness - post	1.593	27	0.721	0.139

Paired Samples Test

		Paired Differences					
		Mean	SD	Std. Err.	t	df	Sig.
Pair 1	Affinity	0.383	0.882	0.170	2.256	26	**0.033**
Pair 2	Confidence	0.253	0.871	0.168	1.509	26	0.143
Pair 3	Usefulness	0.096	0.933	0.180	0.536	26	0.596

Table A32
Model Summary

Model	R	R Square	Adj. R Square	Std. Err.
1	0.185	0.034	0.030	0.719

a Predictors: (Constant), **Abstract Seq.**

ANOVA

Model		SS	df	MS	F	Sig.
1	Regression	4.215	1	4.215	8.164	**0.005**
	Residual	118.750	230	0.516		
	Total	122.965	231			

a Predictors: (Constant), Abstract Seq.
b Dependent Variable: **Affinity**

Table A33
Model Summary

Model	R	R Square	Adj. R Square	Std. Err.
1	0.275	0.076	0.064	0.602

a Predictors: (Constant), **GENDER**

ANOVA

Model		SS	df	MS	F	Sig.
1	Regression	2.429	1	2.429	6.706	**0.011**
	Residual	29.701	82	0.362		
	Total	32.130	83			

a Predictors: (Constant), GENDER
b Dependent Variable: **Anxiety**

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Appendix 10 – Dissertation Study 4 (continued)

Table A34
Model Summary

Model	R	R Square	Adj. R Square	Std. Err.
1	0.190	0.036	0.032	0.472

a Predictors: (Constant), **Sequential**

ANOVA

Model		SS	df	MS	F	Sig.
1	Regression	1.912	1	1.912	8.576	**0.004**
	Residual	51.267	230	0.223		
	Total	53.179	231			

a Predictors: (Constant), Sequential
b Dependent Variable: **Usefulness**

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Appendix 11 – Dissertation Study 5 Survey Questions

Gender ________ Age ______ Academic Major ______________________________________

Please respond to the statements below by putting an "X" or check mark on the line that most agrees with your opinion. Mark only one answer per statement and respond to all statements. **SA = Strongly Agree, A = Agree, D = Disagree, SD = Strongly Disagree**

	SA	A	D	SD
1. I avoid using computers whenever I can.	___	___	___	___
2. I have a lot of self-confidence when it comes to using computers.	___	___	___	___
3. I would feel at ease in a computer class.	___	___	___	___
4. I'm not the type to do well with computers.	___	___	___	___
5. I will use computers in many ways in my life.	___	___	___	___
6. Working with a computer makes me very nervous.	___	___	___	___
7. I like learning with a computer.	___	___	___	___
8. Working with a computer will not be important in my future career.	___	___	___	___
9. With directions, I might be able to assemble a computer from parts.	___	___	___	___
10. You have to know a lot of math to work with computers.	___	___	___	___
11. I would never be able to learn a programming language.	___	___	___	___
12. I learn more (or better) when the instructor uses a computer in class.	___	___	___	___
13. I like playing games on a computer (not a PlayStation or XBox).	___	___	___	___
14. I think computers are useful tools.	___	___	___	___
15. I'm curious about how computers work.	___	___	___	___
16. People in computer science are not very socially skilled.	___	___	___	___
17. I would rather build a house than design it.	___	___	___	___
18. I could handle the discipline and structure of the military.	___	___	___	___
19. Accounting and bookkeeping are boring.	___	___	___	___
20. I would be uncomfortable working with electricity or mechanical things.	___	___	___	___
21. I can take things apart and put them back together correctly.	___	___	___	___
22. I have no problem concentrating on a project for hours at a time.	___	___	___	___
23. I like playing chess or would like to learn how to play.	___	___	___	___
24. Learning a foreign language would be (or was) difficult for me.	___	___	___	___
25. I consider myself to be artistic (like to paint, draw, etc).	___	___	___	___
26. I enjoyed physics and math when I was in jr. high or high school.	___	___	___	___
27. I prefer group or team assignments to individual projects.	___	___	___	___
28. I do better with word problems than number problems.	___	___	___	___
29. In science classes, I enjoyed working in the labs.	___	___	___	___
30. I prefer to communicate by e-mail than by phone or in person.	___	___	___	___

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Appendix 12 – Dissertation Study 5 Tables

Table A35

Group Statistics

	College	N	Mean	SD	Std. Err.
AFF_USE	women's	165	6.712	1.789	0.139
	science	31	5.129	1.176	0.211
CNF_ANX	women's	165	7.470	2.175	0.169
	science	31	5.774	2.093	0.376

