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ANALYSIS OF THE COMPARISON BETWEEN THE PERCEPTIONS OF ADULT AND TRADITIONAL MAJOR AND NONMAJOR COMPUTER SCIENCE STUDENTS IN COMPUTER SCIENCE CLASSES AT THE HIGHER EDUCATION LEVEL

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ABSTRACT

Analysis of the Comparison Between the Perceptions of Adult and Traditional Major and Nonmajor Computer Science Students in Computer Science Classes at the Higher Education Level

By Ray Ahmadnia, EdD

Purpose of the Study. This study identified and described (a) teaching techniques and instructional resources preferred by adult/traditional students in computer science (CS) classes, (b) the characteristics of an effective CS instructor as perceived by adult/traditional students, and (c) adult students' motivation to come back to college.

Methodology. This study used descriptive and ex post facto research to answer the research questions. Descriptive research procedures were applied to Research Questions 1-4. A two-tailed independent-samples *t*-test at the 0.05 level was used to answer Research Questions 5 and 6. Research Question 5 focused on differences between the needs of adult and traditional CS major students; while Research Question 6 focused on differences between the needs of traditional and adult students who are not CS majors, but are taking CS courses.

Findings. Traditional and adult CS-major students have strongly voiced the need for "Hands-on" teaching techniques. Students not majoring in CS most desirable teaching technique included factors, "Hands-on" and "Internship." The study revealed that "Hands-on or experimenting with examples in classrooms or computer labs" and "Computer software and Internet resources for learning" were two of the instructional resources strongly recommended by all students regardless of their age and major. The study has affirmed that a level of instructor's course knowledge was one of the essential characteristics of an effective CS faculty for CS-major students. Moreover, not CS-major adult students also strongly considered a faculty member being prepared in the subject matter. Not CS-major traditional student's most desirable characteristic was "Friendly and approachable to student and their questions, both in class and office hours." Traditional CS-major and most not CS-major students indicated that a motivational factor, such as "career or job advancement," was the main reason for them to come back to college. However, adult CS-major students agreed strongly that "Personal fulfillment" is the integral part of their decision for continuing college. It is important to note that the least desired motivational factor by majority of students was "Family pressure" and "Friends and relatives."

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CHAPTER I

INTRODUCTION

Literacy in the world can no longer be considered merely the ability to read. The information age requires that the concept of literacy be expanded to include information literacy—the ability to locate, evaluate, synthesize, organize, and apply information. In this computer age, students must be effective information consumers in all fields of knowledge and have the capacity to make connections among a variety of information sources. Higher education institutions must produce students who are computer literate in an electronic world. In practical terms, graduates who are computer literate will, in addition to the traditional skills of literacy, understand the role, power, and uses of information; understand the variety of contents and formats of information; understand systems for organizing information; have the capability to retrieve information; and have the ability to evaluate, organize, and manipulate information (Farmer & Mech, 1991).

With decreasing enrollments and less interest among traditional students in computer science programs, many higher education institutions have reoriented their institutional philosophies in order to survive. In searching for new directions, many colleges and universities have decided to address another group of audiences: adult learners. To attract and retain adult students at the higher education level, institutions must know why adults want to enter higher education at a particular stage in their lives.

What is their motivation and how much deserve different learning techniques and different styles of teaching?

The tabulations in Table 1 show the overall change of higher education enrollment from 2008-2010.

Table 1

Change in Higher Education Enrollments 2008-2010

Enrollment standing	2008 (in millions)	2010 (in millions)
By sex of students		
Female	9.2	9.6
Male	6.9	7.5
By age of students		
18-24 years old	9.6	9.9
25 and older	6.7	7.2
By attendance of students		
Full-time	9.6	10.1
Part-time	6.5	7.0
By control of institutions		
Public	12.4	12.8
Private	3.5	4.3
By type of Institutions		
2-year institutions	6.1	6.6
4-year institutions	10.0	10.5

Note. Adapted from *Projections of Education Statistics to 2010,* by U.S. Department of Education, National Center for Education Statistics (NCES), 2010, Government Printing Office, Washington, DC, pp. 11-14.

Most higher education institutions (75%) report increases in students over age 25 during the last decade; among institutions reporting increases in enrollment overall, about

60% point to adult students as the major factor. In addition, the report confirms that enrollments today include more adult students and more part-time students than in earlier years (U.S. Department of Education, 2010). In fact, Aslanian (2001) stated, "The number of older students in American higher education has been growing more rapidly than the number of younger students" (p. 3). He reported that "between 1970 and 2000, the number of younger students increased 41%, but the number of adult students grew up to 170%" (p. 3). Adult learners are an increasingly important segment of the population of students in the United States (Long, 1987). According to Galbraith (1990), "The incremental growth of this population has significant implications in a variety of areas: economic development, occupational trends, governmental policy, and educational programs and practice" (p. 23).

Thus, if universities or colleges are to adequately service this growing population of students, then varied teaching methods for adult population students in computer science courses must be implemented.

Background of the Study

The Carnegie Council on Policy Studies in Higher Education (1980) has indicated that in addition to the traditional students, there is also a student population referred to as adult learners or nontraditional students whose age is over 25 years old. Kizzie (2004) summarized some characteristics that differentiate nontraditional students from traditional students:

- significant responsibility for people other than themselves (children, parents)
- another occupation in addition to school

- crisis-driven, or some other significant life challenge pushing them to change their current lives (e.g., job loss, divorce, spousal death, jailed relatives or selves)
- literacy problems
- low marketable skills level, or very narrow, specialized ones
- significant lack of self-confidence, in and out of the classroom
- determination to try again in spite of the unknown
- limited time to study, attend class, do homework, etc.; all of which may compromise an academic achievement level or encourage a greater focus
- longer time to learn, but deeper learning accomplished; often develop own unique methods of learning, with a little encouragement
- lack of economic resources (p. 6)

James Pappas and Rosalind Loring (1987) pointed out other important characteristics of adults:

> For the adult, the student role is almost always secondary. Even when extensively engaged in education, adults see themselves first in occupational and/or family roles. They are first workers (or potential workers) or parents, and after that students. Knowles (1970) points out that adult students are mature and that their self-concept moves from one of dependency to self-direction. Thus, unlike traditional students who generally go on to college because it is the thing to do, or because there is nothing better going on, the adult has made a conscious decision to pursue further education in spite of competing roles or time demands, and this positive action implies a different and special set of motivations and expectations. As a general statement, adults are part-time students. They are attending school in the evening, on the weekends, online, or in some configuration that allows them to maintain their other social roles of workers and/or family members. Even when they attend school full-time, they try to graduate in as few years as possible and see attendance as a means, not an end. As Marienau and Chichering (1982, p. 10) note, "Adults should be viewed as part-time learners regardless of their credit loads." (pp. 142-143)

In broad-spectrum, adults entering the higher education institutions are mature responsible people who are capable of independent functioning in life and work, and engage in learning of their own desire. In fact, most adults are experienced self-directed learners (Tough, 1979). Since 1988, the College Board has continued its research on adult students to improve understanding of why and when adults return to college and

their patterns of learning. The *Digest of Educational Statistics, 1999* had this to say about adults entering higher and continuing education programs:

> The number of older students has been growing more rapidly than the number of younger students. . . . Between 1990 and 1997, the enrollments of students under age 25 increased by 2 percent. During the same period, enrollments of persons 25 and older rose by 6 percent. Moreover, the number of adult enrollments will rise from 6.5 million in year 2000 to 7.1 million by year 2010. (p. 23)

Adult students who have chosen to enter higher education have a tenacity to let nothing get in their way. Aslanian (2001) stated:

> The economy may falter, but adults keep learning. The economy may prosper, and adults still continue to learn. In good times and bad times, in all regions of the country, among all types of Americans, education seems to be the answer to some goals. (p. 1)

Adult Students' Experience and Readiness to Learn

Knowles (1984) describes adult learners as being self-directing, as deriving only positive benefits from the experience, as possessing great readiness to learn, as voluntarily entering an educational activity with a life centered, task-centered, or problem-centered orientation to learning, and as being internally motivated. Long (1987) stressed the value of experience as part of the adult education process. In Long's perspective, "Adult learners have experienced some learning and all adults have some experiences that may be related to their learning" (p. 223). Thus, there is the implication that experience plays a strong role in the process of learning in adults.

Knowles (1980) promulgated an approach to working with adult learners termed andragogy (the term andragogy, with roots in the Greek word "andr" or "andro," meaning "akin to man," or "man") or the art and science of teaching adults. In this approach,

Knowles built a foundation for working with adult learners differently. He wrote extensively about the concepts of andragogy and identified the following four assumptions:

Self-concept: As a person matures his/her self-concept moves from one of being a dependent personality toward one of being a self-directed human being.

Experience: As a person matures he/she brings rich experience to his/her learning as resources for learning.

Readiness to learn: As a person matures his/her readiness to learn becomes oriented increasingly to the developmental tasks of his/her social roles.

Orientation to learning: As a person matures his/her time perspective changes from one of postponed application of knowledge to immediacy of application, and accordingly his/her orientation toward learning shift to problem-based or performance-based learning.

By 1984, Knowles's concepts had matured, and he had added a fifth assumption to complete the set of assumptions of how adults learn:

Motivation to learn: As a person matures his/her motivation to learn becomes basically intrinsic in nature.

One can predict that there is a direct correlation between motivation and learning; how much a person learns is dependent on how much he or she wants to learn. As Theall (1999) noted, several organizations investigated student motivation and learning to increase retention and improve the quality of education. The Oxford Center for Staff (OCS) development in England published in 1992, its nine strategies for improving adult

student learning. In 1996, the Education Commission of the United States (ECUS) published its 12 attributes of good practice. But, the standard guidelines that would best or most assist faculty members are the *Seven Principles of Good Practice* presented by Chickering and Gamson (1987). The seven principles are listed in Appendix A.

Adults and Higher Education

The U.S. Department of Education projects that college enrollment will continue to increase for years to come—from an expected 16.1 million in 2005 to 17.5 million by 2010. Figure 1 illustrates the pattern of adult student enrollments from 1970 to 2000; a projected figure for the year 2010 is also included.

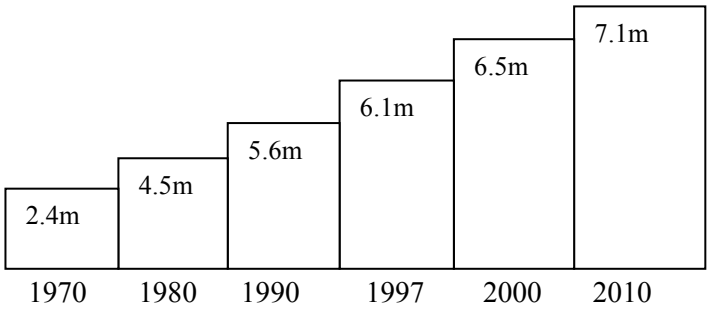

Figure 1. Adult student enrollments from 1970-2000. From *Adult Students Today*, by C. B. Aslanian, 2001, p. 8, The College Board, New York, NY.

In a study of adult students' reasons for enrolling in higher education, the following was found by Rita Preszler Weathersby (1990) in her doctoral dissertation from Harvard University in 1977:

> When the individual enters the adult world characteristic reasons for 20-year-olds to enroll were (1) it's the right time, (2) continuing my education; completing "unfinished business"; (3) furthering career goals; gaining needed credentials; (4) intellectual satisfaction; overcoming stagnation; and (5) personal search; keeping "some spark alive."
>
> Reasons for enrolling given by adults at the so-called age 30 transition were (1) finishing one's education, setting new goals, contingent on children's

> ages and family responsibilities; (2) boredom and dissatisfaction; need for redirection in work and perhaps personal life; (3) overcoming isolation, seeking self-identity, and personal growth; and (4) seeking professional advancement on one's own terms, clear identity and direction in work.
>
> Adult students in their thirties and forties, when individuals settle down and become their own person, gave reasons for enrolling which reveal an acceleration toward long-term goals and enjoyment of opportunities to study for personal and intellectual satisfactions: (1) pursuing long-term goals; accelerating progress; (2) satisfying intellectual curiosity; exploring personal interests; (3) combining study with family responsibilities; enjoying both; and (4) making financial ends meet.
>
> At the mid-life transition in the early forties, reasons for enrolling were related to work, self, and changed family circumstances. At the fifties transition, the reasons given for returning to college were (1) Regaining direction after crisis and personal upheaval; (2) Starting some new work; family responsibilities have lessened or changed; and (3) Pursuing long-valued interests and goals. (p. 23)

The presence of adult learners within higher education suggests the need for varying approaches to working with adult students. Higher education is no longer an activity one does during the traditional-age of 18 to 24. It has become a lifelong endeavor for more and more adult students (Aslanian, 2001). Adults learn when their current skills are no longer adequate. They learn to acquire new competencies for every aspect of their lives.

Education has become the key to the future of the economy, to the development of a populace that can create new solutions to new problems. Employers spend more than $60 billion annually on training because they need employees who have new competencies to meet the changes in science and technology. In the past, "information doubled every 10 years; now it doubles every 4 years" (Aslanian, 2001, p. 5). Most adults had to learn in order to get their jobs, keep them, or advance beyond them. Career transitions are the compelling force that moves millions of adults into undergraduate and graduate study. According to Aslanian (2001),

> The large majority of adult students (about 70%) enroll in degree programs. Of that 70% they most often seek a bachelor's degree (44%), followed by a master's degree (27%), and an associate's degree (25%). Only 3% are enrolled in doctoral programs. Of the other 30% who pursue individual courses, two thirds take the courses for some type of recognition, about 65% to obtain a certificate, 25% to meet licensing requirements, and 10% to obtain a 1- or 2-year diploma. (p. 19)

Aslanian (2001) has described 16 features that a prospective undergraduate adult student might consider in choosing a college (see Table 2). Thus, any higher education institutions or departments that want to be attractive to adult students must consider the ratings in Table 2. Hersh and Merrow (2005) note that to gain the attention of adult learners is one thing; to hold the attention of an adult learner is quite another.

Table 2

Features a Prospective Undergraduate Student Might Consider in Choosing a College

Rating	Futures
1	Desired course or degree offered
2	Quality of programs
3	Quality of faculty
4	Location
5	Schedule of courses
6	General reputation
7	Safety of campus
8	Credit transfer policy
9	Length of times to complete degree
10	Ease of admission
11	Price
12	Credit for prior learning policy
13	Small class size
14	Quality of other students
15	Availability of financial aid
16	Attractiveness of campus

Note. From *Adult Students Today*, by C. B. Aslanian, 2001, p. 19, The College Board, New York, NY.

Computer Science Classrooms and Laboratories

Adult students often choose computer science (CS) as a major because they like computer programming and have an interest in problem solving. Computer programming, however, is only one element in the study of CS. Principal areas within CS include database systems, computer systems, information technology, Web design, artificial intelligence, numerical analysis, theory of computing, electronic game design, Web-based applications, security, and software engineering. In short, the undergraduate CS degree prepares students for careers in applications programming, systems programming, and systems analysis, as well as entrance into graduate and professional schools.

Today, higher education institutions offer computer courses to meet once, twice, or sometimes three times a week depending on either the number of units per course or the institution's class scheduling philosophy. In order to adequately expose students to the concepts behind computer courses, CS departments conduct their computer courses in one of the following formats: (a) lecture in a classroom with limited hands-on time, (b) lecture in classroom and demonstration in computer laboratories, (c) lecture and demonstration in a computer laboratory or in a classroom with computers for each student, and (d) online classes.

In the first format mentioned, otherwise known as traditional lecturing, the instructor uses PowerPoint and/or a whiteboard to present information. Students are allowed to bring their own computers to class and encouraged to get extra help from

tutors or by attending on-campus computer laboratories. This method may be used with large group of students and handouts may be provided to support specific topics.

In the second format, the instructor lectures in a classroom and then the class meets the instructor or teaching assistant(s) in computer lab(s) for demonstration and hands-on practice. This method provides a way for students to determine what knowledge they have gained through practical exercises.

In the third format, both lecture and hands-on practice take place in one room, computer lab or classroom, with enough computers for all students. Information and questions are shared between and among the instructor and students. This computer-based instructional system allows students to interact in real time with the instructor and/or their classmates. This method is useful for participants who will not or cannot use printed materials.

In the last format, the terms "online classes," "distance education," "distance learning," "online distance learning," and "Internet-based distance-learning courses" mean the same thing; these terms have been used interchangeably in texts and publications over the years (Boghikian-Whitby, 2003). In this paradigm, lectures are delivered while students and instructors are online in real time (synchronous interaction) or done on students' and instructors' own time (asynchronous interaction).

Some institutions have open computer labs that are available to students all day. Most often assistants are available to assist students. Although these individuals can help with the mechanics of running programs, they are not necessarily content experts. In some labs, assistants inexperienced in working with adults serve as mentors. This can be

frustrating for those who need additional support in gaining comfort with technology or who have a learning style for personal interaction and tutorial assistance. Additionally, computer labs are often overfilled. Rather than providing opportunities for individualized work, they can become environments in which students compete for scarce resources. At some institutions instructors themselves, however, opt to reserve the computer lab for large group instruction so they can participate directly with their own students in facilitating the teaching-learning transaction.

Problem Statement

Aslanian (2001) believed that "the majority of undergraduate adult students (82%) are motivated to begin or return to college because of career transitions" (p. 52). They expect that their undergraduate education will help them acquire skills and knowledge that will lead them to lucrative jobs in a fast-changing economy that is increasingly becoming more and more technologically based. Meanwhile, college faculty face an enormous number of dilemmas as they plan and carry out instruction for adult students: What should be taught? How it should be taught, and how they will know if it has been taught? Over the years, great effort has been invested in the first area—witnesses the extensive debates about core curricula. But this study focuses on the second and third area—What are the characteristics of an effective computer science instructor, what helps adult students to learn, and what motivates them to learn?

What Educators Know

Adult students continue their education by taking noncredit courses as well as up to three courses toward credit to maintain their credentials and to keep up with the changing nature of their work. As mentioned before, most students rate the quality of the faculty, the quality of the programs, and the general reputation of an institution as highly influential factors when they want to choose a college. But the fact that a high-quality institution has a superb faculty and excellent computer science programs is not enough to make it an institution of choice among adults. The presence of adult students in computer courses suggests the need for varying approaches to working with them.

Universities and colleges are becoming aware that their future may be dependent upon the returning, recruiting, and retaining of adult students. To adapt appropriately to this group, higher education institutions have learned to offer classes in the evenings and weekends, to make degree requirements more flexible, and in some cases, to create off-campus courses and less formal learning experiences (Daloz, 1987).

An example of a successful adult education institution is the University Without Walls (UWW) at Loretto Heights College. Elinor Greenberg (1978), founding director of UWW, developed a 12-point list (Appendix B) that identifies the key processes of the UWW program, which relates them to adult development needs and their intended outcomes. In addition, the UWW pedagogical design is based on Weathersby's (1990) seven motivating factors for reenrolling: (a) to work on career goals, (b) to complete unfinished business, (c) for reorientation and redirection, (d) to pursue valued interests in an individualized manner, (e) for personal growth, (f) for challenge and intellectual

stimulation, and (g) because it was the right time to enroll. Greenberg believes that as educators increase their understanding of adult development and learning, they will improve their ability to design programs for adults that match their needs and interests.

To respond to a wide variety of individual *career goals* and to address the reality of rapid and continuing changes in the world, UWW offers a bachelor of arts degree in a broad array of traditional and innovative fields. In recognition of the *unfinished business* motivation, UWW helps adult students to complete degree requirements as quickly as is academically and financially feasible. To facilitate this process, enrollment is monthly and schedules are flexible within each 16-week learning segment, as semesters are known. Each person's 16-week semester begins on the date of enrollment. After entering the program, the student prepares a credit proposal, which enables students to gain academic credit for prior noncollege learning. This process shortens the time required to complete a degree.

The motivation to gain *reorientation and redirection* is reinforced by the UWW planning process. The admission process requires applicants to answer the questions "Where have you been?" "Where are you now?" and "Where are you going?" The learning contract must state long- and short-range goals. Changes in degree plans and amendments to learning contacts are supported when new learning experiences open up new opportunities and perspectives. Reorientation and redirection for adults depends largely on giving them an opportunity to sample widely, to base new decisions on informed experience, and *to pursue valued* interests in an individualized manner.

Personal growth needs motivate some adult students to reenter a college or university. The UWW admissions application asks candidates to comment on themselves in terms of personal characteristics, including responsibility, initiative, curiosity, tolerance for ambiguity, flexibility, and self-evaluative ability. In UWW, the one-to-one relationship between the faculty advisor and the student is viewed as the core of the program. This relationship allows students to work through personal concerns with supportive persons who are friends and mentors as well as academic advisors.

Needs for *intellectual stimulation and challenge* are met primarily through the content of regular courses, independent study, and independent field projects. One significant source of intellectual stimulation in UWW is the de-emphasis of competition. Since students' programs are individualized, each person competes only with himself or herself. Grades are not based on curves or averages. As a result, adult students often demand more of themselves than others would demand of them.

The motivation for returning to college that *it's time to enroll* is taken quite seriously. To build self-confidence among returnees to college, UWW designed a pre-entry exploratory experience called Project Transition, a 4-month, six-credit sequence. Adults considering enrolling as degree candidates meet in small seminar groups, and engage in individual career/life-planning activities. Project Transition assists the adult student, when ready, to reenter quickly, before the nerve disappears or something happens in daily life to delay reentry.

What Educators Need to Know

Traditional forms of teaching are under increasing pressure to change. Helping adult students learn can be a challenging experience. A basic understanding of the variety of skills to motivate adult students to learn and come back to school can enhance and help guide those involved in this journey. When students found that their needs were being met and university personnel were helping them translate classroom success to success beyond the classroom, education became a clear priority for adults and they returned to campus (Johnson & Christensen, 2000).

The overall goal of this study is to recognize the needs of adult students in CS classes and how faculty and staff can help them to achieve their goals and maintain their retention. In addition, it is intended to help instructors create a classroom in which students feel comfortable, secure, willing to take risks, and ready to test and share. Embedded in the goal of this study is the specific impact of self-efficacy, the preferred learning environment, and the capability to produce recommendations for enhancing CS classroom effectiveness for the adult learner. The 20 organizing principles for program design, which focus on program goals, learning, curriculum, processes, personnel, and purposes as introduced by Greenberg (1978; Appendix C), were used as a guideline to build the foundation of a true learning society for enhancing the quality of life and for developing the skills necessary to cope with the future.

Purpose Statement

The purpose of the study was to identify and describe (a) teaching techniques and instructional resources preferred by adult/traditional students in computer science classes

at the higher education level, (b) the characteristics of an effective computer science instructor as perceived by adult/traditional students at the higher education level, and (c) adult students' motivation to come back to college.

Research Questions

General research questions in guiding this study include:

1. What teaching techniques are considered desirable by students in computer science classes, relative to the following nine factors:
   a) Internship (to give students the opportunity to experience practical applications of the knowledge learned in academic courses)
   b) Mentorship (more experienced or more knowledgeable student helps a less experienced or less knowledgeable student)
   c) Computer-based learning (structured environment in which computers are used for teaching purposes. Minimum use of white-board)
   d) Hands-on or practical activities (a brief lecture followed by completing tasks using computers in the classroom or computer lab)
   e) Traditional classroom lecture utilizing a white-board, textbooks, handouts, and additional instructional resources as necessary.
   f) Classroom PowerPoint presentation, with textbooks, handouts, and additional resources as necessary.
   g) A brief lecture followed by classroom participation via peer and group discussion.
   h) 100% online classes

i) Hybrid courses (courses that blend in-class sessions with web-based activities or virtual classes)

2. What types of instructional resources are considered desirable by students in computer science classes, relative to the following 13 factors:

a) Handouts

b) Note taking

c) Textbook(s)

d) Library books and journals

e) Tutorial service center (offers students and faculty assistance with the teaching and learning of academic courses)

f) Comprehensive course syllabus

g) Use of whiteboard to present information in class

h) Use of Blackboard as a source of communication

i) Computers and other electronic resources (audio/video, links, PowerPoint, slides, and websites) to present information faculty wants students to know

j) Use of computer software and Internet resources for learning

k) Reference book(s) and other printed materials

l) Internet posted video of the instructor presenting a traditional classroom type lecture

m) Hands-on (experimenting with examples in classroom or computer labs)

3. What are the characteristics of an effective computer science instructor at the higher education level, relative to the following 16 factors:

a) Has in-depth knowledge of the subject material

b) Possesses an attitude that motivates students to learn

c) Has good public speaking and communication skills

d) Provides energy

e) Specifies clear lesson objectives and teaches only those objectives

f) Paces materials for the average learner

g) Provides examples which reinforce theory

h) Has classroom rules and norms that allow students to mentally engage and disengage from classroom awareness

i) Follows well-defined instructional plan which is flexible as class interests dictate

j) Has adequate number of assignments to reinforce instruction

k) Promotes frequent student faculty contact in and out of class

l) Identifies problems that can be solved as a result of the instruction

m) Focus on practical skills and knowledge that can be used in solving problems

n) Facilitates learning activities

o) Is friendly and approachable to students and their questions, both in class and office hours

p) Has good rapport with students and other faculty members

4. What motivates students to come back to college, relative to the following 13 factors:

a) Requirement for continued employment

b) Be better positioned in the event of downsizing

c) Family pressure

d) Friends or relatives

e) Joy of learning

f) Personal fulfillment

g) Acquire knowledge required for self employment

h) Career/job advancement

i) Career change

j) Better positioning for a promotion at work

k) Better positioned to obtain a higher paying job

l) Increased marketability

m) Keeping up to date on new technology

5. Are there significant differences between the needs of adult (25 years and older) and traditional (18-24 years old) computer science major students in computer science classes, relative to all factors in Questions 1-4?
6. Are there significant differences between the needs of traditional (age 18-24 years) and adult (25 years and older) not CS-major or undecided major students in computer science classes, relative to all factors in Questions 1-4?

Significance of the Study

Computers and information technology have changed the world rapidly and irreversibly. As educators rush into the information age, their future depends on computers and their ability to understand and use them in productive and positive ways.

The results of this study will be beneficial to institutions of higher education, as they will have a better understanding of the impact of education on adult students and

will develop a more responsive system of higher education, which will attract and retain adult students to meet their educational goals. In addition, the study will provide recommendations that will help the faculty and the administration at colleges and universities to understand how best to nurture and capitalize upon adult learner's needs, expectations, and motivations.

Delimitations of the Study

Delimitation 1. The study was limited to seven private universities in Southern California during the Fall of 2010.

Delimitation 2. The population of this study consisted of students from those private universities who were taking CS courses in their CS departments (not all students were CS majors).

Delimitation 3. Data collection for this study was limited to survey questions and student's opinion at the ended of each question.

Assumptions

This study made the following assumptions:

1. The study did not consider student gender, race, ethnic, or linguistic background.
2. The results of questionnaire instruments rely on the honesty of the respondents. It is possible that some respondents may not have been perfectly truthful on all questions.
3. The study represents the opinion of the of students who attended CS courses at the University of La Verne, Azusa Pacific University, University of Redlands, California

Lutheran University, Chapman University, California Baptist University, and Biola University campuses during the Fall 2010 academic year.

4. Students answered survey questions candidly and completely.

Definitions of Terms

The following terms were defined to provide a guide to usage within the context of this paper:

Adult student. **"**A student who is 25 years of age or older, has no bachelor's degree, and has gone into the workforce for a few years before deciding to attend college" (Boghikian-Whitby, 2003, p. 18).

Attitude. A comfort level with technological advancement, electronic gadgets, and generally overcoming the fear that "the computer will blow up if I touch it" (Kizzie, 2004, p. 4).

Andragogy. The art and science of helping adults learn.

Community college. An institution accredited to award associate degrees as its highest degree.

Continuing education student. Same as "adult student."

Drop out. To completely withdraw from participation in an educational institution.

Higher education institutions. Includes colleges and universities.

Information. Data that have been processed by a computer system.

Information system. Collection of hardware, software, people, data, and procedures that work together to provide information essential to running an organization.

Knowledge. Has two parts: (a) the ability to see how computing affects society and individuals on a number of different levels (i.e., the sociological/political implications for society's future); (b) actual use of the physical computer equipment and developing a reservoir of information about computing.

Mainframe. Computer that can process several million programs' instructions per second.

Nontraditional students. Same as "continuing education student"

Program. An organized curriculum developed to focus on a major field of study.

Pedagogy. The art and science of helping students learn.

Retention. Opposite of drop out, is the act of keeping someone in an educational program and not having them withdraw or drop out

Traditional student. The traditional student is defined as a student who is less than 25 years of age who started attending higher education institutions right after graduation from high school.

Organization of the Study

The report of this study was organized traditionally. Chapter I included the introduction, background of the study, the problem statement, significance of the study, the purpose of the study, research questions to be answered, and the definitions of terms in the study. Chapter II is a summary of relevant literature regarding adult education.

The methodology and procedures of the experiment are reported in Chapter III. Chapter IV presents the results of the analysis of the data in relation to the research questions, and Chapter V includes a summary of findings, conclusions, and recommendations for future study.

CHAPTER II

LITERATURE REVIEW

Introduction

American higher education has existed for only three full centuries. Harvard College stood alone for the better part of the 17th century, being joined by Yale College and the College of William and Mary only as the 18th century commenced. At the time of the American Revolution, nine colleges enrolled perhaps 750 students. By the end of the century the number of functioning colleges had risen to 18, but only 400 more students attended them, and fewer than one in 200 young White males earned a college degree. By the dawn of the next century higher education had altered dramatically. The 19th century witnessed the transformation from the rudimentary college to the basic framework of the modern American university, from institutions that conveyed only textbook knowledge to mostly adolescent boys to the panoply of institutions that included advanced and professional studies for men and women. The 19th century had solidly established universal primary education and cultivated both knowledge and character (Geiger, 2000).

The educators of the 20th century aimed at encouraging students to acquire understanding rather than mere knowledge, and came increasingly to realize that understanding without action was an incomplete understanding (Geiger, 2000).

The beginning of the 21st century finds more than 3,600 colleges and universities in America with an estimated enrollment of 16.1 million in the year 2008 (U.S. Department of Education, 2010). Undergraduate enrollments are projected to increase, with estimates of more than 15 million enrolled by 2010. To a large extent, these actual and projected increases are attributable to the enrollment of adult students. Today, close to 40% of all undergraduates are age 25 and older and 50% are age 22 and older (Aslanian, 2001). In addition, graduate enrollments nationwide have been steadily increasing with a growth of almost 30% since 1985. In all likelihood, enrollments will increase even further as the demand for advanced degrees, credentials, and professional development assistance continues in order for adults to meet their job requirements (Aslanian, 2001).

Given that adults make up an appreciable proportion of all college students and that their numbers are steadily rising, it is especially important for colleges to be familiar with their needs, backgrounds, and learning patterns.

Educational Reforms

Education throughout most of human history has passed through reforms to meet new situations. New tasks explored, fresh approaches to education were canvassed, and reforms, usually modest and conservative, but occasionally radical, were introduced (Connel, 1987).

Stephen C. Ehrmann (1995) identified three major revolutions that redefined the educational reform of today—the reading-writing revolution, the campus revolution, and the online revolution.

Reading-Writing Revolution

The history of education started with Socrates (Greek philosopher and moralist, who was born in Athens in the year 469 B.C.) and Plato (the most famous of Socrates' pupils). Oral dialogue was the only medium used to transfer knowledge from scholars to students in ad hoc locations. Students learned only by explanation and conversation. The student to teacher ratio was very limited; education was scarce and was not accessible to everyone (Ehrmann, 1995).

During this revolution, teachers like Plato were able to capture their knowledge by writing their theories explicitly; students studied the literature without being in the same room as the scholar. Face-to-face meeting was minimal and correcting the misprints in the literature was a problem.

Campus Revolution

Two thousand years later, in 1604, a campus revolution redefined education once more. Scholars, with their students, started organizing the literature. Scarce intellectual manuscripts, books, and resources were collected, organized, and guarded in buildings called libraries. Learners started traveling long distances away from their homes to get access to such resources. They became attracted to the idea of attending campuses because of the interaction with and close access to literature. This led to the creation of chalkboards, lecture halls, laboratories, and dormitories to accommodate the increased interests of the students in discussing materials in the libraries (Boghikian-Whitby, 2003).

In 1636, Harvard College was founded in the United States. Later in 1689, Harvard adopted a system of conferring degrees that encouraged distinctions and grades

of superiority—an ordinary degree plus three degrees of distinction: cum laude, magna cum laude, and summa cum laude (Rudolph, 1997).

By 1939-40, total student enrollment at all U.S. colleges and universities was just under 1.5 million. During World War II, regular student enrollments dipped substantially as a result of the military draft. All of this changed after 1945. By 1945-50, total student enrollments had ballooned to almost 2.7 million, an increase of about 80% in one decade. This was no aberration, for the figure increased to about 3.6 million in 1960 and then doubled again over the next decade, reaching over 7.9 million in 1970 (Thelin, 2004). By 1970, only 75% of all adults had at least a high school degree, and by 1993, the number increased to 87%. The year that more adult men and women over 25 years of age started attending colleges and universities was 1982. This wave of new continuing-education students, adult learners, came with the following assumptions : "(1) they were under-prepared, but were not incapable, (2) their prior failures and being dropouts were complex, (3) they could overcome their fear with the proper support system, (4) they could succeed given the opportunity, and (5) they had special academic needs" (Casazza, 1995, p. 103).

Online Revolution

> The third wave of education reforms resulted with the invention of the microprocessor in 1971, the production of personal computers in 1981, and the introduction of the Internet in 1996, which had a profound impact on online or distance education. Digital communications, wireless technology, and cellular hand-held devices now offer opportunities for increasing the effectiveness of distance learning and give the opportunity to anyone, anywhere in the world. (Boghikian-Whitby, 2003, p. 31)

U.S. school districts spent $7.87 billion on technology equipment for the 2003-2004 school year, and $7.06 billion in expenditures for the 2004-2005 school years (QED Report, 2003). Moreover, 99% of American schools in 1993 had some kind of access to the Internet and teachers were challenged to create meaningful Web-based learning activities for their students (Fast Response Survey System [FRSS], 2003). The rich array of resources, such as up-to-date digital libraries, primary source documents, museum exhibits, and multimedia presentations about events, topics, and process available on the Internet improves students' test performance and intellectual capacities. The Internet-based, distance-learning revolution was the result of introducing innovative strategies to increase individualization, improve quality, and increase access to education (Twigg, 2001).

E-learning is another name for online learning, which is used by companies that offer online training courses. Companies are rapidly moving to e-learning because of the fast change of pace in today's information-driven economy. According to Schellenberg (2003), "E-learning addresses the issues—shorter product life cycle, increasing skills gaps, rapid technology changes that require ongoing learning, and increasing product complexity—that face business today" (p. 91).

Higher Education Settings

Countless numbers of individuals help adults learn in a wide variety of formal and informal educational settings, such as universities, community colleges, vocational/ technical institutions, and a plethora of other settings too numerous to list. Students who have completed high school are eligible to attend higher education institutions, such as

colleges and universities. There are two types of institutions of higher education in America: state (or public schools operated by a state government, which are aided by public funds) and private (operated by private entities and financed by private funds).

Some private schools are religious institutions and about one quarter of the total number of students attend private institutions (UNESCO, 2010). The official name of an institution does not necessary indicate the level of teaching it provides. Thus, certain institutions designated as "universities" do not provide courses beyond those leading to the bachelor's degree, while others designated as "colleges" offer programs leading to the doctorate and enjoy great prestige (UNESCO, 2010)

In a rather general and systematic way, it is possible to classify institutions of higher education in the United States of America into four main categories:

1. Technical institutions and "semiprofessional" schools offering 2-year or 3-year courses, leading to an associate's degree and preparing students for employment in semiprofessional occupations, such as medical, dental, and engineering technician or skilled employees for commerce, accounting, nursing, etc.
2. Junior colleges or community colleges which provide 2 years of courses and may lead to studies in the following two categories:
3. Liberal arts colleges, state colleges, and independent professional institutions awarding the first degree (bachelor's degree) and sometimes the master's degree and the doctorate. Independent professional institutions include teacher-training colleges, institutes of technology, schools of theology, art, etc.

4. Universities award the highest degree (doctoral degree). It should be noted, however, that the various programs offered by the different types of institution often overlap considerably. A university for instance, usually comprises institutions of professional education as well as courses similar to those of a technical institution.

Higher education institutions offer degrees in three stages. The first stage may only be provided by universities and colleges, liberal arts colleges, teachers' colleges, and institutes of technology. It is devoted to more specialized studies, and culminates in the *bachelor's* degree. The second stage of higher education continues with 1 or 2 years of study in a university or in some colleges to the *master's* degree. Candidates must usually submit a significant piece of research for this stage, such as the master's thesis. The third stage of higher education is reached after 2 or 3 years of study in a university or college in a specific subject beyond the master's level. This course of study culminates in the doctoral degree, which is the highest university degree and which, usually requires the submission of an approved dissertation comprised of original research.

Adults and Education

The education of adults was the earliest form of formal education (Knowles, 1989). Many researchers have indicated to educators that adult learners are a population that deserves attention and a different teaching style. Greenfied and Goldberg (1984) argued that the diversity of the population dictates four basic requirements for any meaningful adult program on a college campus. These experienced adult educators stress the need for all programs to coordinate multiple approaches, to provide for interaction

with other returning students, to offer accessible information and support to the students (Tayler, 1996, para. 8). According to Kuhlen (1954):

> Adults want educational experiences that are realistically related to their daily problem. Adults do not easily change their habits or attitudes. Adults' goals do change. Needs and roles change. Vocational advancement seems to give way to cultural concerns. As the adult grows older, he/she appears to need "something more" than vocational satisfaction. The kind of work he does seem to be quite influential in determining the changes that take place.
>
> As compared with adolescents, adults are subject to more conflicting pressures. For example, an adult may experience a pressure to go to school for job experience but at the same time experience pressure to be home at nights to help care for children or a sick spouse.
>
> The serious dropout rate in adult education is due more to these conflicting pressures than to dissatisfaction with the quality of the educational experience. (p. 101)

There comes a point at which adults view their future as now. They attempt to extend the future by means of such things as identification with their children and an increased concern with immortality.

As age advances, adults tend to feel threatened by any number of situations but most importantly by challenges to their competence.

Understanding Adult Learners

Long (1987) believes that two conflicting views of adult learners are fairly widespread. The first is held by Main Street Americans: it represents adult learners as less capable than younger learners. Its essence is captured in the proverb, "You can't teach an old dog new tricks." The second is held by many professional educators of adults; it represents adult learners as super learners. Its essence is captured in Knowles's (1984) assumptions underlying his ideas of andragogy.

Knowles (1984) describes adult learners as being self-directing, as deriving only positive benefits from experience, as possessing great readiness to learn, as voluntarily entering an educational activity with a life-centered, task-centered, or problem-centered orientation to learning, and as being internally motivated.

As enrolled for further study, adult students are quite well educated. About 50% already have attended college for 4 years or have at least a 4-year college degree. This pattern is explained by the fact that one needs a 4-year degree to enroll in graduate school, which attracts 40% of adult students engaged in credit study. But about 60% of undergraduate adult students enroll at a community college and close to 30% have 3 years of college or more when they do so. This overall pattern seems to underpin the adage that the more education one has, the more one seeks (Aslanian, 2001)

According to Aslanian (2001), the great majority of undergraduate adult students who enroll in degree programs (about 80%) enter programs with intent to matriculate. It is noteworthy, however, that 20% actually take some courses prior to any decision to enroll in a degree program, perhaps to try out their skills as a student once again. When adults are enrolled in a degree program, the types of courses they take fall into three main areas: primarily business, followed by education, and then computers. These students exemplify, and give meaning to, the idea that students today are "more interested in learning to earn than in learning to learn" (p. 31).

Adult Student Learning

One strong impetus for developments in the methodology of adult education was the publication of Lindeman's *The Meaning of Adult Education* in 1926, Thorndike's

Adult Learning in 1928 and *Adult Interests* in 1935, Bryson's *Adult Education* in 1936, and Sorenson's *Adult Abilities* in 1938. According to Galbraith (1990),

> These early contributions to adult learning began raising the consciousness of practitioners to the fact that adults were different in many respects from children and youth as learners and therefore a different method from those of traditional pedagogy would likely be more effective with them. (p. ix)

Galbraith (1990) noted that, in 1935 group discussion was touted as the best way to help people learn almost anything. During the early 1940s popular enthusiasm shifted to audio-visual aids and presentations. Making overhead transparencies and filmstrips or slides was introduced in 1946. In the early 1950s three new methods made their appearance and gained momentum: human relations training, programmed instruction, and community development. In the 1960s and early 1970s computer-assisted instruction, competency-based education, self-directed learning, contract learning, networking, and others gained momentum that carried on into the next decade. In 1968, Malcolm Knowles proposed "a new label and a new technology" of adult learning to distinguish it from preadult schooling. The concept of andragogy, which he defined as "the art and science of helping adults learn," was contrasted with pedagogy, the art and science of helping children learn (Knowles, 1980, p. 43).

From 1980 to the present the trend was not so much in the invention of new methods as in the refinement, extension, and combination of existing methods—"interactive television and computer-based learning, videodiscs, motivational techniques, mentorship, nominal group techniques, and distance-learning strategies—and in the laying of theoretical foundations for selecting the most effective methods and techniques for accomplishing particular purposes" (Galbraith, 1990, p. xi).

Adult Motives for Learning

Houle (1961) identified three kinds of adult learning motives: activity oriented, goal oriented, and learning oriented. Houle suggested that one of the three orientations is usually primary in adults' learning activity. According to Aslanian and Brickell (1980), adults' general motivation could be categorized as career, family, leisure, art, health, religion, and citizenship. Examples of specific motives are found in the work of Johnstone and Rivera (1965):

> To become a better informed person; to prepare for a new job or occupation; to become better qualified for the job currently held; to spend spare time more enjoyably; to meet new and interesting people; to better carry out everyday tasks and household duties; or to get away from the daily routine. (p. 71)

Women and men also gave different reasons for learning. The motives of males more frequently were employment related. In contrast women more often gave social, personal improvement, and religious reasons (Bostman, 1975).

What leads an adult to learn at one point in time rather than another? Why not earlier? Why not later? According to Aslanian (2001), "There are identifiable events which trigger an adult's decision to learn. The need and the opportunity, and even the desire, are necessary but not sufficient. There must be other triggers to convert a latent learner into an active learner" (p. 50).

To understand an adult's life schedule is to understand his or her need for learning. That is what colleges must do to be responsive to the more than four million adults entering undergraduate programs each year. The majority of adult students are motivated to begin or return to college by career transitions (Aslanian, 2001). When adults are not enrolled in a degree program, the types of courses they take fall into three

main areas: primarily business, followed by education, and then computers. If an adult student gains knowledge and gets motivated by the instructor he/she will come back to school again. It is assumed that caring faculty will have to be particularly assertive in changing campus attitudes about adult students and developing honest and realistic curricula which attract and retain adults as fully integrated students (Pappas & Loring, 1987).

Motivating Adult Students to Learn

Adults who are motivated to seek out a learning experience do so primarily because they have a use for the knowledge or skill being sought (Zemke, 1984). Motivated students take learning seriously and try to get maximum benefits from the course and the instructor. As suggested by Ames (1990), motivation is a process in which students value learning and involve themselves in classroom assignments and activities. Clearly, instructional behaviors and course structures will enhance students' motivation. McMillan and Forsyth (1991) believed that the most important influences of motivation for learning are needs and expectations. Simply stated, motivation is a function of both needs and expectations. Students are likely to be motivated if their needs are being met, if they see value in what they are learning, and if they believe they are able to succeed with reasonable effort. When all three factors are high, motivation will also be high. If students see little value in what they are learning or in the results of their effort, their motivation to be meaningfully engaged will be lessened, even if they believe that they are capable of success. Instructor's behavior, classroom activities,

grading, and feedback to students will enhance motivation by increasing perceived value, to better meet needs and build positive expectations for success.

The following factors serve as sources of motivation for adult learning as listed by Stephen Lieb (1991) in his *Principles of Adult Learning*:

> *Social relationships*: to make new friends, to meet a need for associations and friendships.
> *External experiences*: to comply with instructions from someone else; to fulfill the expectations or recommendations of someone with formal authority.
> *Social welfare*: to improve ability to serve mankind, prepare for services to the community, and improve ability to participate in community work.
> *Personal advancement*: to achieve higher status in a job, secure professional advancement, and stay abreast of competitors.
> *Escape/Stimulation*: to relieve boredom, provide a break in the routine of home or work, and provide a contrast to other exacting details of life.
> *Cognitive interest*: to learn for the sake of learning, seek knowledge for its own sake, and to satisfy an inquiring mind. (pp. 42-44)

The instructor can be a motivating force in the classroom. The following suggestions were made by Karen Jarrett Thomas (1993), professor of Learning Resources and Technology Service at St. Cloud State University, on how to motivate adult learners to learn:

- Put materials into "bite-size chunks" which people are able to understand
- Use the whole-part-whole concept, showing the overall picture followed by the details and then a refresher with overall picture
- Make the material relevant, as close to the actual requirements of that person's job
- Explain why certain assignments are made and their relevance to the overall course or training sessions
- Provide plenty of documentation for the learner, usually in the form of hands-on experience and paper documentation
- Let the students work in groups, since they would rather ask other students for assistance rather than ask the course instructor
- Add a little "spice to their life" by giving them some degree of options and flexibility in their assignments
- Create a climate of "exploration" rather than one of "prove it"

- Keep the course requirements in perspective to the amount of time for the course
- Make certain the student is equipped with enough knowledge and skill to complete the assignment, rather than setting the person up for failure
- Bend the rules, if necessary and appropriate, so that the adult learner can "push the envelope" and try new things. (p. 42)

Motivating instructors give students special desire to learn. Wlodkowski (1993) classified the characteristics of a motivating instructor by four categories:

- Offers expertise, both in knowledge and preparation
- Has empathy, which includes understanding and consideration
- Shows enthusiasm, for the course, content, students, and profession of teaching
- Demonstrates clarity, whether it be in classroom teaching, explanation of assignments, or classroom discussion. (p. 54**)**

Certainly most adult students come to the classroom ready to expend considerable time and effort in their quest to learn the course material and achieve personal goals of success. Yet, for many students, the motivational pump is unprimed. Students' degree programs require requisite courses and the material may not interest the students, since they did not choose the course themselves, or perhaps they consider its content irrelevant to their personal goals. The course may be so challenging or so easy that discouragement or disillusionment may set in. Adult students also have jobs and other life pursuits to contend with, and extracurricular activities may be far more exciting or involving than the act of learning (McMillan & Forsyth, 1991).

Support for students as they confront change must be supplied by interaction with faculty, social support among peers, staff resources, faculty and staff "role models," and human development programs that are socially and emotionally educational (Stodt, 1987).

Forsyth and McMillan (1991) in their "Practical Proposals for Motivating Students," paper published in *New Directions for Teaching and Learning*, made the following recommendations for instructors who want to motivate students to learn:

- Introduce the course and each topic in an interesting, informative, and challenging way.
- Present material at a challenging level that communicates respect for your students and their abilities.
- Use varied and creative styles of teaching.
- Focus on higher-order learning outcomes, such as application, analysis, synthesis, and evaluation.
- Model enthusiasm for the course content and for learning itself.
- Give responsibility for learning back to the students. Allow them to design and select their learning experiences, topics, and methods of evaluations.
- Minimize competition among students.
- Use tests and other form of evaluation to give students information about their accomplishments, but not to exert control or deny students' autonomy.
- Encourage feelings of controllability in the classroom. Students who perform poorly often react very negatively and seek to blame their outcomes on lack of ability or on factors beyond their control: a poor teacher, a noisy roommate, and the like.
- Identify ways for students to increase their control over their outcomes.
- Provide students with encouraging information about future outcomes.
- Help students develop strategies for achieving their goals.
- Select topics and tasks that interest students. (pp. 65-67)

If educators can keep students intrinsically motivated, provide meaningful feedback, and encourage the development of realistic, valuable, and achievable goals that students expect to achieve, their engagement in learning should be enhanced.

Adult Learning Styles

The term *learning styles* refers to individuals' characteristics and preferred ways of gathering, interpreting, organizing, and thinking about information (Davis, 1993). Some adult students prefer to work independently, while others do better in groups. Some students prefer to absorb information by reading, others by active manipulation.

No one style of learning has been shown to be better than another, and no single style leads to better learning (Davis, 1993). Researchers Claxton and Murrell (1987) grouped various models of learning styles into four general categories. *Personality models* refer to basic personality characteristics. *Information-processing models* reflect how people take in and process information. *Social-interaction models* focus on how students interact and behave in the classroom. *Instructional preference models* focus on the medium in which learning occurs (for example, listening, reading, direct experience model).

Kolb in 1984 identified four passes of learning or learning cycles, each of which entails different processes and abilities in acquiring new information or skills:

> *Concrete experience* (feeling): Becoming fully involved in a new activity in order to understand it firsthand. Concrete experience is offered by films, games, fieldworks, lab work, and observation.
>
> *Reflective observation* (watching): Viewing experiences impartially or from many different perspectives. Reflective observation can be achieved through journals, discussion, and questioning.
>
> *Abstract conceptualization* (thinking): Creating concepts that integrate observations and experiences into theories and developing generalizable explanations or hypotheses. Abstract conceptualization is developed from building models, writing papers, and creating analogies.
>
> *Active experimentation* (doing): Using theories to make decisions and solve problems and testing and elaborating generalizations in different situations. Active experimentation includes case studies, projects, and simulations. (Davis, 1993, pp. 186-187)

Kolb maintained that new information is more meaningful and is retained longer when students work through all four phases of the learning cycle for a major concept or idea (as discussed in Davis, 1993).

To consider how adults learn and change, listed below are major principles and practices of adult learning as pointed by Caffarella (2002):

- Adults have a rich background of knowledge and experience and learn best when this experience is acknowledged as new information builds on their past knowledge and experience.
- Adults are motivated to learn based on a combination (of complex internal and external forces.
- Adults are not likely to willingly be engaged in learning unless the learning is meaningful to them.
- For the most part, adults are pragmatic in their learning; they want to apply their learning to present situations.
- Adults come to a learning situation with their own personal goals and objectives, which may or may not be the same as those that underline the learning situations.
- Adults prefer to be actively involved in the learning process rather than passive recipients of knowledge. (pp. 92-93)

No one style of learning has been shown to be better than any other. Katz (1989) found that to help students recognize their learning style, have students interview each other about their learning processes. Suggest questions, such as, How do you go about reading the assignments and preparing for class? How do you study for exams? How would you describe the learning that takes place in class? What is particularly helpful or not helpful to your learning the material?

Adult Learning Theories

Theories of adult learning can be grouped into several categories. Instrumental learning, self-directed learning, experiential learning, and situated cognition are commonly taught and applied in the context of adult education. Here is a brief description of each as described by Donna Amstutz in the 1999 edition of *New Directions for Adult and Continuing Education*.

> *Instrumental Learning*. Instrumental learning theories focus on individual autonomy as a universal value in adult education and foster the personal growth of individuals.

Self-Directed Learning. The concept of self-directed learning suggests that adults can plan, conduct, and evaluate their own learning; individuals select the content, the processes, and the outcomes for themselves. Based on assumptions from andragogy, self-directed learning has often been promoted as the goal of adult education.
Experiential Learning. Experiential learning is a way to learn from experience. Adult educators organize experiences in order to facilitate this learning.
Situated Cognition. Situated cognition is a promising theory that treats the context of learning as central for meaning making. Wilson (1993) summarizes three main assumptions of situated cognition: (1) learning and thinking are social activities; (2) thinking and learning are structured by the tools available in specific situations; and (3) thinking is influenced by the setting in which learning takes place. (pp. 77-78)

Adult Learning Methods

A method can be defined as a way of organizing an educational activity with the purpose of promoting learning for all involved personnel. Following are the descriptions of an array of methods and techniques that can be used with adult learners as listed in *Adult Learning Methods* (Galbraith, 1990):

Learning Contract. A learning contract is a formal agreement written by a learner which details what will be learned, how the learning will be accomplished, the period of time involved, and the specific evaluation criteria to be used in judging the completion of the learning. The learning contract is a method that is used to individualize the learning process. (p. 134)

Lecture. A lecture is a carefully prepared oral presentation of a particular subject by a highly qualified individual. (p. 134)

Discussion. Discussion places educators and learners on an equal footing, because it impels that everyone has some useful contribution to make to the educational effort, and because it claims to be successful in actively involving learners. (p. 187)

Mentorship. Effective mentorship is akin to guiding the student on a journey at the end of which the student is a different and more accomplished person. Mentors can help their students to see the way ahead, to gain the insight they will need to further their own educational journey rather than remaining dependent on teachers. (p. 216)

Case Study. Case study is used in research to mean the in-depth study of a problem or situation, whether or not it has direct implications for practice. Cases typically include three interrelated components: a case study, case analysis, and case discussion. (p. 226)

Nominal Group Techniques. The nominal group technique was developed by Andre Delbecq and Andrew Van de Ven in the 1960s as a problem-solving technique. Its strength is derived from the power of individuals each generating, exploring, and communicating ideas. (p. 248)

Demonstration and Simulation. Demonstration serves the purpose of arousing interest or motivation and directing attention to the skill, behavior, and/or knowledge to be learned. Demonstration may also be used to support a verbal explanation of a principle or physical process. When used in this way, the demonstration may provide a visual image that contributes to encoding of information. Simulation is the ability to get learners involved cognitively as well as emotionally. This technique enables adults to share valuable insights which can deepen and enhance learning. (p. 272)

Forum, Panel, and Symposium. A *forum* is best defined as an open discussion carried on by one or more resources and an entire group. It is used when large groups of 25 or more meet for the purpose of diffusion of knowledge, information, or opinion. The forum tends to be semiformal in nature and is directed by a moderator. A *panel* is defined as a small group of three to six persons, who sit around a table in the presence of an audience and have a purposeful conversation on a topic in which they have specialized knowledge. The panel is typically informal and usually lasts under an hour, is guided by a moderator who starts the session and sustains discussion, and has no audience participation other than watching and listening. A *symposium* is defined as a series of presentations given by two to five persons of notable authority and competence on different aspect of the same theme or closely related themes. The symposium tends to be formal in nature because of the authoritative presentation. However, once the presentations are given, questions from the audience are encouraged and accepted. (pp. 184-185)

Computer-Enriched Instruction. Computers can be employed in an educational setting to assist with writing (word processor), computation (statistical programs), data management (spreadsheets), graphics (visual production), and the like. While classroom teachers are the key to the potential success of the classroom model for accessing computers, adult educators differ widely in their ability to use computers, their familiarity with available courseware, and their attitudes toward the technology. Fears of change, uncertainty, inertia of the educational system, and concerns about the technology itself often contribute to the incapability

between facilitating learning and integrating computers into an educational setting. (pp. 320-321)

Internship. The definitions and concepts of internships are as varied as the number of fields offering them. Medicine, education, and public affairs are but a few examples of fields utilizing internships as a method of instruction. Internships are designed to "bridge the gap" between the theoretical world of academe and the "real world" of professional practice (Macala, 1996). Internships may be paid or voluntary; they may or may not involve academic credit. (p. 330)

Correspondence Study (or distance education). This teaching technique opened up freedoms not only for learners but for educators and administrators. Freedom for adult learners includes the opportunity to study wherever and whenever they want, drawing on instructional and other resources of their own choosing, wherever they happen to be located. For educators and their institutions, this revolution in thinking provides opportunity to offer instruction to a significantly enlarged student body over an almost universal catchments area in a curriculum that is nearly infinite. Correspondence courses offered by universities are regulated by National University Continuing Education Association (NUCEA). Outside the universities, correspondence education is regulated by the National Home Student Council (NHSC). Correspondence schools for armed forces, the USAF Extension Courses Institute, the Marine Corps Institute, the U.S. Coast Guard Institute, and the Army Institute are members of NHSC. (p. 347)

Communications Technology. There are three general uses for communications technology in adult education. One use is for instructional purpose. Through technology we can reach out to more adults with enriched and varied learning opportunities. Secondly, the domain of communication technology also suggests program planning ideas. For example, many adult learners need to develop skills in using technology to compete in the job market. Equally important, adults need to be better informed about technology in order to exercise their rights and duties as citizens. Finally, we can also use technology to help us manage our business work more productively and intelligently (p. 378).