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
AFF_USE	4.732	194	**0.000**	1.583	0.335
CNF_ANX	4.005	194	**0.000**	1.696	0.423

Group Statistics

	College	N	Mean	SD	Std. Err.
AFF_USE	women's	165	6.712	1.789	0.139
	coed	44	7.205	2.041	0.308
CNF_ANX	women's	165	7.470	2.175	0.169
	coed	44	7.591	2.670	0.403

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
AFF_USE	-1.573	207	0.117	-0.492	0.313
CNF_ANX	-0.312	207	0.755	-0.121	0.388

Group Statistics

	College	N	Mean	SD	Std. Err.
AFF_USE	coed	44	7.205	2.041	0.308
	science	31	5.129	1.176	0.211
CNF_ANX	coed	44	7.591	2.670	0.403
	science	31	5.774	2.093	0.376

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
AFF_USE	5.091	73	**0.000**	2.076	0.408
CNF_ANX	3.163	73	**0.002**	1.817	0.574

Table A36

Group Statistics

	Gender	N	Mean	SD	Std. Err.
AFF_USE	male	24	5.958	1.601	0.327
	female	216	6.669	1.881	0.128
CNF_ANX	male	24	6.333	2.461	0.502
	female	216	7.377	2.294	0.156

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
AFF_USE	-1.779	238	0.076	-0.711	0.399
CNF_ANX	-2.100	238	**0.037**	-1.044	0.497

Table A37

Group Statistics

	Seq. Or Rand.	N	Mean	SD	Std. Err.
AFF_USE	sequential	103	5.927	1.720	0.169
	random	137	7.102	1.815	0.155
CNF_ANX	sequential	103	6.748	2.349	0.231
	random	137	7.668	2.239	0.191

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
AFF_USE	-5.076	238	**0.000**	-1.175	0.231
CNF_ANX	-3.086	238	**0.002**	-0.920	0.298

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Appendix 12 – Dissertation Study 5 Tables (continued)

Table A38

Group Statistics

	Pref. Style	N	Mean	SD	Std. Err.
AFF_USE	cs	58	6.250	1.885	0.248
	as	45	5.511	1.392	0.207
CNF_ANX	cs	58	7.043	2.565	0.337
	as	45	6.367	2.001	0.298

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
AFF_USE	2.203	101	**0.030**	0.739	0.335
CNF_ANX	1.457	101	0.148	0.676	0.464

Group Statistics

	Pref. Style	N	Mean	SD	Std. Err.
AFF_USE	cs	58	6.250	1.885	0.248
	ar	76	7.197	1.734	0.199
CNF_ANX	cs	58	7.043	2.565	0.337
	ar	76	7.711	2.266	0.260

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
AFF_USE	-3.017	132	**0.003**	-0.947	0.314
CNF_ANX	-1.595	132	0.113	-0.667	0.418

Group Statistics

	Pref. Style	N	Mean	SD	Std. Err.
AFF_USE	cs	58	6.250	1.885	0.248
	cr	61	6.984	1.919	0.246
CNF_ANX	cs	58	7.043	2.565	0.337
	cr	61	7.615	2.222	0.284

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
AFF_USE	-2.102	117	**0.038**	-0.734	0.349
CNF_ANX	-1.301	117	0.196	-0.572	0.439

Group Statistics

	Pref. Style	N	Mean	SD	Std. Err.
AFF_USE	as	45	5.511	1.392	0.207
	ar	76	7.197	1.734	0.199
CNF_ANX	as	45	6.367	2.001	0.298
	ar	76	7.711	2.266	0.260

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
AFF_USE	-5.547	119	**0.000**	-1.686	0.304
CNF_ANX	-3.290	119	**0.001**	-1.344	0.409

Group Statistics

	Pref. Style	N	Mean	SD	Std. Err.
AFF_USE	as	45	5.511	1.392	0.207
	cr	61	6.984	1.919	0.246
CNF_ANX	as	45	6.367	2.001	0.298
	cr	61	7.615	2.222	0.284

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
AFF_USE	-4.367	104	**0.000**	-1.472	0.337
CNF_ANX	-2.980	104	**0.004**	-1.248	0.419

Group Statistics

	Pref. Style	N	Mean	SD	Std. Err.
AFF_USE	ar	76	7.197	1.734	0.199
	cr	61	6.984	1.919	0.246
CNF_ANX	ar	76	7.711	2.266	0.260
	cr	61	7.615	2.222	0.284

Independent Samples Test

	t-test for Equality of Means				
	t	df	Sig.	Mean Diff.	Std. Err.
AFF_USE	0.684	135	0.495	0.214	0.313
CNF_ANX	0.248	135	0.805	0.096	0.386

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Appendix 12 – Dissertation Study 5 Tables (continued)