Different forms of communications technology that are especially promising for use in adult education and learning are computers, video technology, and audio technology. (p. 368).

Adult Teaching Techniques

Traditional lecturing suffers from a major defect: It is one-way communication in which the student is a passive participant—merely a listener. Students learn best when they take an active role: when they discuss what they are reading, practice what they are learning, and apply concepts and ideas (Davis, 1993). Engaging the entire class, small group discussions, and making use of alternatives to lecturing are some teaching techniques that have been recommended by most faculty in various fields.

Adult learners are unique because they have come to understand that there is a need for greater adaptation to the variety of teaching and learning styles. While higher institutions are exemplary in their provision of services to adult students, there is not a consistent posture with respect to adult learning and teaching techniques practiced in the classroom.

Cross (1978) suggested that there are four ways that teachers can adapt teaching techniques to adult learners:

1. New information should be presented in a meaningful manner.
2. The material should be presented at a pace that allows students to understand the material.
3. Presentation of one idea at a time and minimization of competing intellectual demands should aid comprehension.
4. Frequent summarization should facilitate retention and recall. (p. 91)

In addition, Zemke (1984) in her paper, *30 Things About Adult Learning*, suggested the following teaching techniques:

- Adults need to be able to integrate new ideas with what they already know if they are going to keep-and use-the new information.
- Information that conflicts sharply with what is already held to be true, and thus forces a re-evaluation of the old material, is integrated more slowly.

- Information that has little "conceptual overlap" with what is already known is acquired slowly.
- Fast-paced, complex or unusual learning tasks interfere with the learning of the concepts or data they are intended to teach or illustrate.
- Adults tend to compensate for being slower in some psychomotor learning tasks by being more accurate and making fewer trial-and-error ventures.
- Adults prefer self-directed and self-designed learning projects over-group-learning experiences led by a professional, they select more than one medium for learning, and they desire to control pace and start/stop time.
- Nonhuman media such as books, programmed instruction and television have become popular with adults in recent years. (pp. 82-83)

Teaching adults is a process that needs to be addressed from the students' perspective as well. Zemke and Zemke (1984) found that adults need to integrate new ideas with what they already know if they are going to retain. In a study one researcher asked, "What do adult students want from their learning environment?" They answered, "Wanted to feel central, not marginal; competent, not childish; independent, not dependent" (Schlossberg, Lynch, & Chickering, 1989, p. 8).

The effectiveness of teaching adult students in CS courses is not just depending on the instructor's academic knowledge. Although knowledgeable, instructors are sent to CS classes; there are significant gaps in the instructor's knowledge about adult learning and its practices. Studies have shown that adult students were demotivated by time constraints and instructors who used pedagogical teaching methods. The adult students appreciate instructors who apply andragogical teaching techniques, use the knowledge of all the students, and bring real-world experience to the classroom.

As instructors and trainers of adults try to guide them toward the achievement of computer literacy, or any other instructional goal, effective teaching techniques demand more understanding and awareness of their special characteristics (Kizzie, 2004). Adults

are more likely to persist in classes where the instructor provides concrete tasks, where class goals are related to the expectations of the class, and where the class is relevant to life. Palmer (1983) pointed out that in the past, teaching adults has meant offering night courses to students eager for personal enrichment and responsive to anything the instructor might provide, "but now many faculty members are meeting up with a new kind of adult audience: experienced professionals who insist on practical ideas for upgrading their skills" (p. 17). These demands can have an invigorating effect on instructors. It can be more challenging teaching people who are committed to learning how to do their jobs better than teaching people who are striving for grades (Pappas & Loring, 1987). In any case, because the demands of teaching adults are unique, institutions should provide faculty members with a comprehensive understanding of the learning styles and needs of adult learners.

Daloz (1987) remarks that neither students nor teachers are inert objects, because for both groups the world is emergent; teaching and learning are about relationships. For more than any other factor, it is the partnership of teacher and student that finally determines the value of an education.

In addition to choosing appropriate instructional techniques, it is important that staff members who design instruction also know how to select and use appropriately a variety of instructional resources. A competent instructor carefully selects resources and aids to enhance the learning efforts of the participants (Caffarella, 2002).

The instructor of adult learners faces a group whose attention may be easily lost, whose interest may wander, and whose effort is parceled out with serious caution. Since

human energy is finite—there is a limited amount instructors can give or apply. In order to bridge the gap, colleges are changing their curricula to match the way students learn, and professors must change their teaching style to fit the way students learn. According to Hersh and Merrow (2005), "Adult students can't transform themselves to fit the college's current model; this is not the way they learn. It is the mission of the university to teach its students, not the other way around" (p. 161). Farmer and Mech (1991) stated,

> The challenges of technology and of resource-based learning demand that faculty develop teaching strategies that help students become autonomous learners who understand the value of integrating the increasing number of information resources available throughout society and the world as linked by new communications technology. In the past teaching was simply a circle of lecture, asking students questions, telling them the answers. But over the years with increasing change in technology, the teaching technique has changed. (p. 104)

Teaching Techniques in Computer Science Classes

In CS classes every student learns differently and it can be difficult to hold the attention of the entire class. Since students have various preferred learning styles, the instructor needs to vary the method of his/her instruction and use techniques that cater to different learning styles. Varying the method of instruction will give students an opportunity to learn in their preferred approach and will help an instructor recap concepts without outward redundancy. Clearly, the classical lecturing technique is not an effective tool in CS classes to help students achieve their goals. Teaching techniques that serve as barriers include poorly organized classes, no motivational processes, not returning assignments and exams in reasonable time, threatening rules and norms, inappropriate instructional strategies and instructional materials, inappropriate examples and programming assignments, and lack of communication. To enhance the learning

experience and make a CS class more effective, an instructor should gain and maintain the attention of students, motivate students to learn and teach them how to learn, accommodate different learning styles, bridge the gap between theory and practice, and review the subject concepts more than once in class. As Hixson and Tinzmann (1990) said, "Instructor's characteristics may hinder student's academic achievement" (p. 15).

Good teaching technique is about deviating from the course syllabus or lecture schedule easily when there is more and better learning elsewhere. As Richard Leblanc (1998), professor at the York University stated, "Effective teaching is not about being locked with both hands glued to a podium or having eyes fixed on a slide projector while you drone on. Good instructors work the room and every student in it" (p. 31). Leblanc argues that "good teaching is about not always having a fixed agenda and being rigid, but being flexible, fluid, experimenting, and having the confidence to react and adjust to changing circumstances" (p. 32). He recommends that "in large lecture classes, there is little time for individual students to ask questions and shy students are unlikely to participate, the faculty office hour is an effective teaching tool to enhance instruction" (p. 32).

Teaching computer courses is preeminently an act of care. Faculty must be concerned not simply with how much knowledge students have acquired but also with how they are making meaning of that knowledge in effective ways to represent and organize information, algorithms to transform information, languages in which to express algorithms, devices which translate or interpret such languages, the theoretical techniques

for insuring the accuracy and minimizing the cost of such processes, and the philosophical foundations of such mechanical intelligence.

According to Henri (1988) pedagogical techniques for teaching CS can be imagined, as

> a) replying to queries and requests from students, b) providing advice and guidance, c) helping students to solve problems with regard to the subject matter, d) serving as a transmission medium for homework and test papers, e) discussing projects and working with the tutoring center, f) bringing students together in accordance with their interests and their needs, and g) encouraging team projects and setting up self-help groups. (p. 88)

To optimize CS instructors' teaching techniques, the 10 characteristics of good teaching prepared by Richard Leblanc are paraphrased in Appendix D.

To encourage students to become self-motivated independent learners, the following are recommended by Barbara Davis (1993):

- Give frequent, early, positive feedback that supports student's beliefs they can do well.
- Ensure opportunities for students' success by assigning tasks that are neither too easy nor too difficult.
- Help students find personal meaning and value in the programming projects.
- Create an atmosphere that is open and positive.
- Help students feel that they are valued members of a learning community. (p. 42)

Faculty-student interaction emerged in earlier research (Asten, 1975) as a leading factor in student satisfaction with higher education institutions and has appeared as a powerful retention factor. Endo and Harpel (1982) have found that informal contact, in which faculty members develop more friendly relationships with students and exhibit a personal and broad concern with their emotional and cognitive growth have more

influence not only on students' personal and social outcomes but also on their intellectual gains.

Increasing Adult Students' Retention

James Pappas and Rosalind Loring (1987) divide adult students into three broad categories: "degree-seekers, problem solvers, and cultural enrichment seekers" (p. 144). For the degree-seeking-adult, institutions need to facilitate degree attainment in a timely fashion and reduce barriers that inhibit attainment. The second category is made up of students taking a class or a series of classes to solve problems. These students may simply want to know how to work a computer or learn accounting to achieve a job promotion. It behooves institutions to provide excellent problem-centered courses, course sequences, curricula, and counseling services so that these students will return. For the latter categories of students, those seeking cultural enrichment who have come back to class because of curiosity or interest in a course topic and have their own special needs, institutions must meet those needs if they want these part-time learners to reenroll. It is important for the higher education institutions to recognize which group of adult students they are seeking and decide whether to offer adult curricula in a way that attracts the degree-seekers, the problem solvers, or the cultural seekers. Obviously these categories are not mutually exclusive.

To make retention a serious matter at any institution, retention-related activities requiring faculty input must be given a degree of distinction in the decision-making processes for tenure, promotion, and salary increases (Noel, 1978). As Noel (1978) observes: "Everyone must be a retention agent—the president, instructors, librarians, the

staff in the cafeteria, business office, and the custodial personnel in the dormitories" (p. 96).

Faculty Involvement in Adult Student Retention

Pantages and Creedon (1978) found that "the quality of the relationship between students and their professors is of critical importance in determining satisfaction with the institution" (p. 79). As Beal and Noel (1980) reported, the retention factor considered most important by all types of institutions (2-year public, 2-year private, 4-year public, and 4-year private) was "caring attitude of faculty and staff" (p. 19). Austin (1975) covered this briefly:

> Student-faculty interaction has a stronger relationship to student satisfaction with the college experience than any other involvement variable, or, indeed, any other student or institutional characteristic. Students who interact frequently with faculty are more satisfied with all aspects of their institutional experience, including student friendships, variety of courses, intellectual environment, and even administration of the institution. (p. 223)

Successful retention programs improve the overall quality of life on campus. Increased enrollment means higher salaries, more support staff and services, and improved facilities. According to Terrence Toy (1985), in, "Increasing Faculty Involvement in Retention Efforts," faculty are a critical part of any retention program but their support should not be assumed. Faculty are not entirely responsible for the existing retention problem nor are they entirely responsible for its solution. Later in the same article he contended:

> Faculty are a key to improving the retention rate on most campuses. They are a liaison between the student and the institution, connecting the student with academic, counseling, and extracurricular resources. Faculty are role models. Both as professionals in a specific discipline and as exemplary citizens, they are

> expected to embrace the highest ethical and moral standards—indeed, standards which generally represent an ideal rather than the norm for the society-at-large. Faculty are friends. The college years are a period of social adjustment, and social problems may become a major source of student dissatisfaction with the institution in general. (Toy, 1985, p.395)

Instructional Resources

Instructional resources that are effective and efficient are important facet of the needs of the academic institution today. There are some attributes and skills needed by an adult educator to effectively help adults learn. Table 3 lists sample instructional resources and aids.

Adults and Computer Literacy

Today, computer skills are considered in the hiring process and may give CS students an edge. However, more important, some skills are valuable to the effective performance of student's jobs once they have them. In a notable article "The Computer Evolution," Valletta and MacDonnald argued that while computers make some tasks easier and reduce required skill levels, many advances in computer technology have enabled increasingly sophisticated applications that require complex analytical and evaluative skills. A leading reason to attend college and study CS is to acquire such skills. It appears that these skills commanded an increasing premium as workplace computer use intensified between 2002 and the present time, enabling college-educated workers to capture the largest benefits from the spread of computers in the workplace during this period.

Table 3

Instructional Resources and Aids

Category	Resources and aids
Real things	• People • Objects and devices • Models, mock-ups, or simulators • Outdoor environment • Job aids
Printed materials	• Handouts • Books • Notebooks, forms for guided note-taking • Manuals, work sheets • Pamphlets, reference lists • Articles, workbooks
Visual aids	• Transparencies • Chalk and white boards • Graphs, photographs • Storyboards • Flip charts • Posters, maps • Slides, diagrams • Charts, pictures
Audio and video materials	• Videotapes • Digital video discs • Audiotapes and CD recordings • Television
Computer-based resources	• PowerPoint presentations • Computer-generated images • World Wide Web • LCD panels • Asynchronous threaded discussions and forums
Interactive technology	• Interactive CD-ROMs • Web-based tools (such as chat rooms, synchronous threaded discussions) • Video and audio conferencing

Note. From *Planning Programs for Adult Learners* (2nd ed.), by R. Caffarella, 2002, p. 184. San Francisco, CA: Jossey-Bass

The following conclusions have been drawn from data collected at Cornell University regarding the expectations of employers in recent graduates that were published in Jan Kennedy Olsen's article "The Electronic Library and Literacy" (1992):

> Computers are used in many companies currently, and their use is increasing. Use of computers does not seem to vary by industry or by size of the organization. Thus, skills in managing information with computers are needed for whatever type of business-related career a person is preparing.
>
> Students require less training in mainframe computer programming languages and more training in the use of application software, including programming within these packages. (p. 101)

The presence of adult students at the higher education levels in the study of CS requires different teaching styles and learning methods to maintain their retention. Those whose main use of the computer is at the workplace, potentially had at least three different types of learning experience: "courses, direct practical experience, and networks of support" (Selwyn, Gorard, & Furlong, 2006, p. 133). Each of them contributes to learning in different ways. In Beckman's (1990) eyes, the future of the information age depends on computers and the human's ability to understand and use them in productive and positive ways, "Adult learners can no longer afford computer illiteracy, financially or otherwise" (p. 128). If adult learners want to keep their computer-related jobs, they should at least avail themselves of resource-based learning strategies, and never be satisfied until their skill is more appropriate for their employer's need.

As Florini stated, "Technology is not staying still. Its rapid evolution includes factors like growing variety, falling cost, increasing diffusion, and improving ease of use. Because of these factors, people who were excluded from using the technology in the recent past are included now" (as cited in Galbraith, 1990, p. 91). Ehrmann (1999)

added, "Waiting for and accepting the impact of new technologies would be ethically indifferent were it not for the fact that technology changes our private lives and personalities, and consequently what we do to one another" (p. 14). Both skills and understanding technology enable adults to identify significant issues and questions about the role of technology in society.

As the number of racially, ethnically, and linguistically learners increases in higher education, new approaches to teaching and learning based on the sociocultural experiences and backgrounds of the population must be developed. As Knox (1980) suggests, however, "Most instructors in adult education programs are expert in the content they teach, but they usually have little preparation in the process of helping adults learn" (p. xi).

Adults Teaching and Learning Based on the Sociocultural Environment

With the possible exception of the area of adult basic education (ABE) programs, which typically serve a higher proportion of adults from minority, poor, and undereducated groups, much adult education theory and practice is based on the White, middle-class experience (Flannery, 1995). Although the majority of learners in ABE classes are White, significantly more African American, Hispanic American, and other ethnic, linguistic, or racial minority groups are in that area than are in other areas of adult education (Martin, 1990).

Following are some suggestions to adult students' faculty who teach in a sociocultural environment as recommended by Amstutz (1994):

> *Help students ask questions relative to their own cultural experiences*.
> Adults bring with them beliefs, values, and understanding that we, as adult educators, may be unfamiliar with. When studying a particular theory, we can ask students to reflect on its meaning from their own experiences. (p. 25)

> *Seek, acknowledge, and foster alternative forms of knowledge*.
> Help learners view knowledge as something they can produce. We can deepen our understanding by students' knowledge from their experiences. (p. 26)

Have the "courage to teach." Collins (1991) encouraged adult *educators to resist viewing* themselves as only facilitators. Having the courage to teach means that educators must recognize and fight the social injustices that pervade our institutions and that create enduring patterns of inquiry within them (Goodlad, Sodar, & Sirotnik, 1990). Categories of social experiences, race, class, and gender shape all social institutions and systems of meaning. Goodlad et al. (1990) stated: "We must not marginalize minority, female, male, homosexual, and working-class intellectual discourse. We must actively make space for these voices to be heard in our classrooms" (p. 27).

Use a variety of instructional strategies. Flannery (1995) cautioned, "If *adult learning theories promote classroom*s that present the same monocultural environment of language, teaching/learning styles, and communication patterns, and ignore the influence of the social context from which the learners come, failure to learn may well be perpetuated" (p. 155). Most educators teach the way they were taught and were most comfortable learning. This natural tendency is understandable but can be very unproductive with students who learn in a different fashion. Goodlad et al. (1990) concluded, "Culturally relevant adult education does not necessarily require discomfort on the part of the teacher. However, changing instruction to be more inclusive can be a long-term, intensive process" (p. 27-28).

Teaching with love. Apps (1996) described the impact that love can have on the adult classroom. He came to this position by recognizing that "we have become people of the mind and have forgotten how to also become people of the heart" (p. 27). He continued, "We believe that our relationships with learners are essential and special and that love and trust are embedded in it" (p. 83).

Hooks (1989) suggested that love also is a crucial component of empowering teaching. She said:

> Love can be and is an important source of empowerment when we struggle to confront issues of sex, race, and class. Working together to identify and face our differences-to face the ways we dominate and are dominated-to change our actions, we need a mediating force that can sustain us so that we are not broken in the process, so that we do not despair. As we work to love, to create a culture that celebrates life, that makes love possible, we move against dehumanization, against domination. (p. 26)

When students come to higher education, they are in a real sense changing environments. According to Robert Kegan (1982), environments affect human development in three ways: they *confirm* (it's okay to be where you are), they *contradict* (it's not okay to be where you are), and they provide *continuity* (when you move, I'll still be here). Laurent Daloz, in Galbraith (1990) translated these three functions into the following:

> What an instructor does; instructors do three things for their students as they work. Instructors can *support* their students in their present ways of being, they can *challenge* their students toward more appropriate adaptations to the higher education environment, and they can provide *vision* for students to help them see where they have been and also where they are going. (Galbraith, 1990, p. 206)

When students look back to describe the most significant contribution of their instructors, they often recall some variant of the message: "You can do it. I know you

can." or "You must do it; I expect it." An effective instructor encourages students by making a personal affirmation of the student's ability while retaining the expectation.

Effective Computer Science Instructors

Stephen Lieb in *Principles of Adult Learning* (1991) indicated that learning results from stimulation of the senses. In some people, one sense is used more than others to learn or recall information. Instructors should present materials that stimulate as many senses as possible in order to increase their chances of teaching success. Lieb believed that there are four critical elements of being an effective instructor to ensure that adult participants learn. These elements are the following:

> *Motivation:* There is a direct correlation between motivation and learning; how much one learns is dependent on how much one wants to learn. If the participant does not recognize the need for the information, all of the instructor's efforts to assist the participants to learn will be in vain. Instructors can motivate students via several means:
>
> *Set a feeling or tone for the lesson*. Instructors should try to establish a friendly, open atmosphere that shows the participants they will help them learn.
>
> *Set an appropriate level of concern*. The level of tension must be adjusted to meet the level of importance of the objective. If the material has a high level of importance, a higher level of tension/stress should be established in the class. However, people learn best under low to moderate stress; if the stress is too high, it becomes a barrier to learning.
>
> *Set an appropriate level of difficulty*. The degree of difficulty should be set high enough to challenge participants but not so high that they become frustrated by information overload.
>
> *Reinforcement:* Reinforcement is a necessary part of the teaching/learning process; through it, instructors encourage correct modes of behavior and performance.
>
> *Positive reinforcement* is normally used by instructors who are teaching participants new skills. As the name implies, positive reinforcement is "good" and reinforces "good" (or positive) behavior.
>
> *Negative reinforcement* is useful in trying to change modes of behavior. The result of negative reinforcement is extinction—that is, the instructor uses negative reinforcement until the "bad" behavior disappears, or becomes extinct.

Retaining Information. Students must retain information from classes in order to benefit from learning. The instructors' jobs are not finished until they have assisted the learner in retaining the information. In order for participants to retain the information taught, they must see a meaning or purpose for that information. They must also understand and be able to interpret and apply the information. Simply stated, if the participants did not learn the material well initially, they will not retain it well either. Retention by the participants is directly affected by their amount of practice during the learning. After the student demonstrates correct (desired) performance, they should be urged to practice to maintain the desired performance.

Transference. Transfer of learning is the result of training—it is the ability to use the information taught in the course but in a new setting. Transference is most likely to occur in the following situations:

Association—participants can associate the new information with something that they already know.

Similarity—the information is similar to material that participants already know; that is, it revisits a logical framework or pattern.

Degree of original learning—participant's degree of original learning was high.

Critical attribute element—the information learned contains elements that are extremely beneficial (critical)

The best motivators for adult learners are interest and selfish benefit. If they can be shown that the course benefits them pragmatically, they will perform better, and the benefits will be longer lasting. (pp. 78-80)

The 30 Things About Adult Learning by Zemke (1984) may seem too old to be useful, but the following recommendations are surprisingly beneficial for today's instructors having adult students in the classroom:

Adults bring a great deal of life experience into the classroom, an invaluable asset to be acknowledged, tapped, and used. Adults can learn well—and much—from dialogue with respect peers.

New knowledge has to be integrated with previous knowledge; students must actively participate in the learning experience. The learner is dependent on the instructor for confirming feedback on skill practice; the instructor is dependent on the learner for feedback about curriculum and in-class performance.

The key to the instructor role is control. The instructor must balance the presentation of new material, debate and discussion, sharing of relevant student experiences, and the clock. Ironically, it seems that instructors are best able to establish control when they risk giving up. When they shelve egos and stifle the tendency to be threatened by challenge to plans and methods, they gain the kind of facilitative control needed to affect adult learning.

> The instructor has to protect minority opinion, keep disagreements civil and unheated, make connections between various opinions and ideas, and keep reminding the group of the variety of potential solutions to the problem.
>
> Instructors who have a tendency to hold forth rather than facilitate can hold that tendency in check—or compensate for it—by concentrating on the use of open-ended questions to draw out relevant student knowledge and experience.
>
> Adults have expectations, and it is critical to take time early on to clarify and articulate all expectations before getting into content. The instructor can assume responsibility only for his or her own expectation, not for those of the students.
>
> The learning environment must be physically and psychologically comfortable; long lectures, periods of interminable sitting and the absence of practice opportunities rate high on the irritation scale.
>
> Adults have something real to lose in a classroom situation. Self-esteem and ego are on the line when they are asked to risk trying a new behavior in front of peers and cohorts. Bad experience in traditional education, feelings about authority, and the preoccupation with events outside the classroom affect in-class experience.
>
> Integration of new knowledge and skill requires transition time and focused effort on application. (pp. 103-106)

According to Galbraith (1990),

> Questioning can be one of the most effective methods of teaching and is often used with other methodologies. Instructors should have a clear purpose in mind when asking questions. The questions should be well thought out and clearly and concisely stated. (p. 128)

Good questions and questioning techniques can make a fair instructor good and a good instructor great.

The explosive impact of computers on everyday lives has generated a need for more computer-educated people. Increasing emphasis on the Internet, computer security, the proliferation of Web sites, and mobile technology, such as the wireless Internet, have suggested that students with broad knowledge and experience in computer are more attractive candidates to employers. As technological advances in the computer field

continue, employers demand new skills and prefer to hire high-tech people who have at least a degree in CS.

Demand for High-Tech Workers

Since the beginning of the Industrial Revolution, technology has generated fears of mass unemployment. More recently, factory automation came under fire from labor groups for threatening to bring the menace of increased unemployment and poverty. The number of bank tellers has dropped dramatically. Government agencies and private financial companies predicted that more teller jobs would disappear in the next 10 years because of automation and electronic banking services. Successful technology eliminates some jobs, but creates others. Countless new products based on computer technology create jobs: DVD players, iPods, medical devices, navigation systems for cars, cell phones, and so on, are just a few examples.

The rush to invest in computers dramatically alters the typical workplace and ups the relative demand for high-tech workers. Consequently, wrote economist James Galbraith in his 1998 book *Created Unequal*, "Those who are most skilled see their pay climb much more rapidly than everyone else" (p. 23). The demand for skilled and knowledgeable employees in the field of CS simply alerts the labor force to get more information-technology training. Traditional college students migrate toward majors that are in demand, and those already in the workforce go back to school as nontraditional students to acquire new skills. Of course, the intent here is not to suggest that everyone should go to college for computer careers. Like any industry, there are only so many positions to fill. The problem is that not enough people are meeting that demand and too

few are sharing in the prosperity the technology age has fostered. Thus the incomes divide yawns wider than necessary.

Computers are used by many employers, and information skills are considered important in the hiring process by employers. Some employers, while not yet ready to use computer technology throughout their organizations, feel that the need for computer skills in their organizations will increase more over the next several years. Since higher education institutions are training future leaders in industry, it is this increasing need that their programs must meet.

Majoring in Computer Science

If technology's overall impact was to destroy jobs, there should have been fewer people working now than in 1900. But with a population that approximately quadrupled between 1900 and 2008, the U.S. unemployment rate is lower than throughout most of the century. The new jobs created by computers are different from the jobs eliminated. The hundreds of thousands of new computer engineering and systems analyst jobs require a college degree and extensive training. Published in *Occupational Outlook Handbook (OOH)*, 2006-2007 Edition, in spite of the trend to automate high-skill jobs, the U.S. Department of Labor's Bureau of Labor Statistics (BLS, 2006-2007) projected that the number of management, financial, software, and other professional jobs, will increase significantly between 2004 and 2014, and that computer software engineering will be one of the fastest-growing occupations.

In recent years the difference in labor costs encouraged manufacturing jobs to move from wealthier countries to less wealthy countries, especially in Asia. In the

United States, data processing and computer programming were among the first service jobs to go offshore. By 2004, 12% of U.S. information technology companies had moved some of their operations to other countries. One reason for offshoring was that there were not enough trained professionals in the United States (Baase, 2007). The BLS reports that offshoring will probably increase, but the percentage of job losses in the United States is small.

Offshoring lowers the cost and reduces prices for consumers. Manufacturing of computer hardware going offshore was responsible for part of the drop in the cost of hardware in the United States. Blinder, the author of "Offshoring: The Next Industrial Revolution?" believed that officials should plan for a major shift in the United States toward jobs that require presence. He opposed attempts to stop offshoring, but warns that we must prepare by shifting emphasis in education. He expected that flexibility of the U.S. economy will help more rigid economies.

What is the overall effect of computerization on employment rates? Does it create more jobs than it destroys? Sarah Baase (2007) argued that measuring the effects of computers alone is difficult, because other factors influence employment trends. In the United States, in the 10 years between 1993 and 2003, 309.9 million jobs ended—a huge number to anyone who has not seen these figures before. But 327.7 million jobs were added in the same period, for a net increase of 17.8 million jobs. This "job churn," roughly 30 million jobs opening and closing each year, is typical of a flexible economy. In a stagnant economy, people do not change jobs often. The BLS projects that, the net increase in jobs for the period 2004 to 2014 will be 18.9 million.

Economics experts believe that salaries will rise in offshoring destinations. One U.S. entrepreneur said salaries of engineers he hired in India went from 25% of U.S. salaries to 75% within 2 years, hiring them is no longer worthwhile for his company. When the gap between salaries in the home and destination countries is no longer big enough to cover the other expenses of offshoring, the trend will decline.

Enrollment in the CS major dropped significantly after the "dot-com bust" in the early 2000s, but the demand for software engineers and network specialists remains very high (Baase, 2007). New technologies and products create jobs in design, marketing, manufacturing, sales, customer services, repair, and maintenance. The enormous growth of retail sales on the Web contributed to an increase in jobs in areas such as Web design and design of new software packages.

BLS reported that the U.S. companies sold more than $500 billion of software for personal computers in 2007 and consumers spent $6 billion on online services. In addition, BLS reported 1.1 million of people working in data entry and 3.2 million people working in a variety of professional-level computer occupations in 2007. According to the Information Technology Association, 12.5 million people worked in information technology jobs in the United States by 2007. In 2007 governments, businesses, and organizations worldwide spent an estimated $1.7 trillion on information technology. That money paid for a very large number of high-tech jobs (Baase, 2007).

As technology is changing rapidly, computers are becoming more a part of everyday life and skilled workers are needed for effective use of computers. Thus, many people believe that computer literacy is vital to success in today's world. Computer

skills, or skills that closely relate to computer use, have an effect in the labor market, especially in conjunction with a college degree.

Today's children are growing up digital—they are tomorrow's customers for colleges and universities. While computers make some tasks easier and reduce required skill levels, many advances in computer technology have enabled increasingly sophisticated applications that require complex analytical and evaluative skills. Better computer programs are constantly being developed to make computers simpler and more natural to use. Scientists have been able to make computers talk for years and now they want to make computers hear and understand human speech. Meanwhile, the growth of networking and the Internet will continue apace, providing ever more communication, informational, and entertainment services to computer users. The future may bring progress toward the elusive goal of artificial intelligence (AI), which makes computers appear to learn, understand, recognize, and reason much as humans do. Although research on AI abounds, little in the way of solid results has been achieved except for expert systems, which are computers that have been provided with the knowledge and intuition of human experts in a given field. Expert systems advise technologists on such diverse tasks as troubleshooting communications networks, analyzing spectrograms, and diagnosing illness.

Colleges and universities need to recognize that once adults are on campus, they prefer to stay until they acquire such skills or degrees to capture the largest benefits from the spread of computers in their workplaces. Higher education institutions that want to attract these adults need to accommodate their rigorous schedules. Among adults

enrolled in degree programs, these five fields of study are most popular: computers, business, education, health, and engineering (Aslanian, 2001).

Final Notes

Many factors have led to the growth in higher education and, specifically, to the steady rise in the number of adult students. Higher education brings substantial change in the lives of adult students. Their lives can be improved by being able to think clearly, to gather and analyze evidence, to work with others, to be more autonomous, self-directed people who appreciate the value of knowledge. They learn to acquire new competencies for every aspect of their lives.

Currently, three out of four jobs require some postsecondary education, and the fastest-growing jobs are those require higher levels of education and training in technical fields (Aslanian, 2001). Consequently, adult learning has become the largest and most rapidly growing segment of today's education. According to Cross (1978),

> Lifelong learning is not a privilege or a right; it is simply a necessity for anyone, young or old, who must live with the escalating pace of change—in the family, on the job, in the community, and in worldwide society. (p. 71)

Adult students often choose CS as a major because they like to program and are concerned with problem solving. In CS classes every student learns differently and it can be difficult to hold the attention of the entire class. Since students have various preferred learning styles, the instructor needs to vary the method of his/her instruction and use techniques that cater to different learning styles. Clearly, the classical lecturing technique is not an effective tool to help adult students achieve their goals.

To enhance the learning experience and make a CS class more effective, instructors should gain and maintain the attention of students and accommodate different learning styles to bridge the gap between theory and practice. The result of a series of studies shows that adults are more likely to persist in classes where the advertised program description is followed. Interestingly, in relation to retention, the institutional environment itself seems to be a significant factor.

Successful programs of study engage students in activity developing their concept of themselves and others by providing access to new insights and new ways of acting in the world. What ensues, for instructors and students, is a somewhat unpredictable journey with uncertain destinations, because instructors can not predict how students make use of the knowledge they encourage them to acquire. An instructor's role is to try to make that journey exciting and challenging (D'Andrea & Gosling, 2005).

CHAPTER III

METHODOLOGY

Introduction

This chapter describes the research design and methodology used in this study. The following sections are reviewed: purpose statement, research questions, research design, rationale for the design, sample population, instrumentation, validity and reliability, data collection and procedures, statistical treatment, assumptions of the study, limitations of the study, and a summary of the chapter.

Purpose Statement

The purpose of the study was to identify and describe (a) teaching techniques and instructional resources preferred by adult/traditional students in computer science classes at the higher education level, (b) the characteristics of an effective computer science instructor as perceived by adult/traditional students at the higher education level, and (c) adult students' motivation to come back to college.

Research Questions

General research questions in guiding this study include:

1. What teaching techniques are considered desirable by students in computer science classes, relative to the following nine factors:

a) Internship (to give students the opportunity to experience practical applications of the knowledge learned in academic courses)

b) Mentorship (more experienced or more knowledgeable student helps a less experienced or less knowledgeable student)

c) Computer-based learning (structured environment in which computers are used for teaching purposes. Minimum use of white-board)

d) Hands-on or practical activities (a brief lecture followed by completing tasks using computers in the classroom or computer lab)

e) Traditional classroom lecture utilizing a white-board, textbooks, handouts, and additional instructional resources as necessary.

f) Classroom PowerPoint presentation, with textbooks, handouts, and additional resources as necessary.

g) A brief lecture followed by classroom participation via peer and group discussion.

h) 100% online classes

i) Hybrid courses (courses that blend in-class sessions with web-based activities or virtual classes)

2. What types of instructional resources are considered desirable by students in computer science classes, relative to the following 13 factors:

a) Handouts

b) Note taking

c) Textbook(s)

d) Library books and journals

e) Tutorial service center (offers students and faculty assistance with the teaching and learning of academic courses)

f) Comprehensive course syllabus

g) Use of whiteboard to present information in class

h) Use of Blackboard as a source of communication

i) Computers and other electronic resources (audio/video, links, PowerPoint, slides, and websites) to present information faculty wants students to know

j) Use of computer software and Internet resources for learning

k) Reference book(s) and other printed materials

l) Internet posted video of the instructor presenting a traditional classroom type lecture

m) Hands-on (experimenting with examples in classroom or computer labs)

3. What are the characteristics of an effective computer science instructor at the higher education level, relative to the following 16 factors:

a) Has in-depth knowledge of the subject material

b) Possesses an attitude that motivates students to learn

c) Has good public speaking and communication skills

d) Provides energy

e) Specifies clear lesson objectives and teaches only those objectives

f) Paces materials for the average learner

g) Provides examples which reinforce theory

h) Has classroom rules and norms that allow students to mentally engage and disengage from classroom awareness

i) Follows well-defined instructional plan which is flexible as class interests dictate

j) Has adequate number of assignments to reinforce instruction

k) Promotes frequent student faculty contact in and out of class

l) Identifies problems that can be solved as a result of the instruction

m) Focus on practical skills and knowledge that can be used in solving problems

n) Facilitates learning activities

o) Is friendly and approachable to students and their questions, both in class and office hours

p) Has good rapport with students and other faculty members

4. What motivates students to come back to college, relative to the following 13 factors:

a) Requirement for continued employment

b) Be better positioned in the event of downsizing

c) Family pressure

d) Friends or relatives

e) Joy of learning

f) Personal fulfillment

g) Acquire knowledge required for self employment

h) Career/job advancement

i) Career change

j) Better positioning for a promotion at work

k) Better positioned to obtain a higher paying job

l) Increased marketability

m) Keeping up to date on new technology

5. Are there significant differences between the needs of adult (25 years and older) and traditional (18-24 years old) computer science major students in computer science classes, relative to all factors in Questions 1-4?
6. Are there significant differences between the needs of traditional (age 18-24 years) and adult (25 years and older) not CS-major or undecided major students in computer science classes, relative to all factors in Questions 1-4?

Research Design

Survey research and ex post facto research design were the two types of research designs used in this study.

The first phase of the study involved a survey research design to accumulate data through the use of a questionnaire survey. As described by Creswell (2005), "Survey research designs are procedures in quantitative research in which investigators administer a survey to a sample or to the entire population of people in order to describe the attitudes, opinions, behaviors, or characteristics of the population" (p. 354). Isaac and Michael (1997) acknowledged that descriptive research design (survey research design) is

> gathering information that describes the nature and extent of a specified set of data ranging from physical counts and frequencies to attitudes and opinions. This information, in turn, can be used to answer questions that have been raised, to solve problems that have been posed or observed, to assess needs and set goals, and generally, to describe what exists, in what amount, and in what context. (p. 136)

According to Gay (2000), "Descriptive data are usually collected through questionnaires, survey, interviews, or observation" (p. 13). This study compiled data with questionnaires, which met the following guiding principles as recommended by Isaac and Michael (1997):

> Systematic—carefully planned and executed to insure appropriate content coverage and sound, efficient data collection.
> Representative—closely reflecting the population of all possible cases or occurrences, either by including everyone or everything, or by using scientific sampling procedures.
> Objective—insuring that the data are as observable and explicit as possible.
> Quantifiable—yielding data that can be expressed in numerical terms. (pp. 136-137)

The systematic, representative, objective, and the quantifiable principles are covered simultaneously in the Validation and Reliability, Sample Population, Statistical Treatment, and the Instrumentation sections of this study.

In Phase 2 of the study, because similarities, differences, and comparisons of adult and traditional major and nonmajor computer science (CS) students' needs showed the results of this study, ex post facto research was used. According to Gay (2000), "Ex post facto research attempts to determine the cause or reason for existing differences in the behavior or status of groups of individuals" (p. 41).

Rationale for the Design

According to Gay (2000),

> Quantitative descriptive research studies are an appropriate way to collect data in order to answer questions about the current status of topic of a study and to acquire information about the preferences, attitudes, practices, concerns, or interests of a group of people. (p. 155)

To answer Research Questions 1-4, the researcher used descriptive research design to collect quantitative data and explain various outcomes that might result from the survey, including surprising ones. The rationale for using ex post facto research design was to compare two group of students: adult (Group 1) and traditional (Group 2) CS major students in Research Question 5, and undecided-major (Group 1) and non CS major (Group 2) students in Research Question 6 to determine similarities and differences in their needs.

Sample Population

The target population of this study consisted of undergraduate students enrolled in CS classes at seven private universities in Southern California: Azusa Pacific University (Azusa), Biola University (La Mirada), California Baptist University (Riverside), Chapman University (Orange), California Lutheran University (Woodland Hills), the University of La Verne (La Verne), and the University of Redlands (Redlands). This sample selection was based on the type (private universities), location (Southern California), and the size (less than 8,000 students) of each institution.

The criteria for participation in this research included: (a) students must have enrolled in any undergraduate CS courses in Fall 2010 (beginning in September and ending on/before December); and (b) students are majoring in CS or not.

Table 4 indicates the number of students who participated in this survey.

Table 4

Number of Respondents Identifying Their Age Group and Major

Traditional students(T) $n = 122$			Adult students (A) $n = 79$		
CS-major (TCS)	Not CS-major (TNCS)	Undecided-major (TU)	CS-major (ACS)	Not CS-major (ANCS)	Undecided-major (AU)
85	31	6	60	15	4

Instrumentation

The instruments employed for this study were designed by the researcher to identify teaching techniques and instructional resources preferred by adult students in CS classes, and to discover the characteristics of an effective CS instructor and what motivates adult students to come back to school. In addition, the instrument was employed to examine possible significant differences between the needs of students when sorted by age and whether they were computer majors or not.

The researcher telephoned, e-mailed, and sent a letter (Appendices E and F) to all CS faculty at each institution requesting those who were interested in participating in this study. Since the design of the research involved surveys, the researcher used a questionnaire to collect quantitative data from undergraduate students in CS classes at all seven campuses.

According to Creswell (2005), a questionnaire provides an efficient and accurate way to determine information about a population. Frankel and Wallen (2006) acknowledge that "questionnaires describe the characteristics of a population, which is inferred from what is found out from a sample" (p. 397).

The questionnaire used in this study was designed to collect quantitative data for Research Questions 1, 2, 3, and 4. The survey questions were reviewed by a panel of experts prior to administration. The panel consisted of a full-time CS faculty member from the University of La Verne, and a full-time and two adjunct CS faculty members from the California State University, Fullerton campus. They helped the researcher to ensure that the questions were well designed.

A pilot survey was administered to 10 students to ensure the reliability and validity of the survey questions and to establish an approximate time needed to take the survey. The participants were asked the following questions regarding the survey instruments as recommended by Creswell (2005):

> Were the instructions clear? If not, please comment on directions that need clarification.
>
> Were the questions clear? If not, please comment on questions that need to be modified.
>
> Was it easy to respond to the instruments? If not, please specify the reasons why it was not easy to respond to the instrument.
>
> Did the instrument require excessive time to complete? If yes, what could be changed to shorten the amount of time to complete the survey?
>
> Does the Likert Rating Scale Survey provide for adequate degrees of freedom? (p. 101)

The researcher received from the students signed informed consent forms before they completed the pilot survey. As a result of the pilot study, two of the questions were reworded. Each instrument was retyped, formatted, and constructed for consistent appearance.

The survey questions were measured on a 5-point Likert scale ranging from *strongly undesirable* to *strongly desirable.* At the end of each question, students were

asked to write their comments or suggestions regarding that question. The advantage of doing this is to allow students to express themselves in their own words.

Validity and Reliability

The validity of a research instrument refers to whether it serves the purpose, and reliability addresses the extent to which data from a particular instrument is accurate (Johnson & Christensen, 2000). Support for the validity and reliability of this study rested upon several factors: (a) careful selection of expert panels to review the questionnaire specifications and the selection of items in each question, (b) protection of participants' confidentiality, (c) obtaining informed consent of all participants prior to the survey, (d) pilot testing the instruments, and (e) transcription of collected data as soon as possible after its collection.

Data Collection and Procedures

The data collection methods included selecting institutions, developing the survey instruments, conducting the pilot study, conducting surveys, and collecting and interpreting data.

Prior to conducting the survey, the researcher filed an application with the Institutional Review Board (IRB) at the University of La Verne, California. The researcher obtained clearance and approval from the IRB committee for obtaining informed consent of the participants selected for this study.

To schedule the survey, the CS faculties at each institution participating in the survey were contacted by e-mail, telephone, and a letter. A signed letter (see Appendix

G) granting permission for research participation was collected and confirmation for 10 to 15 minutes of their class time was obtained based on a convenient date and time.

Data collection of the study was administrated by the researcher during Fall 2010. As part of survey requirements, (a) there were no restrictions on the CS course subject; (b) all students (part-time or full-time, adult or traditional, major or nonmajor) were asked to participate and fill out questionnaires; and (c) students were given the option of not participating in the study. One student out of 201 in all seven institutions chose not to take the survey.

The researchers attended each CS class, distributed the survey instrument, and explained that their responses were confidential and were being used for a current research study. The consent forms, which provided a brief description of the study and emphasized the confidentiality of student responses, were signed by students prior to completing the questionnaires.

The researcher analyzed the quantitative results, and finally made conclusions about findings. All faculty members who participated in this study received a thank-you card from the researcher.

Statistical Treatment

According to Creswell (2005), descriptive statistics are used to describe the basic features of the data in a study. Gay (2000) acknowledged that the descriptive statistics are data analysis techniques that enable a researcher to meaningfully describe many scores with a small number of indices. The gathered quantitative data were placed into the Statistical Package for Social Science (SPSS) software and analyzed by the

researcher. The researcher presented results providing extensive discussion of the quantitative analysis of the survey data, including a discussion about the measurement of variables, such as frequencies, percentages, means, and standard deviations.

To examine the possible differences in Research Questions 5 and 6, a *t*-test for differences between the means was applied. A *t*-value was tabulated as well as the probability level. Testing for significant difference between two groups was completed at the .05 level of significance using two-tailed test. A two-tailed test was selected over a one-tailed test because the researcher was not concerned with the negative or positive direction of the difference, but rather whether indeed a statistically significant difference could be established at a .05 level of significance.

Assumptions of the Study

Several assumptions were made regarding the study:

1. The study did not consider student gender, race, ethnic, or linguistic background.
2. The results of questionnaire instruments rely on the honesty of the respondents. It is possible that some respondents may not have been perfectly truthful on all questions.
3. The study represents the opinion of the of students who attended CS courses at the University of La Verne, Azusa Pacific University, University of Redlands, California Lutheran University, Chapman University, California Baptist University, and Biola University campuses during the Fall 2010 academic year.
4. Students answered survey questions candidly and completely.

Limitations of the Study

Limitations of this study included the following:

1. The respondents were limited to the students who took CS courses in the Department of Computer Science at the University of La Verne, Azusa Pacific University, University of Redlands, California Lutheran University, Chapman University, California Baptist University, and Biola University during Fall 2010.
2. The study was conducted over one semester (Fall 2010) at the above campuses.
3. There may be other intervening variables not considered by this study that might have been important determiners on the effectiveness of CS faculty, their teaching technique strategies and also the needs and expectations of students in CS classes.
4. The study may not have considered all teaching techniques, strategies, and the needs and expectations of students.
5. Data collection of this study was limited to survey instruments.
6. The results of this study are not generalizable and can only be applied to students and programs in similar institutions.

Summary

This chapter described the methodology used in this study. It provided a rationale for the study and the type of research. It also discussed the population and sample, instrumentation, data collection and procedures, and limitations of the study.

Chapter IV presents the analysis of the gathered data. In addition, significant differences are identified.

CHAPTER IV

DATA ANALYSIS

Introduction

This chapter presents a summary and analysis of the data collected in this study. It also demonstrates, through the use of tables, the teaching techniques and technical resources most desired by adult and traditional students in computer science classes. In addition, the study determined the characteristics of an effective computer science instructor and found factors that motivate adult and traditional students attending college. Lastly, the study identified whether there is a significant difference between the needs of students when the sample was sorted by students' ages and whether their stated major was computer science. The findings are presented for each of the six research questions.

Purpose Statement

The purpose of the study was to identify and describe: (a) teaching techniques and instructional resources preferred by adult/traditional students in computer science classes at the higher education level, (b) the characteristics of an effective computer science instructor as perceived by adult/traditional students at the higher education level, and (c) adult students' motivation to come back to college.

Research Questions

General research questions in guiding this study include:

1. What teaching techniques are considered desirable by students in computer science classes, relative to the following nine factors:
   a) Internship (to give students the opportunity to experience practical applications of the knowledge learned in academic courses)
   b) Mentorship (more experienced or more knowledgeable student helps a less experienced or less knowledgeable student)
   c) Computer-based learning (structured environment in which computers are used for teaching purposes. Minimum use of white-board)
   d) Hands-on or practical activities (a brief lecture followed by completing tasks using computers in the classroom or computer lab)
   e) Traditional classroom lecture utilizing a white-board, textbooks, handouts, and additional instructional resources as necessary.
   f) Classroom PowerPoint presentation, with textbooks, handouts, and additional resources as necessary.
   g) A brief lecture followed by classroom participation via peer and group discussion.
   h) 100% online classes
   i) Hybrid courses (courses that blend in-class sessions with web-based activities or virtual classes)
2. What types of instructional resources are considered desirable by students in computer science classes, relative to the following 13 factors:

a) Handouts

b) Note taking

c) Textbook(s)

d) Library books and journals

e) Tutorial service center (offers students and faculty assistance with the teaching and learning of academic courses)

f) Comprehensive course syllabus

g) Use of whiteboard to present information in class

h) Use of Blackboard as a source of communication

i) Computers and other electronic resources (audio/video, links, PowerPoint, slides, and websites) to present information faculty wants students to know

j) Use of computer software and Internet resources for learning

k) Reference book(s) and other printed materials

l) Internet posted video of the instructor presenting a traditional classroom type lecture

m) Hands-on (experimenting with examples in classroom or computer labs)

3. What are the characteristics of an effective computer science instructor at the higher education level, relative to the following 16 factors:

a) Has in-depth knowledge of the subject material

b) Possesses an attitude that motivates students to learn

c) Has good public speaking and communication skills

d) Provides energy

e) Specifies clear lesson objectives and teaches only those objectives

f) Paces materials for the average learner

g) Provides examples which reinforce theory

h) Has classroom rules and norms that allow students to mentally engage and disengage from classroom awareness

i) Follows well-defined instructional plan which is flexible as class interests dictate

j) Has adequate number of assignments to reinforce instruction

k) Promotes frequent student faculty contact in and out of class

l) Identifies problems that can be solved as a result of the instruction

m) Focus on practical skills and knowledge that can be used in solving problems

n) Facilitates learning activities

o) Is friendly and approachable to students and their questions, both in class and office hours

p) Has good rapport with students and other faculty members

4. What motivates students to come back to college, relative to the following 13 factors:

a) Requirement for continued employment

b) Be better positioned in the event of downsizing

c) Family pressure

d) Friends or relatives

e) Joy of learning

f) Personal fulfillment

g) Acquire knowledge required for self employment

h) Career/job advancement

i) Career change

j) Better positioning for a promotion at work

k) Better positioned to obtain a higher paying job

l) Increased marketability

m) Keeping up to date on new technology

5. Are there significant differences between the needs of adult (25 years and older) and traditional (18-24 years old) computer science major students in computer science classes, relative to all factors in Questions 1-4?
6. Are there significant differences between the needs of traditional (age 18-24 years) and adult (25 years and older) not CS-major or undecided major students in computer science classes, relative to all factors in Questions 1-4?

Data Collection and Population

The survey was conducted at seven private universities in Southern California. The questionnaire was designed to closely match the research questions. Of the invitations sent to each institution, 13 faculty members (77%) responded to the invitation and agreed to take part in this study. The tables that follow reflect the results of the analysis and data collected beginning with Table 4 (also in Chapter III).

Results of the frequency of adult (n = 79) and traditional (n = 122) students in this study are summarized in Table 4. Participants were asked to select their age group within the age range groups designated as less than 25 (traditional students) and over 25 (adult

students). In addition, students were asked to mark whether they were a computer science major, not a computer science major, or undecided (no declared major).

Among all students ($N = 202$) who took the survey, only one did not answer all questions and the questionnaire was removed from the pool. Worth noting is that the size of classes at almost all these private universities was between 7 and 24 students. Students who were registered for more than one computer science (CS) course were asked to participate only once.

Table 4

The Number of Respondents Identifying Their Age Group and Major

Traditional students(T) $n = 122$			Adult students (A) $n = 79$		
CS-major (TCS)	Not CS-major (TNCS)	Undecided-major (TU)	CS-major (ACS)	Not CS-major (ANCS)	Undecided-major (AU)
85	31	6	60	15	4

Research Findings

This section presents the findings for the research questions.

Analysis of Research Question 1

What teaching techniques are considered desirable by students in computer science classes [relative to the following 9 factors]?

a) Internship (to give students the opportunity to experience practical applications of the knowledge learned in academic courses)

b) Mentorship (more experienced or more knowledgeable student helps a less experienced or less knowledgeable student)

c) Computer-based learning (structured environment in which computers are used for teaching purposes. Minimum use of white board)

d) Hands-on or practical activities (a brief lecture followed by completing tasks using computers in the classroom or computer lab)

e) Traditional classroom lecture utilizing a white-board, textbooks, handouts, and additional instructional resources as necessary

f) Classroom PowerPoint presentation, with textbooks, handouts, and additional resources as necessary

g) A brief lecture followed by classroom participation via peer and group discussion

h) 100% online classes

i) Hybrid courses (courses that blend in-class sessions with web-based activities or virtual classes)

The results of responses to the first question are displayed in Tables 5-12. Table 5 represents the number and the percentage of traditional CS-major students who answered Research Question 1.

Table 5

Number and Percentage of Survey Results for Traditional CS-Major Students (n = 85)

Teaching techniques	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Internship	3	3.5	0	0.0	5	5.9	20	23.5	57	67.1
2. Mentorship	3	3.5	5	5.9	11	12.9	31	36.5	35	41.2
3. Computer-based learning	7	8.2	7	8.2	13	15.3	21	24.7	37	43.5
4. Hands-on or practical activities	2	2.4	1	1.2	3	6.5	16	18.8	63	74.1
5. Traditional classroom lecture…	9	10.6	15	17.6	23	27.1	22	25.9	16	18.8
6. Classroom PowerPoint presentation, with textbooks…	15	17.6	14	16.5	33	38.8	14	16.5	9	10.6
7. A brief lecture followed by classroom participation….	3	3.5	16	18.8	19	22.4	35	41.2	12	14.1
8. 100% online classes	36	42.4	24	28.2	17	20.0	5	5.9	3	3.5
9. Hybrid courses	16	18.8	13	15.3	29	34.1	20	23.5	7	8.2

Table 5 reveals that 74.1% of traditional CS-major students strongly prefer the "Hands-on or practical activities" teaching technique. The same group of students (42.4%) reported that their most undesirable teaching technique is Factor 8, "100% online." In addition this table shows that 27.1% of traditional students were *uncertain* regarding Factor 5, "Traditional classroom lecture utilizing a whiteboard, textbooks, handouts, and additional resources as necessary." The data in this table indicate that 34.1% of this group were *uncertain* on Factor 9, "Hybrid courses." This means that traditional students are still not very familiar with this new teaching technique. One student wrote,

> It sometimes becomes a problem when teachers treat an online class like a traditional class and expect the students to carry on a conversation about the topic in the discussion board and expect the students to do many papers and class projects.

Moreover, another student wrote, "As a student, I'm afraid I'll never have time for my family or outside interest if I have to study everything by myself."

Table 6 represents the number and the percentage of CS-major adult students who answered Research Question 1. Table 3 reveals that 55% of adult CS-major students ranked Factor 4, "Hands-on or practical activities" as a strongly desirable teaching technique. The next highest marked went to Factor 1, "Internship" with 51.7%. Adult CS-major students marked Factor 5, "Traditional classroom lecture utilizing a white board, textbooks, handouts, and additional instructional resources as necessary," and

Table 6

Number and Percentage of Survey Results for Adult CS-Major Students (n = 60)

Teaching techniques	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1.Internship	4	6.7	1	1.7	8	13.3	16	26.7	31	51.7
2. Mentorship	3	55.0	3	5.0	17	28.3	19	31.7	18	30.0
3. Computer-based learning	2	3.3	8	13.3	10	16.7	20	33.3	20	33.3
4. Hands-on or practical activities	2	3.3	3	3.3	8	13.3	14	23.3	33	55.0
5. Traditional classroom lecture…	4	6.7	6	10.0	18	30.0	22	36.7	10	16.7
6. Classroom PowerPoint presentation, with textbooks . . .	8	13.3	10	16.7	15	25.0	20	33.3	7	11.7
7. A brief lecture followed by class participation	5	8.3	8	13.3	14	23.3	21	35.0	12	20.0
8. 100% online classes	15	25.0	14	23.3	9	15.0	12	20.0	10	16.7
9. Hybrid courses	4	6.7	7	11.7	22	36.7	13	21.7	14	23.3

Factor 7, "A brief lecture followed by class participation via peer and group discussion," 36.7% and 35.0% respectively as strongly desirable teaching techniques. One student wrote,

> By hearing a lecture from a professor each time, the student can learn more about the professor expertise, and teaching style. My age and my job depend on textbooks and notes to accomplish good work, and I appreciate open book learning of any form.