Table A39

Between-Subjects Factors

	Value Label	N
GENDER	male	24
	female	216
PREFSTY	cs	58
	as	45
	ar	76
	cr	61

Tests of Between-Subjects Effects

Dependent Variable: **AFF_USE**

Source	Type III SS	df	MS	F	Sig.
Corrected Model	102.244	7	14.606	4.650	0.000
Intercept	2370.567	1	2370.567	754.725	0.000
Gender	0.063	1	0.063	0.020	0.887
Pref. Style	49.347	3	16.449	5.237	**0.002**
Gender * Pref. Style	3.803	3	1.268	0.404	0.751
Error	728.704	232	3.141		
Total	11278.750	240			
Corrected Total	830.949	239			

R Squared = .123 (Adjusted R Squared = .097)

Between-Subjects Factors

	Value Label	N
GENDER	male	24
	female	216
PREFSTY	cs	58
	as	45
	ar	76
	cr	61

Tests of Between-Subjects Effects

Dependent Variable: **CNF_ANX**

Source	Type III SS	df	MS	F	Sig.
Corrected Model	83.229	7	11.890	2.278	0.029
Intercept	2821.231	1	2821.231	540.419	0.000
Gender	2.353	1	2.353	0.451	0.503
Pref. Style	46.052	3	15.351	2.941	**0.034**
Gender * Pref. Style	10.287	3	3.429	0.657	0.579
Error	1211.144	232	5.220		
Total	13989.250	240			
Corrected Total	1294.374	239			

R Squared = .064 (Adjusted R Squared = .036)

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Figure A1 – Theories of Reasoned Action and Planned Behavior

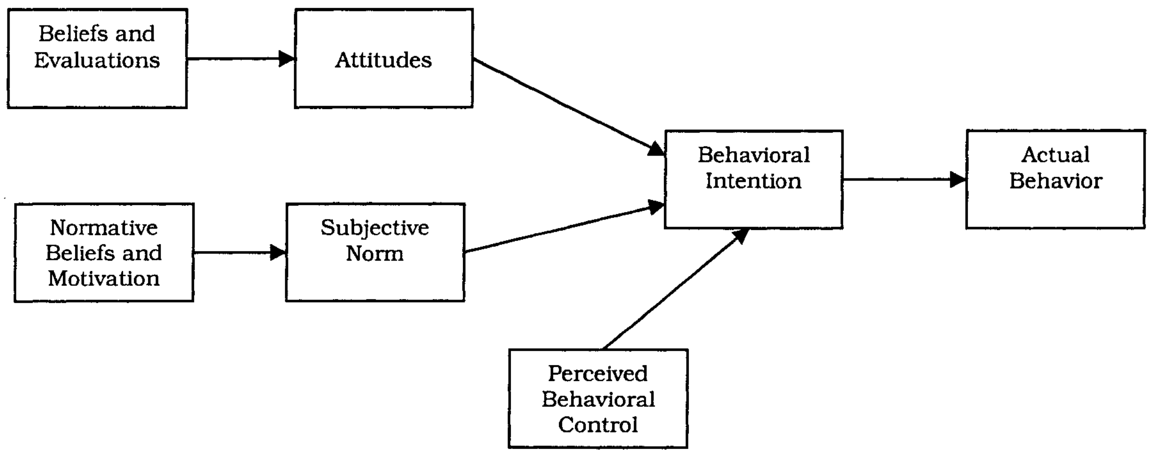
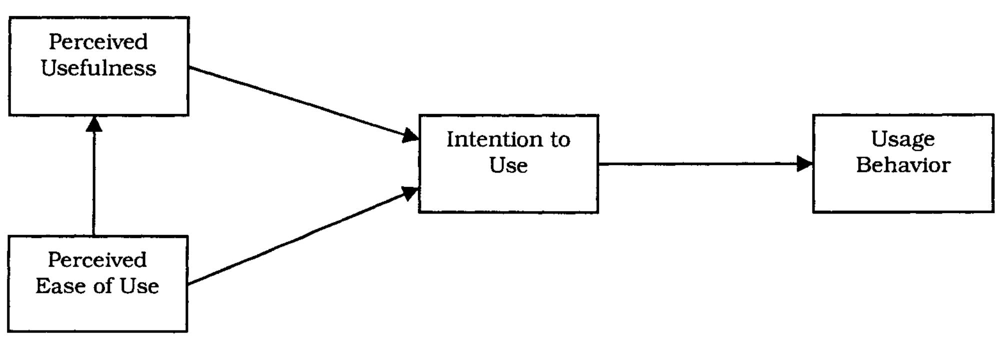


Figure A2 – Technology Acceptance Model



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