Factor 6, "Class PowerPoint presentation" was ranked the lowest (11.7%) desirable technique by the same group of students. In addition, this table shows that 23.3% of adult CS-major students ranked Factor 8, "100% online classes," undesirable. One student wrote, "At each stage of 100% online classes it is nice to invite all students to come together and listen to a lecture by professors in each subject in that major."

Table 7 represents the number and the percentage of traditional not CS-major students who answered Research Question 1. The data in Table 7 indicate that even traditional not CS-major students (58.1%) strongly support Factor 4, "Hands-on." One student wrote, "I am more of hands-on learner." In addition, Factor 1, "Internship" was marked by 45.2% as the next strongly desirable teaching technique by this group of students. However, the same group of students rated Factor 8,"100% online classes," 3.2%; Factor 6, "Classroom PowerPoint presentation with textbooks, handouts, and traditional resources as necessary"; and Factor 9, "Hybrid courses," 9.7% as least *strongly desirable* teaching techniques.

Table 7

Number and Percentage of Survey Results for Traditional Not-CS-Major Students (n = 31)

Teaching techniques	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Internship	0	0.0	1	1.2	3	9.7	14	45.2	14	45.2
2. Mentorship	0	0.0	2	6.5	5	16.1	14	45.2	10	32.3
3. Computer-based learning	0	0.0	2	6.5	5	16.1	11	35.5	13	41.9
4. Hands-on or practical activities	0	0.0	0	0.0	0	0.0	13	41.9	18	58.1
5. Traditional classroom lecture…	1	3.2	4	12.9	10	32.3	10	32.3	6	19.4
6. Classroom PowerPoint presentation, with textbooks, . . .	1	3.2	4	12.9	7	22.6	16	51.6	3	9.7
7. A brief lecture followed by class participation . . .	1	3.2	2	6.5	10	32.3	13	41.9	5	16.1
8. 100% online classes	9	29.0	8	25.8	11	35.5	2	6.5	1	3.2
9. Hybrid courses	3	9.7	5	16.1	8	25.8	12	38.7	3	9.7

The data in Table 7 also indicate that Factors 1, "Internship"; 2, "Mentorship"; 4, "Hands-on or practical activities"; 7, "A brief lecture followed by class participation" were ranked equally *desirable* by both groups. A traditional not CS-major student wrote, "An internship that allows you the hands-on experience not just the observational aspect like some companies is my favorite teaching technique."

Table 8 represents the number and the percentage of adult not CS-major students who answered Research Question 1. The data in Table 8 indicate that adult not CS-major students find Factor 4, "Hands on" or practical activities, *strongly desirable*, but they didn't find Factors 8, "100% online classes"; 2, "Mentorship"; and 5, "Traditional classroom lecture utilizing a whiteboard, textbooks, handouts, and additional instructional resources as necessary," *strongly desirable*. This group cited Factor 1, "Internship," 46.7%, which was the second highest percentage for *strongly desirable* teaching techniques.

The highest ranked factors by adult not-CS-major students were Factor 3, "Computer-based learning," 46.7%, followed by a cluster of two factors: 2, "Mentorship" and 6, "Classroom PowerPoint presentation with textbooks, handouts, and additional resources as necessary," both with 40.0%. The most mentioned u*ndesirable* techniques for this group were Factors 7, "A brief lecture followed by class participation via peer and group discussion," and 8, "100% online classes."

Tables 8 and 9 represent the number and percentage of traditional and adult students who declared "undecided-major." This means that these students have not yet

Table 8

Number and Percentage of Survey Results for Adult Not CS-major Students (n = 15)

Teaching techniques	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Internship	0	0.0	3	20.0	3	20.0	2	13.3	7	46.7
2. Mentorship	0	0.0	2	13.3	5	33.3	6	40.0	2	13.3
3. Computer-based learning	1	6.7	0	0.0	3	20.0	7	46.7	4	26.7
4. Hands-on or practical activities	0	0.0	0	0.0	2	13.3	3	20.0	10	66.7
5. Traditional classroom lecture …	1	6.7	3	20.0	4	26.7	5	33.3	2	13.3
6. Classroom PowerPoint presentation, with textbooks ….	0	0.0	2	13.3	4	26.7	6	40.0	3	20.0
7. A brief lecture followed by classroom participation	1	6.7	4	26.7	5	33.3	3	20.0	2	13.3
8. 100% online classes	4	26.7	4	26.7	4	26.7	3	20.0	0	0.0
9. Hybrid courses	0	0.0	3	20.0	6	40.0	3	20.0	3	20.0

declared a major, but were attending CS courses during this experiment. Table 9 represents the number and percentage of traditional undecided-major students who answered Research Question 1. The data in Table 9 reveal that a cluster of three factors: Factor 3, "Computer-based learning"; Factor 4, "Hands on or practical activities"; and Factor 5, "Traditional classroom lecture utilizing a white board, textbooks, handouts, and traditional instructional resources as necessary," were among the *strongly desirable* teaching techniques for traditional undecided-major students.

The same group of students marked Factor 2, "Mentorship"; Factors 3-5 (see previous paragraph); and Factor 7, "A brief lecture followed by classroom participation via peer and group discussion," as their highest ranking desirable teaching techniques. However, the most mentioned undesirable factors for this group of students were Factors 8, "100% online classes," and 9, "Hybrid courses."

The data in Table 9 indicate that for Factors 6, "Classroom PowerPoint presentation, with textbooks, handouts, and additional resources as necessary"; 7, "A brief lecture followed by classroom participation via peer and group discussion"; 8, "100% online classes"; and 9, "Hybrid courses," no traditional undecided-major student respondents rated them strongly desirable.

Table 10 represents the number and percentage of adult undecided-major students who answered Research Question 1. The data in Table 10 reveal that 50% of adult undecided-major students marked Factors 3, "Computer-based learning"; 4, "Hands-on or practical activities"; and 5, "Traditional classroom lecture utilizing a white board,

Table 9

Number and Percentage of Survey Results for Traditional Undecided-Major Students (n = 6)

Teaching techniques	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1.Internship	0	0.0	0	0.0	3	50.0	2	33.3	1	16.7
2. Mentorship	0	0.0	1	16.7	1	16.7	3	50.0	1	16.7
3. Computer-based learning	0	0.0	0	0.0	0	0.0	3	50.0	3	50.0
4. Hands-on or practical activities	0	0.0	0	0.0	0	0.0	3	50.0	3	50.0
5. Traditional classroom lecture…	0	0.0	0	0.0	0	0.0	3	50.0	3	50.0
6. Classroom PowerPoint presentation, with textbooks . . .	1	16.7	1	16.7	2	33.3	2	33.3	0	0.0
7. A brief lecture followed by class participation …..	0	0.0	2	33.3	1	16.7	3	50.0	0	0.0
8. 100% online classes	2	33.3	3	50.0	1	16.7	0	0.0	0	0.0
9. Hybrid courses	1	16.7	3	50.0	2	33.3	0	0.0	0	0.0

Table 10

Number and Percentage of Survey Results for Adult Undecided-Major Students (n = 4)

Teaching Techniques	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1.Internship	0	0.0	0	0.0	3	50.0	2	33.3	1	16.7
2. Mentorship	0	0.0	1	16.7	1	16.7	3	50.0	1	16.7
3. Computer-based learning	0	0.0	0	0.0	0	0.0	3	50.0	3	50.0
4. Hands-on or practical activities	0	0.0	0	0.0	0	0.0	3	50.0	3	50.0
5. Traditional classroom lecture	0	0.0	0	0.0	0	0.0	3	50.0	3	50.0
6. Classroom PowerPoint presentation with . . .	1	16.7	1	16.7	2	33.3	2	33.3	0	0.0
7. A brief lecture followed by class participation….	0	0.0	2	33.3	1	16.7	3	50.0	0	0.0
8 .100% online classes	2	33.3	3	50.0	1	16.7	0	0.0	0	0.0
9. Hybrid courses	1	16.7	3	50.0	2	33.3	0	0.0	0	0.0

textbooks, handouts, and additional instructional resources as necessary," as *strongly desirable* factors. However, Factors 6-9, that is, "Classroom PowerPoint presentation with textbooks, handouts, and additional resources as necessary"; "A brief lecture followed by class participation via peer and group discussion"; "100% online classes"; and "Hybrid courses," received no support as *strongly desirable* factors by the same group of students.

Table 11, which is a combination of Tables 5 and 6, compares the percentage of traditional and adult CS-major students who answered Research Question 1. The data in this table reveal that 42.4% of traditional and 25.0% of adult CS-major students marked Factor 9, "100% online classes," as *strongly undesirable*. Among this group of students, 38.8% of traditional and 25.0% of adults were strongly *uncertain* regarding Factors 6, "Classroom PowerPoint presentation, with textbooks, handouts, and additional resources as necessary," and Factor 5, "Traditional classroom lecture utilizing a whiteboard, textbooks, handouts, and additional instructional resources as necessary," respectively. However, the data in this table indicate that the most desirable cited factor for both traditional and adult CS-major student was Factor 4, "Hands-on or practical activities." Factor 1, "Internship," with 67.1% and 51.7% was marked highest after Factor 4 by traditional and adult students respectively.

The factors cited strongly undesirable include Factor 8, "100% online," and Factor 6, "Classroom PowerPoint Presentation, with textbooks, handouts, and additional

Table 11

Percentage of Survey Results for Traditional (n = 85) and Adult (n = 60) CS-Major Students

Teaching techniques	Strongly undesirable (%)		Undesirable (%)		Uncertain (%)		Desirable (%)		Strongly desirable (%)	
	Age ≤ 24	Age ≥ 25	Age ≤ 24	Age ≥ 25	Age ≤ 24	Age ≥ 25	Age ≤ 24	Age ≥ 25	Age ≤ 24	Age ≥ 25
1. Internship	3.5	6.7	0.0	1.7	5.9	13.3	3.5	26.7	67.1	51.7
2. Mentorship	3.5	5.0	5.9	5.0	12.9	28.3	36.5	31.7	41.2	30.0
3. Computer-based learning	8.2	3.3	8.2	13.3	15.3	16.7	24.7	33.3	43.5	33.3
4. Hands-on or practical act.	2.4	3.3	1.2	3.3	6.5	13.3	18.8	23.3	74.1	55.0
5. Traditional classroom . . .	10.6	6.7	17.6	10.0	27.1	30.0	25.9	36.7	18.8	16.7
6. PowerPoint presentation	17.6	13.3	16.5	16.7	38.8	25.0	16.5	33.3	11.6	11.7
7. Brief lecture followed . . .	3.5	8.3	18.8	13.3	22.4	23.3	41.2	35.0	14.1	20.0
8. 100% online classes	42.4	25.0	28.2	23.3	20.0	15.0	5.9	20.0	3.5	16.7
9 .Hybrid courses	18.8	6.7	15.3	11.7	34.1	36.7	23.5	21.7	8.2	23.3

resources as necessary" by both traditional and adult CS-major students. Finally, Factor 9, "Hybrid" was ranked highly *uncertain* with both groups. This indicates that this new teaching technology still is not popular among CS-major students.

Table 12 is the combination of Tables 7 and 8 and represents the percentage of students who answered Research Question 1 when students were not CS-major students grouped by their age.

The data in Table 12 indicate that both traditional and adult not CS-major students were not strongly supportive of Factor 8, "100% online classes." In fact 29.0% of traditional and 26.7% of adult students marked Factor 8 as a *strongly undesirable* teaching technique. Moreover 6.5% of traditional students compared with 26.7% of adult students agreed that Factor 7, "A brief lecture followed by classroom participation via peer and group discussion," is one of their *undesirable* teaching technique method. This difference indicates that adult students agreed less with this factor.

The factors cited *strongly desirable* by both traditional and adult students in Table 12 included Factor 4, "Hands-on or practical activities," and Factor 1, "Internship." Factor 3,"Computer-based learning," was cited 41.9% strongly desirable by traditional students, adult students agreed less with this factor.

Table 13, which is the combination of Tables 9 and 10, represents the percentage of survey results for undeclared-major students when grouped by their age.

Table 12

Percentage of Survey Results for Traditional (n = 31) and Adult (n = 15) Not CS-Major

Teaching techniques	Strongly undesirable (%)		Undesirable (%)		Uncertain (%)		Desirable (%)		Strongly desirable (%)	
	Age ≤ 24	Age ≥ 25	Age ≤ 24	Age ≥ 25	Age ≤ 24	Age ≥ 25	Age ≤ 24	Age ≥ 25	Age ≤ 24	Age ≥ 25
1.Internship	0.0	0.0	1.2	20.0	9.7	20.0	45.2	13.3	45.2	46.7
2. Mentorship	0.0	0.0	6.5	13.3	16.1	33.3	45.2	40.0	32.3	13.3
3. Computer-based learning	0.0	6.7	6.5	0.0	16.1	20.0	35.5	46.7	41.9	26.7
4. Hands-on	0.0	0.0	0.0	0.0	0.0	13.3	41.9	20.0	58.1	66.7
5. Traditional classroom..	3.2	6.7	12.9	20.0	32.3	26.7	32.3	33.3	19.4	13.3
6.PowerPoint Presentation	3.2	0.0	12.9	13.3	22.6	26.7	51.6	40.0	9.7	20.0
7. A brief lecture…	3.2	6.7	6.5	26.7	32.3	33.3	49.9	20.0	16.1	13.3
8. 100% online classes	29.0	26.7	25.8	26.7	35.5	26.7	6.5	20.0	3.2	0.0
9. Hybrid courses	9.7	0.0	16.1	20.0	25.8	40.0	38.7	20.0	9.7	20.0

Table 13

Percentage of Survey Results for Traditional (n = 6) and Adult (n = 4) Undeclared-Major Students

Instructional resources	Strongly undesirable (%)		Undesirable (%)		Uncertain (%)		Desirable (%)		Strongly desirable (%)	
	Age ≤ 24	Age ≥ 25	Age ≤ 24	Age ≥ 25	Age ≤ 24	Age ≥ 25	Age ≤ 24	Age ≥ 25	Age ≤ 24	Age ≥ 25
1. Internship	0.0	0.0	0.0	0.0	50.0	50.0	33.3	33.3	35.3	6.7
2. Mentorship	0.0	0.0	16.7	16.7	16.7	16.7	50.0	50.0	36.5	16.7
3. Computer-based learning	0.0	0.0	0.0	0.0	0.0	0.0	50.0	50.0	34.1	50.0
4. Hands-on	0.0	0.0	0.0	0.0	0.0	0.0	50.0	50.0	14.1	50.0
5. Traditional classroom lec.	0.0	0.0	0.0	0.0	0.0	0.0	50.0	50.0	31.8	50.0
6. Classroom PowerPoint.. ..	16.7	16.7	16.7	16.7	33.3	33.3	33.3	33.3	47.1	0.0
7. A brief lecture followed.…	0.0	0.0	33.3	33.3	16.7	16.7	50.0	50.0	32.9	0.0
8. 100% online	33.3	33.3	50.0	50.0	16.7	16.7	0.0	0.0	27.1	0.0
9. Hybrid courses	16.7	16.7	50.0	50.0	33.3	33.3	0.0	0.0	36.5	0.0

The results of traditional undeclared-major students responses to all factors indicate that Factor 6, "Classroom PowerPoint presentation with textbooks, handouts, and additional resources as necessary," was cited strongly desirable than any other factors. However, adult undeclared-major students did not strongly support this factor at all; instead their most strongly desirable factors were Factor 3, "Computer-based learning"; 4, "Hands-on" or practical activities; and 5, "Traditional classroom lecture utilizing a white board, textbooks, handouts, and additional instructional resources as necessary." Other factors cited as occurring frequently by the same group of students were Factors 2, "Mentorship"; 9, "Hybrid courses"; and 1, "Internship."

When all these factors were considered, adult undeclared-major students sitting in CS classes prefer the traditional classroom environment combined with computer-based learning and hands-on practices.

Research Question 1 Findings

A summary of total combined percentage and ranking (1 = highest) as perceived by all students is displayed in Table 14. Table 14 represents a summary of total combined results of *strongly desirable* factors of Tables 11-13 when the percentages are ranked for all groups of students: Column 1, "Traditional Students (TS)" grouped by CS-major (TCS), Not CS-major (TNCS), and Undeclared (TU) students; Column 2, "Adult Students (AS)" grouped into same categories as Column 1.

Table 14

Order of Preference When Students Are Grouped by Their Age and Major

	Traditional students(T) $n = 122$						Adult students (A) $n = 79$					
	CS-major (TCS, $n = 85$)		Not CS-major (TNCS, $n = 31$)		Undeclared (TU, $n = 6$)		CS-Major (ACS, $n = 60$)		Not CS-major (ANCS, $n = 15$		Undeclared (AU, $n = 4$)	
Teaching techniques	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank
1. Internship	67.1	2	45.2	2	35.3	3	51.5	2	46.7	2	16.7	2
2 .Mentorship	41.2	4	32.3	4	36.5	2	30.0	4	13.3	5	16.7	2
3. Computer-based learning	43.5	3	41.9	3	34.1	4	33.3	3	26.7	3	50.0	1
4. Hands-on or practical activities	74.1	1	58.1	1	14.1	8	55.0	1	66.7	1	50.0	1
5. Traditional classroom lecture . . .	18.8	5	19.4	5	31.8	6	16.7	7	13.3	5	50.0	1
6. Classroom PowerPoint Pres…	10.6	7	9.7	7	47.1	1	11.7	9	20.0	4	0.0	3
7. A brief lecture followed by . . .	14.1	6	16.1	6	32.9	5	20.0	6	13.3	5	0.0	3
8 .100% online classes	3.5	9	3.2	8	27.1	7	16.7	7	0.0	6	0.0	3
9. Hybrid courses	8.2	8	9.7	7	36.5	2	23.3	5	20.0	4	0.0	3

In each of the nine factors that made up the first question, Factor 4, "Hands-on," or practical activities was rated the highest among all group of students except traditional undeclared-major. The traditional undeclared-major student's first choice of teaching technique was Factor 6, "Classroom PowerPoint presentation with textbooks, handouts, and additional resources as necessary." In addition, data reveal that all students agreed that Factor 1, "Internship," was their second most desirable teaching technique with the exception of traditional undeclared-major students. For traditional undeclared-major students' Factor 2, "Mentorship," received the next highest rank after Factor 6.

The data also indicate that Factor 9, "Hybrid courses," was cited least frequently by all students regardless of their major with the exception of traditional undecided-major students. In addition, all students disagreed with Factor 8, "100% online classes"; however, adult students disagreed less.

One student wrote,

> I am a full-time working mother who needs flexibility in my learning schedule, and [do] not require mentors or group study experiences. I am working in the field in which I am studying. My desire is to layer the learning I have with the new knowledge and to achieve/earn my degree.

Analysis of Research Question 2

What types of instructional resources are considered desirable by students in computer science classes [relative to the following 13 factors]?

a) Handouts

b) Note taking

c) Textbook(s)

d) Library book(s) and journals

e) Tutorial service center (offers students and faculty assistance with the teaching and learning of academic courses)

f) Comprehensive course syllabus

g) Use of whiteboard to present information in class

h) Use of Blackboard as a source of communication

i) Computers and other electronic resources (audio/video, links, PowerPoint, slides, and websites) to present information faculty wants students to know

j) Use of computer software and Internet resources for learning

k) Reference book(s) and other printed materials

l) Internet posted video of the instructor presenting a traditional classroom type lecture

m) Hands-on (experimenting with examples in classroom or computer labs)

Tables 15-24 detail the results of responses to the second question. Table 15 represents the number and the percentage of traditional CS-major students who answered Research Question 2. Data in Table 15 reveal that the Factor 13, "Hands-on," or experimenting with examples in classroom or computer lab was marked *strongly desirable* by 75.3% of traditional CS-major students. Factor 10, "Use of computer software and Internet resources for learning," with 50.6%, was the second most ranked by the same group of students. The data indicate that Factor 6, "Comprehensive course syllabus," was also marked strongly desirable by 47.1% of traditional CS-major students.

Table 15

Number and Percentage of Survey Results for Traditional CS-Major Students (n = 85)

Instructional resources	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Handouts	2	2.4	2	2.4	9	10.6	42	49.4	30	35.3
2 .Note-taking	4	4.7	7	8.2	12	14.1	31	36.5	31	36.5
3. Textbook(s)	1	1.2	7	8.2	15	17.6	33	38.8	29	34.1
4. Library books and journals	9	10.6	19	22.4	25	29.4	20	23.5	12	14.1
5. Tutorial service center	6	7.1	3	3.5	20	23.5	29	34.1	27	31.8
6. Comprehensive course syllabus	0	0.0	2	2.4	14	16.5	29	34.1	40	47.1
7. Use of whiteboard to present information in class	2	2.4	6	7.1	13	15.3	36	42.4	28	32.9
8. Use of Blackboard as a source of communication	8	9.4	11	12.9	13	15.3	30	35.3	23	27.1
9. Computers and other electronic resources to present information	5	5.9	7	8.2	10	11.8	32	37.6	31	36.5
10.Use of computer software and Internet resources for learning	1	1.2	4	4.7	10	11.8	27	31.8	43	50.6
11. Reference book(s) and other printed materials	4	4.7	13	15.3	19	22.4	26	30.6	23	27.1
12. Internet posted video of instructor presenting a traditional . . .	12	14.1	14	16.5	21	24.7	17	20.0	21	24.7
13. Hands-on (experimenting with examples in classroom . . .)	2	2.4	1	1.2	3	3.5	15	17.6	64	75.3

The desirable instructional resources for this group were Factor 1, "Handouts," and Factor 7, "Use of whiteboard to present information in class." However, the undesirable factor was found to be Factor 4, "Library books and journals."

Table 16 represents the number and the percentage of adult CS-major students who answered Research Question 2. The data in this table indicate that the factor found to appear most frequently by adult CS-major students was Factor 13, "Hands-on," or experimenting with examples in the classroom or computer lab. This factor was also marked the highest by traditional CS-major students. Other factors strongly supported by this group of students were Factors 6, "Comprehensive course syllabus," and 10, "Computer software and Internet resources for learning."

Factor 1, "Handouts," was marked desirable by 55.0% of adult CS-major students. In fact one student wrote, "Because of travel time I prefer handouts to be given in class or posted in the instructors Website."

Use of whiteboard to present information in class (Factor 7) was another desirable instructional resource for this group. One student wrote, "Presenting information using both visual and auditory method makes class session interactive."

The data also indicate that adult CS-major students were strongly supportive of Factor 5, "Tutorial service center." A student wrote, "On-line tutoring should be available for on-line classes."

Table 16

Number and Percentage of Survey Results for Adult CS-Major Students (n = 60)

Instructional resources	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Handouts	2	3.3	4	6.7	4	6.7	33	55.0	17	28.3
2. Note-taking	3	5.0	9	15.0	8	13.3	23	38.3	17	28.3
3. Textbook(s)	4	6.7	1	1.7	8	13.3	25	41.7	22	36.7
4. Library books and journals	4	6.7	7	11.7	25	41.7	17	28.3	7	11.7
5. Tutorial service center	2	3.3	10	16.7	17	28.3	19	31.7	12	20.0
6. Comprehensive course syllabus	3	5.0	4	6.7	13	21.7	13	21.7	27	45.0
7. Use of whiteboard to present information in class	2	3.3	4	6.7	13	21.7	22	36.7	19	31.7
8. Use of Blackboard as a source of communication	1	1.7	5	8.3	13	21.7	21	35.0	20	33.3
9. Computers and other electronic resources to present information	0	0.0	4	6.7	8	13.3	25	41.7	23	38.3
10. Use computer software and Internet resources for learning	1	1.7	2	3.3	9	15.0	18	30.0	30	50.0
11. Reference books and other printed materials	4	6.7	5	8.3	16	26.7	20	33.3	15	25.0
12. Internet posted video of the instructor presenting . . .	3	5.0	10	16.7	12	20.0	15	25.0	20	33.3
13. Hands-on (experimenting with examples in classroom or . . .)	0	0.0	3	5.0	7	11.7	17	28.3	33	55.0

The most undesirable instructional resources cited by this group of students were Factors 2, "Note taking"; 5, "Tutorial service center"; and 12, "Internet posted video of the instructor presenting a traditional classroom type lecture."

Table 17 represents the number and the percentage of traditional not CS-major students who answered Research Question 2. The data in Table 17 reveal that 71.0% of traditional not CS-major students marked Factor 13, "Hands-on," or experimenting examples in classroom or computer labs most as a *strongly desirable* instructional resource. In addition, Factor 9, "Computer and other electronic resources to present information faculty wants students to know," was cited most (54.8%) as a desirable instructional resource by this group of students. Other desirable instructional resources with high percentages were Factors 1, "Handouts," and 5, "Tutorial service center."

The data in Table 17 also indicate that the most undesirable factors ranked by not CS-major students were Factor 3, "Textbooks," and 12, "Internet posted video of the instructor lecture."

Table 18 represents the number and the percentage of adult not-CS major students who answered Research Question 2.

Table 18 indicates that Factor 13, "Hands-on," with 60.0%, and Factor 4, "Library books and journals," with only 6.7%, were marked the most and least strongly desirable factors respectively by adult not CS-major students. The same group of students marked Factor 4, "Library books, journals, and other printed materials" (6.7%), and Factor 12,

Table 17

Number and Percentage of Survey Results for Traditional Not CS-Major Students (n = 31)

Instructional resources	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Handouts	0	0.0	2	6.5	4	12.9	15	48.4	10	32.3
2. Note taking	2	6.5	3	9.7	4	12.9	14	45.2	8	25.8
3. Textbook(s)	2	6.5	5	16.1	8	25.8	11	35.5	5	16.1
4. Library books and journals	5	16.1	4	12.9	12	38.7	7	22.6	3	9.7
5. Tutorial service center	1	3.2	3	9.7	6	19.4	15	48.4	6	19.4
6. Comprehensive course syllabus	1	3.2	0	0.0	5	16.1	11	35.5	14	45.2
7. Use of whiteboard for lecture	0	0	1	3.2	8	25.8	9	29.0	13	41.9
8. Use of Blackboard as a source of communication	1	3.2	0	0.0	7	22.6	9	29.0	14	45.2
9. Computer and other electronic resources to present information …..	0	0	1	3.2	2	6.5	17	54.8	11	35.5
10. Computer Software and Internet resources for learning	0	0	3	9.7	5	16.1	12	38.7	11	35.5
11. References book(s) and other printed materials	4	12.9	3	9.7	12	38.7	5	16.1	7	22.6
12. Internet posted video of the instructor lecture	3	9.7	5	16.1	8	25.8	8	25.8	7	22.6
13. Hands-on (experimenting with examples in class or computer lab)	1	3.2	0	0.0	0	0.0	5	25.8	22	71.0

Table 18

Number and Percentage of Survey Results for Adult Not CS-Major Students (n = 15)

Instructional resources	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Handouts	0	0.0	2	13.3	1	6.7	5	33.3	7	46.7
2. Note taking	0	0.0	1	6.7	1	6.7	8	53.3	5	33.3
3. Textbook(s)	0	0.0	1	6.7	3	20.0	7	46.7	5	26.7
4. Library books and journals	1	6.7	2	13.3	5	33.3	6	40.0	1	6.7
5. Tutorial service center	0	0.0	2	13.3	3	20.0	5	33.3	5	33.3
6. Comprehensive course syllabus	0	0.0	1	6.7	3	20.0	4	26.7	7	46.7
7. Use of whiteboard to present information in class	0	0.0	2	13.3	3	20.0	4	26.7	6	40.0
8. Use of Blackboard as a source of communication	0	0.0	2	13.3	4	26.7	3	20.0	6	40.0
9. Computer and other electronic resource to present lecture	0	0.0	1	6.7	2	13.3	6	40.0	6	40.0
10. Computer Software and Internet resources for learning	0	0.0	0	0.0	5	33.3	4	26.7	6	40.0
11. Reference books and other printed materials	0	0.0	2	13.3	6	40.0	3	20.0	4	26.7
12. Internet posted video of the instructor lecture	2	33.3	4	26.7	1	6.7	6	40.0	2	13.3
13. Hands-on	0	0.0	1	6.7	1	6.7	4	26.7	9	60.0

"Internet posted video of the instructor presenting a traditional classroom type lecture" (13.3%), least often as *strongly desirable* instructional resources.

Factors cited most often as *undesirable* instructional resources included Factors 12, " Internet posted video of the instructor presenting a traditional classroom type lecture," 1, "Handouts"; 4, "Library books and journals"; 5, "Tutorial service center"; 7, "Use of whiteboard to present information in class"; 8, "Use of Blackboard as a source of communication"; and 11, "Reference books and other printed materials." Almost 40% of adult not CS-major students were *uncertain* regarding Factor 11, "Reference books and other printed materials."

Table 19 represents the number and percentage of traditional undeclared-major students who answered Research Question 2. Table 19 reveals that the most *strongly desirable* instructional resource for this group of students was again Factor 13, "Hands-on," or experimenting with examples in classrooms or computer labs.

A cluster of three factors: Factor 2, "Note taking," 4, "Library books and journals," and 6, "Comprehensive course syllabus," were not marked *strongly desirable* by traditional undecided-major students. However this group of students marked Factor 2, "Note taking" as a desirable instructional resource.

The data in Table 19 also indicate that traditional undeclared-major students were not strongly supportive of Factor 12, "Internet posted video of the instructor presenting a traditional classroom type lecture," as one of the *desirable* instructional resources.

Table 19

Number and Percentage of Survey Results for Traditional Undeclared-Major Students (n = 6)

Instructional Resources	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Handouts	0	0.0	0	0.0	0	0.0	4	66.7	2	33.3
2. Note taking	0	0.0	0	0.0	0	0.0	6	100.0	0	0.0
3. Textbook(s)	0	0.0	1	16.7	1	16.7	2	33.3	2	33.3
4. Library books and journals	0	0.0	0	0.0	4	66.7	2	33.3	0	0.0
5. Tutorial service center	0	0.0	1	16.7	1	16.7	3	50.0	1	16.7
6. Comprehensive course syllabus	0	0.0	0	0.0	1	16.7	5	83.3	0	0.0
7. Use of whiteboard to present information in class	0	0.0	0	0.0	1	16.7	4	66.7	2	33.3
8. Use of Blackboard as a source of communication	0	0.0	2	33.3	1	16.7	1	16.7	2	33.3
9. Computers and other electronic resources to present lecture	0	0.0	0	0.0	2	33.3	3	50.0	1	16.7
10. Computer software and Internet resources for learning	0	0.0	1	16.7	1	16.7	2	33.3	2	33.3
11.Reference books and other printed materials	1	16.7	0	0.0	2	33.3	2	33.3	1	16.7
12. Internet posted video of the instructor lecture	1	16.7	3	50.0	0	0.0	0	0.0	2	33.3
13. Hands-on	0	0.0	0	0.0	1	16.7	2	33.3	3	50.0

Table 20 represents the number and the percentage of adult undeclared-major students who answered Research Question 2. The data in this table reveal that Factor 12, "Internet posted video of the instructor presenting a traditional classroom type lecture," was rated *strongly desirable* by adult undeclared-major students. This group of students was strongly supportive of Factor 13, "Hands-on," or experimenting with examples in classroom or computer labs. Other instructional resource factors were marked either zero or only 25% by this group of students.

Only Factor 8, "Use of Blackboard as a source of communication," was marked by 50.0% of these students as a *desirable* instructional resource. However, Factors 5, "Tutorial service center," and 12, "Internet posted video of the instructor presenting a traditional classroom type lecture," were not cited *desirable* by any adult undeclared-major students. The remaining factors were cited by only 25% of this group of students.

Library book(s) and journals (Factor 4) were marked as a *strongly undesirable* instructional resource by 50.0% of this group. One student wrote, "I am too busy to come to library and read journals. This is the 21st century." The most undesirable instructional resources cited by this group of students were Factors 5, "Tutorial service center," which offers students and faculty assistance with teaching and learning of academic sources, and 7, "Use of whiteboard to present information in class."

Table 20

Number and Percentage of Survey Results for Adult Undeclared-Major Students (n = 4)

Instructional resources	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Handouts	1	25.0	0	0.0	1	25.0	1	25.0	1	25.0
2. Note-taking	1	25.0	0	0.0	1	25.0	1	25.0	1	25.0
3. Textbook(s)	1	25.0	0	0.0	2	50.0	1	25.0	0	0.0
4. Library books and journals	2	50.0	0	0.0	1	25.0	1	25.0	0	0.0
5.Tutorial service center	1	25.0	1	25.0	1	25.0	0	0.0	1	25.0
6. Comprehensive course syllabus	1	25.0	0	0.0	1	25.0	1	25.0	1	25.0
7. Use of Whiteboard to present information in class	1	25.0	1	25.0	1	25.0	1	25.0	0	0.0
8. Use of Blackboard as a source of communication	1	25.0	0	0.0	1	25.0	2	50.0	0	0.0
9. Computer and other electronic resources to present lecture	1	25.0	0	0.0	1	25.0	1	25.0	1	25.0
10. Computer software and Internet resources for learning	1	25.0	0	0.0	1	25.0	1	25.0	1	25.0
11. Reference books and other printed materials	1	25.0	0	0.0	2	50.0	1	25.0	0	0.0
12. Internet posted video of the instructor lecture	1	25.0	0	0.0	0	0.0	0	0.0	3	75.0
13. Hands-on	1	25.0	0	0.0	1	25.0	0	0.0	2	50.0

Table 21 is a combination of Tables 19 and 20, which compares the percentage of traditional and adult CS-major students who answered Research Question 2. Table 21 indicates that the *strongly desirable* marked factors for traditional and adult CS-major students was Factor 13, "Hands-on," or experimenting with examples in classrooms or computer labs," and Factor 10, "Use of computer software and Internet resources for learning." Both groups were not strongly supportive of Factor 4, "Library book(s) and journals."

Two factors, 8, "Use of Blackboard as a source of communication," and 10, "Use computer software and Internet resources for learning," were supported equally as *desirable* instructional resources by both traditional and adult CS-major students. Other factors, such as 2, "Note-taking"; 3, "Textbooks"; 5, "Tutorial service center"; and 11, "Reference books and other printed materials," were cited *desirable,* with the difference not more than 3% by both group of students.

The data in Table 21 reveal that both traditional and adult students disagreed with Factors 2, "Note-taking"; 5, "Tutorial Service Center"; and 13, "Hands-on"; however, adult students disagreed less with these factors when responding to the *desirable* instructional resources. In addition, the data reveal that traditional students agreed less with Factors 3, "Textbook(s)," and 12, "Internet posted video of the instructor presenting a traditional classroom type lecture."

Table 22, which is the combination of Tables 17 and 18, represents the percentage of survey results for not CS-major students when grouped by their age. The factors cited

Table 21

Percentage of Survey Results for Traditional (n = 85) and Adult (n = 60) CS-Major Students

Instructional resources	Strongly undesirable (%)		Undesirable (%)		Uncertain (%)		Desirable (%)		Strongly desirable (%)	
	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25
1. Handouts	2.4	3.3	2.4	6.7	10.6	6.7	49.4	55.0	35.3	28.3
2. Note-taking	4.7	5.0	8.2	15.0	14.1	13.3	36.5	38.3	36.5	28.3
3. Textbook(s)	1.2	6.7	8.2	1.7	17.6	13.3	38.8	41.7	34.1	36.7
4. Library books and journals	10.6	6.7	22.4	11.7	29.4	41.7	23.5	28.3	14.1	11.7
5.Tutorial service center	7.1	3.3	3.5	16.7	23.5	28.3	34.1	31.7	31.8	20.0
6. Comprehensive course syllabus	0.0	5.0	2.4	6.7	16.5	21.7	34.1	21.7	47.1	45.0
7. Use of whiteboard for lecture	2.4	3.3	7.1	6.7	15.3	21.7	42.4	36.7	32.9	31.7
8. Use of Blackboard as a source of comm..	9.4	1.7	12.9	8.3	15.3	21.7	35.3	35.0	27.1	33.3
9. Electronic resources to lecture	5.9	0.0	8.2	6.7	11.8	13.3	37.6	41.7	36.5	38.3
10.Use computers software and Internet..	1.2	1.7	4.7	3.3	11.8	15.0	31.8	30.0	50.6	50.0
11. Reference books and other printed materials	4.7	6.7	15.3	8.3	22.4	26.7	30.6	33.3	27.1	25.0
12 .Internet posted video of the instructor	14.1	5.0	16.5	16.7	24.7	20.0	20.0	25.0	24.7	33.3
13. Hands-on	2.4	0.0	1.0	5.0	3.5	11.7	17.6	28.3	75.3	55.0

strongly desirable by both traditional and adult students not majoring in CS were Factor 13, "Hands-on," and Factor 6, "Comprehensive course syllabus." The least *strongly desirable* factors marked by this group of students were Factors 4, "Library books, journals, and other printed materials," and 11, "Reference book(s) and other printed materials." Factor 6, "Comprehensive course syllabus," was cited equally by both groups of students as a *strongly desirable* instructional resource. The traditional and adult students not majoring in computer science cited Factor 4, "Library books and journals," and Factor 12, "Internet posted of the instructor lecture," as their most *strongly undesirable* factors respectively.

The data in Table 22 indicate that both groups of not CS-major students disagreed with Factor 8, "Use of Blackboard as a source of communication," when they ranked instructional resources as *strongly desirable* choices; however, adult students disagreed less with this factor. In addition, Factors 9, "Computer and other electronic resources to present information faculty wants students to know"; 10, "Use computer software and Internet resources for learning"; and 11, "Reference book(s) and other printed materials," also disagreed by both adult and traditional students not majoring in computer science; however, traditional students disagreed less.

The most undesirable factors by traditional not CS-major students were Factors 3, "Textbook(s)," and 12, "Internet posted video of the instructor presenting a traditional classroom type lecture." However, adult students' most undesirable factor was Factor 12.

Table 22

Percentage of Survey Results for Traditional (n = 31) and Adult (n = 15) Not CS-Major Students

Instructional resources	Strongly undesirable (%)		Undesirable (%)		Uncertain (%)		Desirable (%)		Strongly desirable (%)	
	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25
1. Handouts	0.0	0.0	6.5	13.3	12.9	6.7	48.4	33.3	32.3	46.7
2. Note taking	6.5	0.0	9.7	6.7	12.9	6.7	45.2	53.3	25.8	33.3
3.Textbook(s)	6.5	0.0	16.1	6.7	25.8	20.0	35.5	46.7	16.1	26.7
4. Library books and journals	16.1	6.7	12.9	13.3	38.7	33.3	22.6	40.0	9.7	6.7
5.Tutorial service center	3.2	0.0	9.7	13.3	19.4	20.0	48.4	33.3	19.4	33.3
6. Comprehensive course syllabus	3.2	0.0	0.0	6.7	16.1	20.0	35.5	26.7	45.2	46.7
7. Use of whiteboard for lecture	0.0	0.0	3.2	13.3	25.8	20.0	29.0	26.7	41.9	40.0
8. Use of Blackboard as a source of comm.	3.2	0.0	0.0	13.3	22.6	26.7	29.0	20.0	45.2	40.0
9. Electronic resources to lecture	0.0	0.0	3.2	6.7	6.5	13.3	54.8	40.0	35.5	40.0
10. Use computers software and Internet..	0.0	0.0	9.7	0.0	16.1	33.3	38.7	26.7	35.5	40.0
11. Reference books and other printed materials	12.9	0.0	9.7	13.3	38.7	40.0	16.1	20.0	22.6	26.7
12. Internet posted video of the inst…	9.7	13.3	16.1	26.7	25.8	6.7	25.8	40.0	22.6	13.3
13. Hands-on	3.2	0.0	0.0	6.7	0.0	6.7	25.8	26.7	71.0	60.0

Table 23 is the combination of Tables 19 and 20 and represents the percentage of survey results for undeclared major students when they grouped by their age. The factor cited *strongly desirable* was Factor 13, "Hands-on," by traditional students and Factor 12, "Internet post of the instructor lecture," by adult students. The factors cited least desirable by traditional students were Factors 12, "Internet posted video of the instructor presenting a traditional classroom type lecture," and 11, "References and other printed materials." Both groups cited Factor 11 equally in regard to option *strongly desirable*, but adult students agreed more on Factors 5, "Tutorial service center"; 6, "Comprehensive course syllabus"; 9, "Computer and other electronic resources to present information faculty wants students to know"; and 12, "Internet posted video of the instructor presenting a traditional classroom type lecture."

The factors cited undesirable by adult undeclared-major students were Factors 5, "Tutorial service center," and 7, "Use of whiteboard to present information in class." However, traditional undeclared-major students' undesirable factor was Factor 12, "Internet posted video of the instructor presenting a traditional classroom type lecture."

Research Question 2 Findings

A summary of total combined percentage and ranking (1 = highest), as perceived by all students, is presented in Table 24. Table 24 represents a combined result of *strongly desirable* factors of Tables 21-23 when the percentages are ranked for all groups of students: Column 1, "Traditional Students (T)," and Column 2, "Adult Students (A)."

Table 23

Percentage of Survey Results for Traditional (n = 6) and Adult (n = 4) Undeclared-Major Students

Instructional resources	Strongly undesirable (%)		Undesirable (%)		Uncertain (%)		Desirable (%)		Strongly desirable (%)	
	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25
1. Handouts	0.0	25.0	0.0	0.0	0.0	25.0	66.7	25.0	33.3	25.0
2. Note taking	0.0	25.0	0.0	0.0	0.0	25.0	100.0	25.0	0.0	25.0
3. Textbook(s)	0.0	25.0	16.7	0.0	16.7	0.0	33.3	25.0	33.3	0.0
4. Library books and journals	0.0	25.0	0.0	0.0	66.7	25.0	33.3	25.0	0.0	0.0
5. Tutorial service center	0.0	25.0	16.7	25.0	16.7	25.0	50.0	0.0	16.7	25.0
6. Comprehensive course syllabus	0.0	25.0	0.0	0.0	16.7	25.0	83.3	25.0	0.0	25.0
7. Use of whiteboard for lecture	0.0	25.0	0.0	25.0	16.7	25.0	66.7	25.0	33.3	0.0
8. Use of Blackboard as a source of comm. . . .	0.0	25.0	33.3	0.0	16.7	25.0	16.7	0.0	33.3	0.0
9. Electronic resources to lecture	0.0	25.0	0.0	0.0	33.3	25.0	50.0	25.0	16.7	25.0
10. Computer software and Internet . . .	0.0	25.0	16.7	0.0	16.7	25.0	33.3	25.0	33.3	25.0
11. References and other printed materials	16.7	25.0	0.0	0.0	33.3	0.0	33.3	25.0	16.7	0.0
12. Internet post of the instructor lecture	16.7	25.0	50.0	0.0	0.0	0.0	0.0	0.0	33.3	75.0
13. Hands-on	0.0	25.0	0.0	0.0	16.7	25.0	33.3	0.0	50.0	50.0

Table 24

Order of Preference When Students Are Grouped by Their Age and Major

	Traditional students(T, *n* = 122)						Adult students(A, *n* = 79)					
	CS-major (TCS, *n* = 85)		Not CS-major (TNCS, *n* = 31)		Undeclared (TU, *n* = 6)		CS-major (ACS, *n* = 60)		Not CS-major (ANCS, *n* = 15)		Undeclared (AU, *n* = 4)	
Instructional resources	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank
1. Handouts	35.3	5	32.3	5	33.3	2	28.3	8	46.7	2	25.0	2
2. Note taking	36.5	4	25.8	6	0.0	4	28.3	8	33.3	4	25.0	2
3. Textbook(s)	34.1	6	16.1	9	33.3	2	36.7	5	26.7	5	0.0	3
4. Library books and journal	14.1	11	9.7	10	0.0	4	11.7	11	6.7	7	0.0	3
5. Tutorial service center	31.8	8	19.4	8	16.7	3	20.0	10	33.3	4	25.0	2
6. Comprehensive course syllabus	47.1	3	45.2	2	0.0	4	45.0	3	46.7	2	25.0	2
7. Use of whiteboard for lecture	32.9	7	41.9	3	33.3	2	31.7	7	40.0	3	0.0	3
8. Use of Blackboard as a source of comm. . . .	27.1	9	45.2	2	33.3	2	33.3	6	40.0	3	0.0	3
9. Electronic resources to lecture	36.5	4	35.5	4	16.7	3	38.3	4	40.0	3	25.0	2
10. Use of computer software and Internet	50.6	2	35.5	4	33.3	2	50.0	2	40.0	3	25.0	2
11. Reference book(s) and other printed…	27.1	9	22.6	7	16.7	3	25.0	9	26.7	5	0.0	3
12. Internet posted of the instructor lecture	24.7	10	22.6	7	33.3	2	33.3	6	13.3	6	75.0	1
13. Hands-on	75.3	1	71.0	1	50.0	1	55.0	1	60.0	1	50.0	2

Each column is divided into CS-major, not CS-major, and Undeclared-major respectively.

Considering all factors in Research Question 2, Factor 13, "Hands-on," or experimenting examples in classroom or computer labs was marked more frequently by both traditional and adult students regardless of their major.

Factor 10, "Use of computer software and Internet resources for learning," was among the highest rated factor for traditional and adult CS-major students. The data in this table reveal that both adult and traditional CS-major students agree with Factors 3, "Textbooks"; 6, "Comprehensive course syllabus"; 7, "Use of whiteboard for lecture"; 9, "Electronic resources to lecture"; and 11, "Reference book(s) and other printed materials," almost by ±2%. Both groups disagreed with Factors 2, "Note taking"; 4, "Library books and journals"; and 5, Tutorial service center." However, adult students disagreed less with these factors. In contrast, traditional students disagreed more strongly than adult students with Factors 3, 8, and 12.

Factor 6, "Comprehensive course syllabus," was cited most desirable by traditional and adult students not majoring in CS. "Use of Blackboard as a source of communication," or Factor 8, was strongly supported by the same groups of students. The least frequently cited factor for almost all students was Factor 4, "Library books and journals."

Analysis of Research Question 3

What are the characteristics of an effective computer science instructor at the higher education level [relative to the following 16 factors]?

a) Has in-depth knowledge of the subject material

b) Possesses an attitude that motivates students to learn

c) Has good public speaking and communication skills

d) Provides energy

e) Specifies clear lesson objectives and teaches only those objectives

f) Paces materials for the average learner

g) Provides examples which reinforce theory

h) Has classroom rules and norms that allow students to mentally engage and disengage from classroom awareness

i) Follows well-defined instructional plan which is flexible as class interests dictate

j) Has adequate number of assignments to reinforce instruction

k) Promotes frequent student faculty contact in and out of class

l) Identifies problems that can be solved as a result of the instruction

m) Focuses on practical skills and knowledge that can be used to in solving problems

n) Facilitates learning activities

o) Is friendly and approachable to students and their questions, both in class and office hours

p) Has good rapport with students and other faculty members

The results of responses to the third question are displayed in Tables 25-34. Table 25 represents the number and the percentage of traditional CS-major students who answered Research Question 3.

Table 25 reveals that 89.4% of traditional CS-major students marked that Factor 1, "In-depth knowledge of the subject material," is a *strongly desirable* characteristic for faculty who are teaching CS courses. In addition, this group of students marked Factor 2, "Possesses an attitude that motivates students to learn," 81.2%, and Factor 15, "Friendly and approachable to students and their questions, both in class and office hours," 81.2%, as another *strongly desirable* characteristic of an effective CS faculty. However, Factor 8, "Classroom rules and norms that allow students to mentally engage and disengage from classroom awareness," was the least marked as a *strongly desirable* factor by this group of students. In fact, this factor was marked by 22.4% as an *uncertain* characteristic of an effective CS faculty. More than 22.4% of traditional CS-major students were *uncertain* regarding Factor 11, "Frequent student faculty contact in and out of class."

Table 26 represents the number and percentage of adult CS-major students who answered Research Question 3. The survey results in Table 26 reveal that adult CS-major students marked Factor 1, "In depth knowledge of the subject material," 73.0%; Factor 2, "Possesses an attitude that motivates students to learn," 68.3%; and Factor 15, "Friendly and approachable to students and their questions, both in class and office hours," 65.0% as *strongly desirable* characteristics for an effective CS faculty.

Table 25

Number and Percentage of Survey Results for Traditional CS-Major Students (n = 85)

Characteristics	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Has in-depth knowledge of the subject material	0	0.0	1	1.2	1	1.2	7	8.2	76	89.4
2. Possesses an attitude that motivates students to learn	0	0.0	1	1.2	4	4.7	11	12.9	69	81.2
3. Has a good public speaking and communication skills	0	0.0	0	0.0	8	9.4	18	21.2	59	69.4
4. Provides energy	0	0.0	1	1.2	9	10.6	23	27.1	52	61.2
5. Specifies clear lesson objectives and teaches only to those objectives	4	4.7	5	5.9	11	12.9	28	32.9	37	43.5
6. Paces material for the average learner	1	1.2	4	4.7	11	12.9	29	34.1	40	47.1
7. Provides examples which reinforce theory	0	0.0	2	2.4	4	4.7	21	24.7	58	68.2
8. Has classroom rules and norms allow students to mentally engage . . .	2	2.4	2	2.4	19	22.4	31	36.5	31	36.5
9. Follows well-defined instructional plan which is flexible as class…	0	0.0	1	1.2	2	2.4	25	29.4	57	67.1
10. Has adequate number of assignments to reinforce instruction	1	1.2	2	2.4	10	11.8	31	36.5	41	48.2
11. Promotes frequent student-faculty contact in and out of class	0	0.0	1	1.2	19	22.4	27	31.8	38	44.7
12. Identifies problems that can be solved as a result of instruction	0	0.0	2	2.4	7	8.2	26	30.6	50	58.8
13. Focuses on practical skills and knowledge that can be used . . .	0	0.0	1	1.2	2	2.4	20	23.5	62	72.9
14. Facilitates learning activities	1	1.2	3	3.5	9	10.6	25	29.4	47	55.2
15. Is friendly and approachable to students and their questions, both . . .	0	0.0	1	1.2	5	5.9	10	11.8	69	81.2
16.Has good rapport with students and other faculty members	1	1.2	1	1.2	5	5.9	24	28.2	54	63.5

Table 26

Number and Percentage of Survey Results for Adult CS-Major Students (n = 60)

Characteristics	Strongly not desired		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Has in-depth knowledge of the subject material	2	3.3	2	3.3	2	3.3	10	16.7	44	73.0
2. Possesses an attitude that motivates students to learn	0	0.0	2	3.3	4	6.7	13	21.7	41	68.3
3. Has a good public speaking and communication skills	0	0.0	2	3.3	6	10.0	19	31.7	33	55.0
4. Provides energy	1	1.7	2	3.3	12	20.0	19	31.7	26	43.3
5. Specifies clear lesson objectives and teaches only to those objectives	3	5.0	4	6.7	15	25.0	20	33.3	18	30.0
6. Paces material for the average learner	2	3.3	4	6.7	17	28.3	19	31.7	18	30.0
7. Provides examples which reinforce theory	1	1.7	2	3.3	6	10.0	18	30.0	33	55.0
8. Has classroom rules and norms allow students to mentally engage ….	0	0.0	8	13.3	24	40.0	12	20.0	16	26.7
9. Follows well-defined instructional plan which is flexible as class . . .	2	3.3	4	6.7	6	10.0	20	33.3	28	46.7
10. Has adequate number of assignments to reinforce instruction	0	0.0	0	0.0	10	16.7	28	46.7	22	36.7
11. Promotes frequent student-faculty contact in and out of class	1	1.7	1	1.7	17	28.3	22	36.7	19	31.7
12. Identifies problems that can be solved as a result of instruction	0	0.0	4	6.7	11	18.3	19	31.7	26	43.3
13. Focuses on practical skills and knowledge that can be used . . .	0	0.0	3	5.0	7	11.7	17	28.3	33	55.0
14. Facilitates learning activities	0	0.0	2	3.3	11	18.3	20	33.3	27	45.0
15. Is friendly and approachable to students and their questions, both . . .	1	1.7	3	5.0	6	10.0	11	18.3	39	65.0
16.Has good rapport with students and other faculty members	1	1.7	4	6.7	10	16.7	15	25.0	30	50.0

The *strongly desirable* characteristics least marked by this group of students were Factors 5, "Specify clear lesson objectives and teach only those objectives"; 6, "Introduces material at a pace required for the average learner"; 8, "Classroom rules and norms that allow students to mentally engage and disengage from classroom awareness"; and 11, "Frequent student faculty contact in and out of class." In addition, Factor 8, "Classroom rules and norms that allow students to mentally engage and disengage from classroom awareness," was marked most often as an *undesirable* characteristic by this group of students.

Table 27 represents the number and percentage of traditional not CS-major students who answered Research Question 3. The data in this table reveal that 74.2% of traditional not CS-major traditional students strongly support Factor 15, "Is a friendly and approachable to students and their questions, both in class and office hours." Other factors, such as Factors 2, "Possesses an attitude that motivates students to learn," and 3, "Good public speaking and communication skills," were highly ranked as *strongly desirable* factors by this group of students. However, Factor 11, "Frequent student-faculty contact in and out of class," with 32.3% was marked the least as a *strongly desirable* characteristic of an effective CS faculty.

Traditional not CS-major students marked Factor 12, "Identifies problems that can be solved as a result of the instruction," as the most desirable characteristics of a CS instructor. However, a cluster of three factors, 9, "An instructional plan that is well defined, but flexible as class interests dictate"; 10, "Has adequate number of assignments

Table 27

Number and Percentage of Survey Results for Traditional Not CS-Major Students (n = 31)

Characteristics	Strongly not desired		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1 Has in-depth knowledge of the subject material	0	0.0	1	3.2	1	3.2	8	25.8	21	67.7
2. Possesses an attitude that motivates students to learn	0	0.0	0	0.0	1	3.2	8	25.8	22	71.0
3. Has a good public speaking and communication skills	0	0.0	0	0.0	0	0.0	9	29.0	22	71.0
4. Provides energy	0	0.0	1	3.2	1	3.2	12	38.7	17	54.8
5. Specifies clear lesson objectives and teaches only to those objectives	0	0.0	0	0.0	5	16.1	13	41.9	13	41.9
6. Paces material for the average learner	0	0.0	2	6.5	3	9.7	8	25.8	18	58.1
7. Provides examples which reinforce theory	1	3.2	1	3.2	2	6.5	8	25.8	19	61.3
8. Has classroom rules and norms allow students to mentally engage ….	0	0.0	2	6.5	3	9.7	14	45.2	12	38.7
9. Follows well-defined instructional plan which is flexible as class…	0	0.0	0	0.0	2	6.5	15	48.4	14	45.2
10. Has adequate number of assignments to reinforce instruction	0	0.0	0	0.0	4	12.9	15	48.4	12	38.7
11. Promotes frequent student-faculty contact in and out of class	0	0.0	0	0.0	6	19.4	15	48.4	10	32.3
12. Identifies problems that can be solved as a result of instruction	0	0.0	0	0.0	1	3.2	17	54.8	13	41.9
13. Focuses on practical skills and knowledge that can be used. . ..	0	0.0	1	3.2	4	12.9	6	19.4	20	64.5
14. Facilitates learning activities	0	0.0	0	0.0	2	6.5	10	32.3	19	61.3
15. Is friendly and approachable to students and their questions, both …	0	0.0	0	0.0	1	3.2	7	22.6	23	74.2
16.Has good rapport with students and other faculty members	0	0.0	0	0.0	2	6.5	9	29.0	20	64.5

to reinforce instruction"; and 11, "Frequent student faculty contact in and out of class," were also highly marked as desirable factors for an effective CS instructors by traditional not CS-major students. In fact one student wrote, "The most effective professors organize their presentations and demonstrate clarity, task orientation, and flexibility as they teach."

Table 28 represents the number and percentage of adult not CS-major students who answered Research Question 3. The data in Table 28 indicate that 80.0% of adult not CS-major students rated Factor 2, "Possesses an attitude that motivates students," as a *strongly desirable* characteristic of an effective CS faculty. Of the same group of students, 73.3% marked Factor 1, "Has in depth knowledge of the subject material," and 7, "Paces material for the average learner" as *strongly desirable*. However, Factor 11, "Promotes frequent student faculty contact in and out of class," was marked by the lowest percentage as a *strongly desirable* factor for an effective CS faculty.

Factor 10, "Has adequate number of assignments to reinforce instruction," was marked most often as a *desirable* factor by adult students not majoring in CS. However, this group of students ranked Factor 11, "Promotes frequent student faculty contact in and out of class," as the most *uncertain* factor.

Tables 29 and 30 represent the number and percentage of traditional and adult students whose major was not CS who were taking computer courses during this experiment.

Table 28

Percentage of Survey Results for Adult Not CS-Major Students (n = 15)

Characteristics	Strongly not desired		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Has in-depth knowledge of the subject material	0	0.0	0	0.0	1	6.7	3	20.0	11	73.3
2. Possesses an attitude that motivates students to learn	0	0.0	0	0.0	1	6.7	2	13.3	12	80.0
3 Has a good public speaking and communication skills	0	0.0	0	0.0	1	6.7	4	26.7	10	66.7
4. Provides energy	0	0.0	0	0.0	3	20.0	5	33.3	7	46.7
5. Specifies clear lesson objectives and teaches only to those objectives	0	0.0	0	0.0	4	26.7	3	20.0	8	53.3
6. Paces material for the average learner	0	0.0	0	0.0	3	20.0	4	21.7	8	53.3
7. Provides examples which reinforce theory	0	0.0	0	0.0	1	6.7	3	20.0	11	73.3
8. Has classroom rules and norms allow students to mentally engage ….	0	0.0	0	0.0	5	33.3	3	20.0	7	46.7
9. Follows well-defined instructional plan which is flexible as class…	0	0.0	0	0.0	2	13.3	5	33.3	8	53.3
10. Has adequate number of assignments to reinforce instruction	0	0.0	0	0.0	1	6.7	6	40.0	8	53.3
11. Promotes frequent student-faculty contact in and out of class	0	0.0	0	0.0	7	46.7	4	26.7	4	26.7
12. Identifies problems that can be solved as a result of instruction	0	0.0	0	0.0	4	26.7	5	33.3	6	40.0
13. Focuses on practical skills and knowledge that can be used. . ..	0	0.0	0	0.0	2	13.3	3	20.0	10	66.7
14. Facilitates learning activities	0	0.0	0	0.0	3	20.0	3	20.0	9	60.0
15. Is friendly and approachable to students and their questions, both …	0	0.0	0	0.0	4	26.7	2	13.3	9	60.0
16.Has good rapport with students and other faculty members	0	0.0	0	0.0	2	13.3	5	33.3	8	53.3

Table 29

Number and Percentage of Survey Results for Traditional Undeclared-Major Students (n = 6)

Characteristics	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Has in-depth knowledge of the subject material	0	0.0	0	0.0	0	0.0	0	0.0	6	100.0
2. Possesses an attitude that motivates students to learn	0	0.0	0	0.0	0	0.0	0	0.0	6	100.0
3. Has a good public speaking and communication skills	0	0.0	0	0.0	0	0.0	1	16.7	5	83.3
4. Provides energy	0	0.0	0	0.0	0	0.0	1	16.7	5	83.3
5. Specifies clear lesson objectives and teaches only to those objectives	0	0.0	0	0.0	4	66.7	1	16.7	1	16.7
6. Paces material for the average learner	0	0.0	0	0.0	1	16.7	3	50.0	2	33.3
7. Provides examples which reinforce theory	0	0.0	0	0.0	0	0.0	1	16.7	5	83.3
8. Has classroom rules and norms allow students to mentally engage ….	0	0.0	0	0.0	1	16.7	4	66.7	1	16.7
9. Follows well-defined instructional plan which is flexible as class…	0	0.0	0	0.0	0	0.0	2	33.3	4	66.7
10. Has adequate number of assignments to reinforce instruction	0	0.0	0	0.0	1	16.7	3	50.0	2	33.3
11. Promotes frequent student-faculty contact in and out of class	0	0.0	1	16.7	2	33.3	3	50.0	0	0.0
12. Identifies problems that can be solved as a result of instruction	0	0.0	0	0.0	1	16.7	1	16.7	4	66.7
13. Focuses on practical skills and knowledge that can be used. . ..	0	0.0	0	0.0	0	0.0	3	50.0	3	50.0
14. Facilitates learning activities	0	0.0	0	0.0	1	16.7	2	33.3	3	50.0
15. Is friendly and approachable to students and their questions, both …	0	0.0	0	0.0	0	0.0	0	0.0	6	100.0
16.Has good rapport with students and other faculty members	0	0.0	0	0.0	0	0.0	1	16.7	5	83.3

Table 30

Percentage of Survey Results for Adult Undeclared-Major Students (n = 4)

Characteristics	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Has in-depth knowledge of the subject material	0	0.0	1	25.0	1	25.0	0	0.0	2	50.0
2. Possesses an attitude that motivates students to learn	0	0.0	1	25.0	0	0.0	0	0.0	3	75.0
3. Has a good public speaking and communication skills	1	25.0	0	0.0	0	0.0	0	0.0	3	75.0
4. Provides energy	1	25.0	0	0.0	0	0.0	0	0.0	3	75.0
5. Specifies clear lesson objectives and teaches only to those objectives	0	0.0	1	25.0	0	0.0	2	50.0	1	25.0
6. Paces material for the average learner	1	25.0	0	0.0	1	25.0	2	50.0	0	0.0
7. Provides examples which reinforce theory	1	25.0	0	0.0	1	25.0	1	25.0	1	25.0
8. Has classroom rules and norms allow students to mentally engage ….	2	50.0	1	25.0	2	50.0	0	0.0	1	25.0
9. Follows well-defined instructional plan which is flexible as class . . .	0	0.0	0	0.0	1	25.0	0	0.0	1	25.0
10. Has adequate number of assignments to reinforce instruction	1	25.0	0	0.0	2	50.0	2	50.0	0	0.0
11. Promotes frequent student-faculty contact in and out of class	1	25.0	0	0.0	2	50.0	0	0.0	1	25.0
12. Identifies problems that can be solved as a result of instruction	0	0.0	0	0.0	1	25.0	1	25.0	1	25.0
13. Focuses on practical skills and knowledge that can be used	1	25.0	0	0.0	1	25.0	1	25.0	1	25.0
14. Facilitates learning activities	1	25.0	0	0.0	1	25.0	2	50.0	0	0.0
15. Is friendly and approachable to students and their questions, both …	1	25.0	0	0.0	1	25.0	0	0.0	1	25.0
16.Has good rapport with students and other faculty members	0	0.0	0	0.0	2	50.0	0	0.0	2	50.0

Table 29 represents the number and percentage of traditional undeclared-major students who answered Research Question 3. Table 29 reveals that traditional undeclared-major students ranked Factors 1, "In depth knowledge of the subject material"; 2, "Possesses an attitude that motivated students to learn"; and 15, "Friendly and approachable to students and their questions, both in class and office hours," as the most *strongly desirable* characteristics of an effective CS instructor. However, the same group of students rated Factors 5, "Specify clear lesson objectives and teach only those objectives"; 8, "Classroom rules and norms that allow students to mentally engage and disengage from classroom awareness"; and 11, "Frequent student faculty contact in and out of class," as *strongly desirable* choices marked the least.

Table 30 represents the number and percentage of adult undeclared-major students who answered Research Question 3. The data in Table 30 indicate that 75.0% of adult undeclared-major students strongly support Factors 2, "Possession of an attitude that motivates students to learn"; 3, "Has a good public speaking and communication skills"; and 4, "Provides energy" for a CS instructor to be effective in class.

Adult undeclared-major students did not rank Factors 6, "Paces material for average learner"; 10, "Has adequate number of assignments to reinforce instruction"; and 14, "Facilitates learning activities," as *strongly desirable* characteristics of an effective instructor who is teaching CS courses.

Table 31 is the combination of Tables 25 and 26, which represent the percentage of traditional and adult CS-major students who answered Research Question 3.

Table 31

Percentage of Survey Results for Traditional (n = 85) and Adult (n = 60) CS-Major Students

Characteristics	Strongly undesirable (%)		Undesirable (%)		Uncertain (%)		Desirable (%)		Strongly desirable (%)	
	Age≤24	Age≥25	Age≤24	Age≤24	Age≤24	Age≤24	Age≤24	Age≥25	Age≤24	Age ≥25
1. Has in-depth knowledge of the subject material	0.0	3.3	1.2	3.3	1.2	3.3	8.2	16.7	89.4	73.0
2. Possesses an attitude that motivates students to learn	0.0	0.0	1.2	3.3	4.7	6.7	12.9	21.7	81.2	68.3
3. Has a good public speaking and . . .	0.0	0.0	0.0	3.3	9.4	10.0	21.2	31.7	69.4	55.0
4. Provides energy	0.0	1.7	1.2	3.3	10.6	20.0	27.1	31.7	61.2	43.3
5. Specifies clear lesson objectives and teaches . . .	4.7	5.0	5.9	6.7	12.9	25.0	32.9	33.3	43.5	30.0
6. Paces material for the average learner	1.2	3.3	4.7	6.7	12.9	28.3	34.1	31.7	47.1	30.0
7. Provides examples which reinforce theory	0.0	1.7	2.4	3.3	4.7	10.0	24.7	30.0	68.2	55.0
8. Has classroom rules and norms allow students . . .	2.4	0.0	2.4	13.3	2.4	40.0	36.5	20.0	36.5	26.7
9. Follows well-defined instructional plan …	0.0	3.3	1.2	6.7	2.4	10.0	29.4	33.3	67.1	46.7
10. Has adequate number of assignments to reinforce..	1.2	0.0	2.4	0.0	11.8	16.7	36.5	46.7	48.2	36.7
11. Promotes frequent student-faculty contact . . .	0.0	1.7	1.2	1.7	22.4	28.3	31.8	36.7	44.7	31.7
12. Identifies problems that can be solved as a result	0.0	0.0	2.4	6.7	8.2	18.3	30.6	31.7	58.8	43.3
13. Focuses on practical skills and knowledge used	0.0	0.0	1.2	5.0	2.4	11.7	23.5	28.3	72.9	55.0
14. Facilitates learning activities	1.2	0.0	3.5	3.3	10.6	18.3	29.4	33.3	55.2	45.0
15. Is friendly and approachable to students ..	0.0	1.7	1.2	5.0	5.9	10.0	11.8	18.3	1.2	65.0
16. Has good rapport with students and other faculty	1.2	1.7	1.2	6.7	5.9	16.7	28.2	25.0	63.5	50.0

The survey results in Table 31 indicate that the most *strongly desirable* characteristic of an effective CS faculty rated by traditional and adult CS-major students was Factor 1, "Has in-depth knowledge of the subject material." Other factors, such as 2, "Possesses an attitude that motivates students to learn," and 15, "Friendly and approachable to students and their questions, both in class and office hours," were also rated highly as *strongly desirable* characteristics of an effective CS faculty by the same group of students.

A cluster of three factors 5, "Specifies clear lesson objectives and teaches only those objectives"; 6, "Paces material for the average learner"; and 11, "Promotes frequent student faculty contact in and out of class," were also ranked among the least *strongly desirable* factors for a CS instructor to be effective in class.

Traditional and adult CS-major students ranked Factor 8, "Classroom rules and norms that allow students to mentally engage and disengage from classroom awareness," as their least *strongly desirable* choice. In fact this is the only factor that was rated by these two groups with less than 10.0% difference. However, even though these data reveal that both traditional and adult CS-major students strongly agree with the rest of the factors, adults agreed less.

Traditional CS-major students marked *desirable* only Factors 6, "Paces material for the average learner"; 8, "Has a classroom rules and norms"; and 16, "Has a good rapport with students and other faculty members," higher than adult students. Other characteristics were marked by adult students much higher than traditional students.

Table 32, which is the combination of Tables 27 and 28, represents the percentage of adult and traditional students not majoring in computer science who answered Research Question 3.

Table 32 reveals that traditional not-CS major students ranked Factor 15, "Is friendly and approachable to student and their questions, both in class and office hours," with 74.2% as their *strongly desirable* characteristic of an effective CS instructor. However, adult students not majoring in CS ranked Factor 1, "Has in-depth knowledge of the subject," with 73.3% as their most *strongly desirable* choice.

Both traditional and adult not CS-major students agreed with Factor 11, "Promotes frequent student faculty contact in and out of class," to be their least *strongly desirable* choice; adult students agreed less. In addition, the data indicate that both groups approved Factors 6, "Introduces material at a pace required for the average learner"; 13, "Focuses on practical skills and knowledge that can be used in solving problems"; and 14, "Facilitates learning activities," as *strongly desirable* characteristics of an effective CS faculty within ±4%. While 46.7% of adults not majoring in CS are *uncertain* on Factor 11, only 19.4% of traditional students are supportive of this factor.

Table 33 which is the combination of Tables 29 and 30, represents the percentage of survey results for traditional and adult undeclared-major students.

Table 32

Percentage of Survey Results for Traditional (n = 31) and Adult (n = 15) Not CS-Major Students

Characteristics	Strongly undesirable (%)		Undesirable (%)		Uncertain (%)		Desirable (%)		Strongly desirable (%)	
	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25
1. Has in depth knowledge of the subject material	0.0	0.0	3.2	0.0	3.2	6.7	25.8	20.0	67.7	73.3
2. Possesses an attitude that motivates students to learn	0.0	0.0	0.0	0.0	3.2	6.7	25.8	13.3	71.0	80.0
3. Has a good public speaking and communication skills	0.0	0.0	0.0	0.0	0.0	6.7	29.0	26.7	71.0	66.7
4. Provides energy	0.0	0.0	3.2	0.0	3.2	20.0	38.7	33.3	54.8	46.7
5. Specifies clear lesson objectives and teaches only to those objectives	0.0	0.0	0.0	0.0	16.1	26.7	41.9	20.0	41.9	53.3
6. Paces material for the average learner	0.0	0.0	6.5	0.0	9.7	20.0	25.8	21.7	58.1	53.3
7. Provides examples which reinforce theory	3.2	0.0	3.2	0.0	6.5	6.7	25.8	20.0	61.3	73.3
8. Has classroom rules and norms allow students to mentally engage . . .	0.0	0.0	6.5	0.0	9.7	33.3	45.2	20.0	38.7	46.7
9. Follows well-defined instructional plan which is . . .	0.0	0.0	0.0	0.0	6.5	13.3	48.4	33.3	45.2	53.3
10. Has adequate number of assignments to reinforce . . .	0.0	0.0	0.0	0.0	12.9	6.7	48.4	40.0	38.7	53.3
11. Promotes frequent student-faculty contact in and out of class	0.0	0.0	0.0	0.0	19.4	46.7	48.4	26.7	32.3	26.7
12. Identifies problems that can be solved as a result of instruction	0.0	0.0	0.0	0.0	3.2	26.7	54.8	33.3	41.9	40.0
13. Focuses on practical skills and knowledge that can be used . . .	0.0	0.0	3.2	0.0	12.9	13.3	19.4	20.0	64.5	66.7
14. Facilitates learning activities	0.0	0.0	0.0	0.0	6.5	20.0	32.3	20.0	61.3	60.0
15. Is friendly and approachable to students and their questions . . .	0.0	0.0	0.0	0.0	3.2	26.7	22.6	13.3	74.2	60.0
16.Has good rapport with students and other faculty members	0.0	0.0	0.0	0.0	6.5	13.3	29.0	33.3	64.5	53.3

Table 33

Percentage of Survey Results for Traditional (n = 6) and Adult (n = 4) Undeclared-Major Students

Characteristics	Strongly undesirable (%)		Undesirable(%)		Uncertain(%)		Desirable(%)		Strongly Desirable(%)	
	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25
1. Has in depth knowledge of the subject material	0.0	0.0	0.0	25.0	0.0	25.0	0.0	0.0	100.0	50.0
2. Possesses an attitude that motivates students to learn	0.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	100.0	75.0
3. Has a good public speaking and comm..	0.0	25.0	0.0	0.0	0.0	0.0	16.7	0.0	83.3	75.0
4. Provides energy	0.0	25.0	0.0	0.0	0.0	0.0	16.7	0.0	83.3	75.0
5. Specifies clear lesson objectives and teaches . . .	0.0	0.0	0.0	25.0	66.7	0.0	16.7	50.0	16.7	25.0
6. Paces material for the average learner	0.0	25.0	0.0	0.0	0.0	25.0	0.0	50.0	33.3	0.0
7. Provides examples which reinforce theory	0.0	25.0	0.0	0.0	0.0	25.0	16.7	25.0	83.3	25.0
8. Has classroom rules and norms allow students to . . .	0.0	50.0	0.0	25.0	16.7	50.0	66.7	0.0	16.7	25.0
9. Follows well-defined instructional plan which . . .	0.0	0.0	0.0	0.0	0.0	25.0	33.3	0.0	66.7	25.0
10. Has adequate number of assignments to reinforce . . .	0.0	25.0	0.0	0.0	16.7	50.0	50.0	50.0	33.3	0.0
11. Promotes frequent student-faculty contact . . .	0.0	25.0	16.7	0.0	33.3	50.0	50.0	0.0	0.0	25.0
12. Identifies problems that can be solved as a result . . .	0.0	0.0	0.0	0.0	16.7	25.0	16.7	25.0	66.7	25.0
13. Focuses on practical skills and knowledge . . .	0.0	25.0	0.0	0.0	0.0	25.0	50.0	25.0	50.0	25.0
14. Facilitates learning activities	0.0	25.0	0.0	0.0	0.0	25.0	33.3	0.0	50.0	0.0
15. Is friendly and approachable to students	0.0	25.0	0.0	0.0	0.0	25.0	0.0	0.0	100.0	25.0
16.Has good rapport with students and other . . .	0.0	0.0	0.0	0.0	0.0	50.0	16.7	0.0	83.3	50.0

The results of this table indicate that the most *strongly desirable* factors cited by traditional undecided-major students were Factors 1, "Has in-depth knowledge of the subject"; 2 "Possesses an attitude that motivates students"; and 15, "Is friendly and approachable to students." However, among adult undecided- major students, Factor 2, "Possesses an attitude that motivates students"; Factor 3, "Has a good communication skills"; and Factor 4, "Provides energy," were cited *strongly desirable* more frequently than other factors.

Only three factors, 5, "Specifies clear lesson objectives and teaches only those objectives"; 8, "Has a classroom rules and norms that allow students to mentally engage and disengage from classroom awareness"; and 11, "Promotes frequent student faculty contact in and out of class," were marked *strongly desirable* more frequently by adult students compared with traditional students, other factors were supported much higher by traditional students.

Research Question 3 Findings

A summary of total combined percentage and ranking (1 = highest) as perceived by all students are displayed in Table 34. Table 34 represents a combined result of *strongly desirable* factor of Tables 31-33 when the percentages are ranked for all group of students: Column 1, "Traditional Students (T)," and Column 2, "Adult Students (A)." Each column is divided into CS-major, not CS-major, and Undeclared-major students respectively.

Table 34

Order of Preference When Students Are Grouped by Their Age and Major

Characteristics	Traditional students (T, *n* = 122)						Adult students (A, *n* = 79)					
	CS-major (TCS, *n* = 85)		Not CS-major (TNCS, *n* = 31)		Undeclared (TU, *n* = 6)		CS-major (ACS, *n* = 60)		Not CS-major (ANCS, *n* = 15)		Undeclared (AU, *n* = 4)	
	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank
1. Has in depth knowledge of ….	89.4	1	67.7	3	100	1	73.0	1	73.3	2	50.0	2
2. Possesses an attitude that motivates …..	81.2	2	71.0	2	100	1	68.3	2	80.0	1	75.0	1
3. Has a good public speaking and comm..	69.4	4	71.0	2	83.3	2	55.0	4	66.7	3	75.0	1
4. Provides energy	61.2	8	54.8	7	83.3	2	43.3	8	46.7	6	75.0	1
5. Specifies clear lesson objectives . . .	43.5	14	41.9	9	16.7	6	30.0	11	53.3	5	25.0	3
6. Paces material for the average learner	47.1	12	58.1	6	33.3	5	30.0	11	53.3	5	0.0	4
7. Provides examples which reinforce theory	68.2	5	61.3	5	83.3	2	55.0	4	73.3	2	25.0	3
8. Has classroom rules and norms allow . . .	36.5	15	38.7	10	16.7	6	26.7	12	46.7	6	25.0	3
9. Follows well-defined instructional	67.1	6	45.2	8	66.7	3	46.7	6	53.3	5	25.0	3
10. Has adequate number of assignments	48.2	11	38.7	10	33.3	5	36.7	9	53.3	5	0.0	4
11. Promotes frequent student-faculty . . .	44.7	13	32.3	11	0.0	7	31.7	10	26.7	8	25.0	3
12. Identifies problems that can be solved . . .	58.8	9	41.9	9	66.7	3	43.3	8	40.0	7	25.0	3
13. Focuses on practical skills and . . .	72.9	3	64.5	4	50.0	4	55.0	4	66.7	3	25.0	3
14. Facilitates learning activities	55.2	10	61.3	5	50.0	4	45.0	7	60.0	4	0.0	4
15. Is friendly and approachable to . . .	81.2	2	74.2	1	100	1	65.0	3	60.0	4	25.0	3
16.Has good rapport with students and . . .	63.5	7	64.5	4	83.3	2	50.0	5	53.3	5	50.0	2

The factors cited most frequently in this table included Factor 1, "In depth knowledge of the subject material," by traditional CS-major students; Factor 15, "Is friendly and approachable to students," by traditional not CS-major students; and Factors 1 and 2, "Possesses an attitude that motivates students," and Factor 15 by traditional undecided-major students.

Adult CS-major students ranked Factor 1, "Has in-depth knowledge of the subject," the highest. The same group of students ranked Factor 5, "Specifies clear lesson objectives and teaches only those objectives," the lowest. Among adult not CS-major students, Factor 2, "Possesses an attitude that motivates students," marked the highest and Factor 11, "Promotes frequent student faculty contact in and out of class," was marked the least.

The factors cited most frequently by the adult undeclared-major students were Factors 2-4, and for the same group of students, Factor 10, "Has adequate number of assignments to reinforce instruction," and Factor 14, "Facilitates learning activities," were cited least frequently.

All characteristics of an effective CS faculty considered, Factor 1, "Has in-depth knowledge of the subject"; 2, "Possesses an attitude that motivates students"; and 3, "Is friendly and approachable to students," rated more frequently by all groups. Factors 10, "Has adequate number of assignments to . . . " and 11, "Promotes frequent student faculty contact in and out of class," were rated least frequently by all students.

Analysis of Research Question 4

What motivates students to come back to college [relative to the following 13 factors]?

a) Requirement for continued employment

b) Be better positioned in the event of downsizing

c) Family pressure

d) Friends or relatives

e) Joy of learning

f) Personal fulfillment

g) Acquire knowledge required for self employment

h) Career/job advancement

i) Career change

j) Better positioning for a promotion at work

k) Better positioned to obtain a higher paying job

l) Increased marketability

m) Keeping up to date on new technology

Tables 35-44 represent the result of responses to the fourth question. Table 35 represents the number and the percentage of traditional CS-major students who answered Research Question 4. The survey results in Table 35 indicate that 75.3% of traditional CS-major students cited Factor 8, "Career and job advancement," as their *strongly desirable* motivational factor for coming back to college. In addition, Factors 11, "Better

Table 35

Number and Percentage of Survey Results for Traditional CS-Major Students (n = 85)

Motivation factors	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Requirements for continued employment	9	10.6	2	2.4	11	12.9	21	24.7	42	49.4
2. Be better positioned in the event of downsizing	7	8.2	1	1.2	16	18.8	18	21.2	43	50.6
3. Family pressure	20	23.5	11	12.9	21	24.7	17	20.0	16	18.8
4. Friends/relatives	15	17.6	8	9.4	25	29.4	23	27.1	14	16.5
5. Joy of learning	1	1.2	3	3.5	13	15.3	30	35.3	38	44.7
6. Personal fulfillment	1	1.2	0	0.0	6	7.1	19	22.4	59	69.4
7. Acquire knowledge/ skills required for self employment	3	3.5	3	3.5	14	16.5	16	18.8	49	57.6
8. Career/job advancement	2	2.4	1	1.2	6	7.1	12	14.1	64	75.3
9. Career change	23	27.1	6	7.1	28	32.9	11	12.9	17	20.0
10. Better positioning for a promotion at work	13	15.3	1	1.2	25	29.4	11	12.9	35	41.2
11. Better positioned to obtain a higher paying job	4	4.7	0	0.0	6	7.1	14	16.5	61	71.8
12. Increase marketability	2	2.4	0	0.0	9	10.6	13	15.3	61	71.8
13. Keeping up-to-date on new technology	4	4.7	4	4.7	8	9.4	15	17.6	54	63.5

positioned to obtain a higher paying job," and 12, "Increase marketability," were both marked *strongly desirable* by 71.8% of this group. However, traditional CS-major students were not strongly supportive of Factors 4, "Friend and relatives"; 3, "Family pressure"; and 9, "Career change."

More than 12% of traditional CS-major students cited Factor 3, "Family pressure," as an *undesirable* motivational factor for them to come back to college. The same group of students cited Factor 9, "Career change," 32.9% *uncertain*. The most *desirable* factor cited by this group of students was Factor 5, "Joy of learning."

Table 36 represents the number and percentage of adult CS-major students who answered Research Question 4. The data in Table 36 reveal that the most strongly desirable motivational factor for adult CS-major students to attend college was Factor 6, "Personal fulfillment." Factor 8, "Career/job advancement," was their second *strongly desirable* choice. However, the least *strongly desirable* factor cited by this group of students was 3, "Family pressure." The majority of adult CS-major students cited Factor 4, "Friend/relatives," as one of their *undesirable* motivational factors to make them come back to college. As with traditional CS-major students, Factor 9, "Career change" was cited *uncertain* by most adult CS-major students. The least *desirable* factor for this group was Factor 3, "Family pressure." Table 37 represents the number and percentage of traditional not CS-majors who answered Research Question 4.

Table 36

Number and Percentage of Survey Results for Adult CS-Major Students (n = 60)

Motivation factors	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Requirements for continued employment	4	6.7	4	6.7	17	28.3	16	26.7	19	31.7
2. Be better positioned in the event of downsizing	5	8.3	5	8.3	15	25.0	10	16.7	25	41.7
3. Family pressure	20	33.3	5	8.3	18	30.0	7	11.7	10	16.7
4. Friends/relatives	13	21.7	11	18.3	20	33.3	8	13.3	8	13.3
5. Joy of learning	0	0.0	0	0.0	13	21.7	17	28.3	30	50.0
6. Personal fulfillment	2	3.3	2	3.3	6	10.0	11	18.3	39	65.0
7. Acquire knowledge/skills required for self employment	2	3.3	5	8.3	12	20.0	11	18.3	30	50.0
8. Career/job advancement	2	3.3	2	3.3	4	6.7	15	25.0	37	61.7
9. Career change	4	6.7	9	15.0	24	40.0	8	13.3	15	25.0
10. Better positioning for a promotion at work	3	5.0	5	8.3	17	28.3	12	20.0	23	38.3
11. Better positioned to obtain a higher paying job	4	6.7	0	0.0	5	8.3	16	26.7	35	58.3
12. Increase marketability	4	6.7	1	1.7	10	16.7	13	21.7	32	53.3
13. Keeping up-to-date on new technology	5	8.3	1	1.7	9	15.0	13	21.7	32	53.3

Table 37

Number and Percentage of Survey Results for Traditional not CS-Major Students (n = 31)

Motivation factors	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No	%
1. Requirements for continued employment	1	3.2	0	0.0	2	6.5	8	25.8	20	64.5
2. Be better positioned in the event of downsizing	0	0.0	1	3.2	5	16.1	7	22.6	18	58.1
3. Family pressure	3	9.7	4	12.9	4	12.9	13	41.9	7	22.6
4. Friends/relatives	5	16.1	3	9.7	7	22.6	11	35.5	5	16.1
5 Joy of learning	2	6.5	1	3.2	2	6.5	14	45.2	12	38.7
6. Personal fulfillment	0	0.0	0	0.0	1	3.2	8	25.8	22	71.0
7. Acquire knowledge/ skills required for self employment	0	0.0	0	0.0	5	16.1	6	19.4	20	64.5
8. Career/job advancement	0	0.0	1	3.2	0	0.0	4	12.9	26	83.9
9. Career change	5	16.1	5	16.1	4	12.9	6	19.4	11	35.5
10. Better positioning for a promotion at work	4	12.9	2	6.5	4	12.9	9	29.0	12	38.7
11. Better positioned to obtain a higher paying job	0	0.0	0	0.0	1	3.2	7	22.6	23	74.2
12. Increase marketability	0	0.0	0	0.0	2	6.5	8	25.8	21	67.7
13. Keeping up-to-date on new technology	0	0.0	1	3.2	6	19.4	12	38.7	12	38.7

The data in Table 37 indicate that Factor 8, "Career and job advancement," was marked strongly desirable by 83.9% of traditional not CS-major students. Moreover, Factor 6, "Personal fulfillment," was marked as their second strongly desirable choice. However, the data reveal that traditional not CS-major students were not strongly supportive of Factor 4, "Friends/relatives." The most *desirable* factor cited by this group of students was Factor 5, "Joy of learning."

Factor 9, "Career change," cited by majority of traditional not CS-major students as their most *undesirable* motivational factor to come back to college. In addition, Factors 4, "Friends/relatives"; 7, "Acquire knowledge/ skills required for self employment"; and 13, "Keeping up-to-date on new technology," cited strongly *uncertain* by this group of students.

Table 38 represents the number and percentage of adult not-CS-major students who answered Research Question 4. Table 38 reveals that 93.3% of adult not CS-major students strongly agreed that Factor 8, "Career and job advancement," was a *strongly desirable* reason for them to come back to college. The second most *strongly desirable* choice for this group of students was Factor 2, "Be better positioned in the event of downsizing," which was cited 80.0%. Factor 3, "Family pressure," and Factor 4, "Friends and relatives," with zero and 6.7% respectively were selected by this group of students as their least *strongly desirable* choices of motivation to come back to college. The same factors were also marked as the most *undesirable* reasons by adult not CS-major students.

Table 38

Number and Percentage of Survey Results for Adult Not CS-Major Students (n = 15)

Motivation factors	Strongly undesirable		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Requirements for continued employment	0	0.0	0	0.0	3	20.0	6	40.0	6	40.0
2. Be better positioned in the event of downsizing	0	0.0	0	0.0	2	13.3	1	6.7	12	80.0
3. Family pressure	2	13.3	1	6.7	9	60.0	3	20.0	0	0.0
4. Friends/relatives	1	6.7	1	6.7	9	60.0	3	20.0	1	6.7
5. Joy of learning	0	0.0	0	0.0	2	13.3	4	26.7	9	60.0
6. Personal fulfillment	0	0.0	0	0.0	3	20.0	2	13.3	10	66.7
7. Acquire knowledge/ skills required for self-employment	1	6.7	0	0.0	3	20.0	3	20.0	8	53.3
8. Career/job advancement	0	0.0	0	0.0	0	0.0	1	6.7	14	93.3
9. Career change	1	6.7	0	0.0	4	26.7	0	0.0	10	66.7
10. Better positioning for a promotion at work	0	0.0	0	0.0	3	20.0	3	20.0	9	60.0
11. Better positioned to obtain a higher paying job	0	0.0	0	0.0	4	26.7	3	20.0	8	53.3
12. Increase marketability	0	0.0	0	0.0	2	13.3	5	33.3	8	53.3
13. Keeping up-to-date on new technology	1	6.7	0	0.0	0	0.0	4	26.7	10	66.7

The data in Table 38 also indicate that the most *desirable* factor to motivate this group of students come back to college was Factor 1, "Requirements for continued employment."

Table 39 represents the number and percentage of traditional undeclared-major students who answered Research Question 4. Table 39 shows that, among traditional undeclared-major students, Factor 8, "Career or job advancement," was ranked the highest motivational factor to attend college by almost 100.0%. The second highest motivational factor by this group of students was Factor 12, "Increase marketability." Factors 3, "Family pressure," and 4, "Friends and relatives," were the least *strongly desirable* reasons for this group of students to come back to college. The data in Table 39 also indicates that Factor 4, "Friends and relatives," was the most *undesirable* reason for traditional undecided-major students to return to college.

Table 40 represents the number and percentage of adult undeclared-major students who answered Research Question 4. The data in Table 40 indicate that a cluster of Factors 8-13 ranked as the highest motivational factors for adult undeclared-major students to attend college. The Factors 1, "Requirements for continued employment"; 3, "Family pressure"; and 4, "Friends and relatives," marked the lowest (0.0%) *strongly desirable* reasons for coming back to college by this group of students. In fact, Factors 3, "Family pressure," and 4, "Friends and relatives," were also marked as most *undesirable* factors by adult undeclared-major students.

Table 39

Number and Percentage of Survey Results for Traditional Undeclared-Major Students (n = 6)

Motivation factors	Strongly not desired		Undesirable		Uncertain		Desirable		Strongly desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Requirements for continued employment	0	0.0	0	0.0	1	16.7	1	16.7	3	50.0
2. Be better positioned in the event of downsizing	0	0.0	0	0.0	1	16.7	2	33.3	3	50.0
3. Family pressure	1	16.7	0	0.0	2	33.3	2	33.3	1	16.7
4. Friends/relatives	0	0.0	2	33.3	2	33.3	3	50.0	1	16.7
5. Joy of learning	0	0.0	0	0.0	0	0.0	2	33.3	2	33.3
6. Personal fulfillment	0	0.0	0	0.0	0	0.0	3	50.0	3	50.0
7. Acquire knowledge/ skills required for self employment	0	0.0	0	0.0	2	33.3	1	16.7	3	50.0
8. Career/job advancement	0	0.0	0	0.0	0	0.0	0	0.0	6	100.0
9. Career change	0	0.0	0	0.0	3	50.0	1	16.7	2	33.3
10. Better positioning for a promotion at work	1	16.7	0	0.0	1	16.7	0	0.0	4	66.7
11. Better positioned to obtain a higher paying job	0	0.0	0	0.0	1	16.7	1	16.7	4	66.7
12. Increase marketability	0	0.0	0	0.0	0	0.0	1	16.7	5	83.3
13. Keeping up-to-date on new technology	0	0.0	0	0.0	1	16.7	1	16.7	4	66.7

Table 40

Number and Percentage of Survey Results for Adult Undeclared-Major Students (n = 4)

Motivation factors	Strongly not desired		Undesirable		Uncertain		Desirable		Strongly Desirable	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Requirements for continued employment	1	25.0	0	0.0	2	50.0	1	25.0	0	0.0
2. Be better positioned in the event of downsizing	0	0.0	1	25.0	1	25.0	1	25.0	1	25.0
3. Family pressure	1	25.0	2	50.0	1	25.0	0	0.0	0	0.0
4. Friends/relatives	1	25.0	2	50.0	1	25.0	0	0.0	0	0.0
5. Joy of learning	1	25.0	0	0.0	1	25.0	1	25.0	1	25.0
6. Personal fulfillment	1	25.0	0	0.0	1	25.0	1	25.0	1	25.0
7. Acquire knowledge/ skills required for self employment	1	25.0	0	0.0	2	50.0	0	0.0	1	25.0
8. Career/job advancement	0	0.0	1	25.0	1	25.0	0	0.0	2	50.0
9. Career change	0	0.0	1	25.0	1	25.0	0	0.0	2	50.0
10. Better positioning for a promotion at work	1	25.0	0	0.0	1	25.0	0	0.0	2	50.0
11. Better positioned to obtain a higher paying job	1	25.0	0	0.0	1	25.0	0	0.0	2	50.0
12. Increase marketability	0	0.0	1	25.0	1	25.0	0	0.0	2	50.0
13. Keeping up-to-date on new technology	0	0.0	1	25.0	1	25.0	0	0.0	2	50.0

Table 41, which is a combination of Tables 35 and 36, compares the percentage of CS-major students who answered Research Question 4. Table 41 reveals that Factor 8, "Career and job advancement," was marked the highest by both CS-major traditional and adult students with 75.3% and 61.7% respectively. Both group of students marked Factors 3, "Family pressure"; 4, "Friends and relatives"; and 9, "Career change," as their lowest *strongly desirable* choices.

The data in Table 41 also indicate that traditional CS-major students were strongly supportive of Factor 11, "Better positioned to obtain a higher paying job," and Factor 12, "Increase marketability," by 71.8% each. However, adult CS-major students cited the same factors 58.3 and 53.3% respectively. Two factors that both groups of students were almost agreed (with difference less that 4%) were Factors 6, "Personal fulfillment," and 10, "Better positioning for a promotion at work"; however, adult students agreed more.

Both adult and traditional CS-major students disagreed with Factors 3, "Family pressure," and 4, "Friends and relatives"; however, adult students disagreed less. In fact, both groups cited Factor 4 as their most *undesirable* motivational factor to return to college.

Table 42 is the combination of Tables 37 and 38 and compares the percentage of traditional and adult not CS-major students who answered Research Question 4.

Table 41

Percentage of Survey Results for Traditional (n = 85) and Adult (n = 60) CS-Major Students

Motivation factors	Strongly undesirable (%)		Undesirable (%)		Uncertain (%)		Desirable (%)		Strongly desirable (%)	
	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25
1. Requirements for continued employment	10.6	6.7	2.4	6.7	12.9	28.3	24.7	26.7	49.4	31.7
2. Be better positioned in the event of downsizing	8.2	8.3	1.2	8.3	18.8	25.0	21.2	16.7	50.6	41.7
3. Family pressure	23.5	33.3	12.9	8.3	24.7	30.0	20.0	11.7	18.8	16.7
4. Friends/relatives	17.6	21.7	9.4	18.3	29.4	33.3	27.1	13.3	16.5	13.3
5. Joy of learning	1.2	0.0	3.5	0.0	15.3	21.7	35.3	28.3	44.7	50.0
6. Personal fulfillment	1.2	3.3	0.0	3.3	7.1	10.0	22.4	18.3	69.4	65.0
7. Acquire knowledge/ skills required for self employment	3.5	3.3	3.5	8.3	16.5	20.0	18.8	18.3	57.6	50.0
8. Career/job advancement	2.4	3.3	1.2	3.3	7.1	6.7	14.1	25.0	75.3	61.7
9. Career change	27.1	6.7	7.1	15.0	32.9	40.0	12.9	13.3	20.0	25.0
10. Better positioning for a promotion at work	15.3	5.0	1.2	8.3	29.4	28.3	12.9	20.0	41.2	38.3
11. Better positioned to obtain a higher paying job	4.7	6.7	0.0	0.0	7.1	8.3	16.5	26.7	71.8	58.3
12. Increase marketability	2.4	6.7	0.0	1.7	10.6	16.7	15.3	21.7	71.8	53.3
13. Keeping up-to-date on new technology	4.7	8.3	4.7	1.7	9.4	15.0	17.6	21.7	63.5	53.3

Table 42

Percentage of Survey Results for Traditional (n = 31) and Adult (n = 15) Not CS-Major Students

Motivation factors	Strongly not desired (%)		Undesirable (%)		Uncertain (%)		Desirable (%)		Strongly desirable (%)	
	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25
1. Requirements for continued employment	3.2	0.0	0.0	0.0	6.5	20.0	25.8	40.0	64.5	40.0
2. Be better positioned in the event of downsizing	0.0	0.0	3.2	0.0	16.1	13.3	22.6	6.7	58.1	80.0
3. Family pressure	9.7	13.3	12.9	6.7	12.9	60.0	41.9	20.0	22.6	0.0
4. Friends/relatives	16.1	6.7	9.7	6.7	22.6	60.0	35.5	20.0	16.1	6.7
5. Joy of learning	6.5	0.0	3.2	0.0	6.5	13.3	45.2	26.7	38.7	60.0
6. Personal fulfillment	0.0	0.0	0.0	0.0	3.2	20.0	25.8	13.3	71.0	66.7
7. Acquire knowledge/ skills required for self employment	0.0	6.7	0.0	0.0	16.1	20.0	19.4	20.0	64.5	53.3
8. Career/job advancement	0.0	0.0	3.2	0.0	0.0	0.0	12.9	6.7	83.9	93.3
9. Career change	16.1	0.0	16.1	0.0	12.9	26.7	19.4	0.0	35.5	66.7
10. Better positioning for a promotion at work	12.9	0.0	6.5	0.0	12.9	20.0	29.0	20.0	38.7	60.0
11. Better positioned to obtain a higher paying job	0.0	0.0	0.0	0.0	3.2	26.7	22.6	20.0	74.2	53.3
12. Increase marketability	0.0	0.0	0.0	0.0	6.5	13.3	25.8	33.3	67.7	53.3
13. Keeping up-to-date on new technology	0.0	6.7	3.2	0.0	19.4	0.0	38.7	26.7	38.7	66.7

The data in Table 41 indicate that the *strongly desirable* motivational factor for both not CS-major traditional and adult students was Factor 8, "Career/job advancement." Factors 2, "Be better positioned in the event of downsizing"; 5, "Joy of learning"; 10, "Better positioning for a promotion at work"; and 13, "Keeping up-to-date on new technology," were cited much more *strongly desirable* by adult not CS-major students. However, Factors 1, "Requirements for continued employment"; 7, "Acquire knowledge/skills required for self employment"; 11, "Better positioned to obtain a higher paying job"; and 12, "Increase marketability," were strongly supported by traditional not CS-major students comparing with adult not CS-major students.

Traditional students ranked Factor 4, "Friends/relatives," and Factor 9, "Career change," as their least desired motivational factors to come back to college. However, adult not CS-major students marked Factor 3, "Family pressure," and Factor 4, "Friends and relatives," as their least deciding motivational factors for coming back to college. Of all motivational factors, Factor 6, "Personal fulfillment," was rated more frequently by both traditional and adult not CS-major students.

Table 43 is combination of Tables 39 and 40 and compares the percentage of traditional and adult undeclared-major students. The data in Table 43 reveal that the most desirable motivational factors among traditional undeclared-major students were Factor 8, "Career/job advancement," and Factor 12, "Increase marketability." The same group of students ranked Factor 4, "Friends and relatives," as their least desired motivational factor.

Table 43

Percentage of Survey Results for Traditional (n = 6) and Adult (n = 4) Undeclared-Major Students

Motivation Factors	Strongly undesirable (%)		Undesirable (%)		Uncertain (%)		Desirable (%)		Strongly desirable (%)	
	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25	Age≤24	Age≥25
1. Requirements for continued employment	0.0	25.0	0.0	0.0	16.7	50.0	16.7	25.0	50.0	0.0
2. Be better positioned in the event of downsizing	0.0	0.0	0.0	25.0	16.7	25.0	33.3	25.0	50.0	25.0
3. Family pressure	16.7	25.0	0.0	50.0	33.3	25.0	33.3	0.0	16.7	0.0
4. Friends/relatives	0.0	25.0	33.3	50.0	33.3	25.0	50.0	0.0	16.7	0.0
5. Joy of learning	0.0	25.0	0.0	0.0	0.0	25.0	33.3	25.0	33.3	25.0
6. Personal fulfillment	0.0	25.0	0.0	0.0	0.0	25.0	50.0	25.0	50.0	25.0
7. Acquire knowledge/ skills required for self employment	0.0	25.0	0.0	0.0	33.3	50.0	16.7	0.0	50.0	25.0
8. Career/job advancement	0.0	0.0	0.0	25.0	0.0	25.0	0.0	0.0	100	50.0
9. Career change	0.0	0.0	0.0	25.0	50.0	25.0	16.7	0.0	33.3	50.0
10. Better positioning for a promotion at work	16.7	25.0	0.0	0.0	16.7	25.0	0.0	0.0	66.7	50.0
11. Better positioned to obtain a higher paying job	0.0	25.0	0.0	0.0	16.7	25.0	16.7	0.0	66.7	50.0
12. Increase marketability	0.0	0.0	0.0	25.0	0.0	25.0	16.7	0.0	83.3	50.0
13. Keeping up-to-date on new technology	0.0	0.0	0.0	25.0	16.7	25.0	16.7	0.0	66.7	50.0

The highest ranked factors by adult undeclared-major students were a cluster of factors: 8, “Career/Job advancement”; 9, “Career change”; 10, “Better positioning for a promotion at work”; 11, “Better positioned to obtain a higher paying job”; 12, “Increase marketability”; and 13, “Keeping up-to-date on new technology.” However, the least desirable motivational factors by this group of students were Factor 3, “Family pressure,” and Factor 4, “Friends and relatives.”

The data in Table 40 indicate that only Factor 9, “Career change,” was supported much stronger by adult students. However, even though the data reveal that both adult and traditional undeclared-major students agree with other factors, adult undeclared-major students agreed less.

Research Question 4 Findings

A summary of total combined percentages and ranking (1 = highest) as perceived by all students who answered Research Question 4 are displayed in Table 44. Table 44 represents a summary of total combined results of *strongly desirable* factors of Tables 41-4e when percentages are ranked for all group of students: Column 1,”Traditional Students (TS),” grouped by CS-major (TCS), not CS-major (TNCS), and undeclared (TU) students; Column 2, “Adult Students (AS)” grouped into the same categories as Column 1.

Out of all 13 factors, Factor 8, “Career and job advancement,” rated the highest among all students except CS adult students. The CS adult students gave their highest priority to Factor 6, “Personal fulfillment.” However, considering all factors,

Table 44

Order of Preference When Students Are Grouped by Their Age and Major

Motivation factors	Traditional Students(T, *n* = 85)						Adult Students(A, *n* = 60)					
	CS-major (TCS, *n* = 85)		Not CS-major (TNCS, *n* = 31)		Undeclared (TU, *n* = 6)		CS-major (ACS, *n* = 60)		Not CS-major (ANCS, *n* = 15)		Undeclared (AU, *n* = 4)	
	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank
1. Requirements for continued employment	49.4	7	64.5	5	50.0	4	31.7	8	40.0	6	0.0	3
2. Be better positioned in the event of downsizing	50.6	6	58.1	6	50.0	4	41.7	6	80.0	2	25.0	2
3. Family pressure	18.8	12	22.6	9	16.7	6	16.7	10	0.0	8	0.0	3
4. Friends/relatives	16.5	11	16.1	10	16.7	6	13.3	11	6.7	7	0.0	3
5. Joy of learning	44.7	8	38.7	7	33.3	5	50.0	5	60.0	4	25.0	2
6. Personal fulfillment	69.4	3	71.0	3	50.0	4	65.0	1	66.7	3	25.0	2
7. Acquire knowledge/ skills required for self employment	57.6	5	64.5	5	50.0	4	50.0	5	53.3	5	25.0	2
8. Career/job advancement	75.3	1	83.9	1	100	1	61.7	2	93.3	1	50.0	1
9. Career change	20.0	10	35.5	8	33.3	2	25.0	9	66.7	3	50.0	1
10. Better positioning for a promotion at work	41.2	9	38.7	7	66.7	3	38.3	7	60.0	4	50.0	1
11. Better positioned to obtain a higher paying job	71.8	2	74.2	2	66.7	3	58.3	3	53.3	5	50.0	1
12. Increase marketability	71.8	2	67.7	4	83.3	2	53.3	4	53.3	5	50.0	1
13. Keeping up-to-date on new technology	63.5	4	38.7	7	66.7	3	53.3	4	66.7	3	50.0	1

Factor 3, "Family pressure," and Factor 4, "Friends and relatives," were marked the lowest by all groups of students.

Both traditional and adult CS-major students agreed equally with Factors 2, "Better positioned in the event of downsizing"; 4, "Friends and relatives"; 7, "Acquire knowledge/skills required for self employment"; and 13, "Keep up-to-date on new technology." However, Factors 6, "Personal fulfillment"; 7, "Acquire knowledge/skills required for self employment"; and 8, "Career and job advancement," were marked equally by the traditional and adult not CS-major students.

A cluster of two factors, 3, "Family pressure," and 4, "Friends or relatives," was ranked and cited as occurring most frequently by traditional and adult undeclared-major students.

Analysis of Research Question 5

Are there significant differences between the needs of traditional (18-24 years old) and adult (25 tears and older) students majoring in computer science, relative to all factors in Questions 1-4?

This research question examined significant differences between the needs of adult and traditional CS students in CS classes. A two-tailed, independent-sample *t*-test with 95% confidence interval was conducted to analyze each of the first four research questions. The purpose of the analysis was to determine whether a significant difference existed at the 0.05 level between these two groups.

Table 45

Summary of t-Test to Determine Whether Significant Differences Existed Between Traditional and Adult CS-Major Students (RQ1)

Teaching techniques	Traditional CS-major (TCS, n = 85)		Adult CS-major (ACS, n = 60)		t-value	df	p-value	95% Confidence interval of the mean difference	
	Mean (m_t)	SD	Mean (m_a)	SD				Lower	Upper
1. Internship	4.51	.895	4.15	1.147	2.097	143	.038	.020	.691
2. Mentorship	4.06	1.051	3.77	1.095	1.621	143	.107	-.064	.648
3. Computer-based learning	3.87	1.289	3.80	1.147	.340	143	.735	-.340	.481
4. Hands-on	4.61	.818	4.22	1.075	2.513	143	.013	.084	.706
5. Traditional classroom lecture	3.25	1.253	3.47	1.096	-1.094	143	.276	-.616	.177
6. PowerPoint presentation, with textbooks and	2.86	1.207	3.13	1.228	-1.119	143	.183	-.680	.131
7. Brief lecture followed by class participation	3.44	1.063	3.45	1.199	-1.339	143	.938	-.388	.359
8. 100% online courses	2.00	1.091	2.80	1.447	-.078	143	.000	-1.217	-.383
9. Hybrid classes	2.87	1.213	3.43	1.170	-3.794	143	.006	-.961	-.164

Table 45 represents the results of a two-tailed independent *t*-test when traditional and adult CS-major students answered Research Question 1. Table 45 reveals that there were significant differences between the traditional and adult CS- major students on teaching techniques relative to Factors 1, "Internship"; 4, "Hands-on"; 8, "100% online courses"; and 9, "Hybrid." However, the data indicate that there were no significant differences between these two groups of students relative to other factors in Research Question 1.

Both traditional and adult CS-major students were not strongly supportive of Factor 8, "100% online courses." However, since the mean value for adult students ($m_a = 2.80$) is greater than the mean value of traditional students ($m_t = 2.0$) for this factor, this relationship indicates that adult students disagreed less than traditional CS-major students in regard to Factor 8. In addition, even though the data reveal that both adult and traditional CS-major students agree with Factors 2, "Mentorship"; 5, "Traditional classroom lecture utilizing a whiteboard, textbooks, handouts, and additional instructional resources as necessary"; and 6, "Classroom PowerPoint presentation, with textbooks, handouts and additional resources as necessary," but $m_a > m_t$ for Factors 5 and 6 indicates that adult CS-major students disagreed less-than-traditional CS-major students with these two factors, however, $m_a < m_t$ for Factor 2 implies that adults disagreed more in regard to Factor 2.

Table 46 represents the results of a two-tailed independent *t*-test when traditional and adult CS-major students answered Research Question 2.

Table 46

Summary of t-Test to Determine Whether Significant Differences Existed Between Traditional and Adult CS-Major Students (RQ2)

Instructional resources	Traditional CS-major (TCS, n = 85)		Adult CS-major (ACS, n = 60)		t-value	df	p-value	95% Confidence interval of the mean difference	
	Mean (m_t)	SD	Mean (m_a)	SD				Lower	Upper
1. Handouts	4.13	.870	3.98	.965	.951	143	.343	-.157	.450
2. Note taking	3.92	1.126	3.70	1.183	1.123	143	.263	-.166	.601
3. Textbook(s)	3.96	.981	4.00	1.089	-.205	143	.839	-.378	.307
4. Library books, journals, . . .	3.08	1.207	3.27	1.039	-.958	143	.340	-.565	.196
5. Tutorial service center	3.80	1.142	3.48	1.097	1.671	143	.097	-.058	.691
6. Comprehensive course syllabus	4.26	.819	3.95	1.185	1.875	143	.065	-.020	.638
7. Use of whiteboard for lecture	3.96	.993	3.87	1.049	.572	143	.568	-.241	.437
8. Use of Blackboard as a source of communication	3.58	1.276	3.90	1.020	-1.630	143	.105	-.716	.069
9. Electronic resources to lecture	3.91	1.161	4.12	.885	-1.184	143	.238	-.563	.141
10. Computer software and Internet resources for learning	4.26	.928	4.23	.945	.162	143	.872	-.286	.337
11. References and other printed materials	3.60	1.177	3.62	1.151	-.085	143	.933	-.405	.372
12. Internet posted of the instructor lecture	3.25	1.371	3.65	1.246	-1.809	143	.073	-.843	.037
13. Hands-on	4.62	.816	4.33	.877	2.045	143	.043	.010	.571

Table 46 indicates that there was a significant difference between traditional and adult CS-major students only on Factor 13, "Hands-on," or experimenting examples in classroom or computer labs. The highest *p*-value was obtained by Factors 3, "Textbook(s)"; 10, "Use computer software and Internet resources for learning"; and, 11, "References and other printed materials." Both traditional and adult CS-major students' means for Factors 10 and 11 were almost the same, which indicates that both groups of students support these two instructional resources equally. However, $m_a < m_t$ for Factor 3 indicates that adult CS-major students disagree more of this factor in compare with traditional CS-major students.

Table 47 represents the result of a two-tailed independent *t*-test when traditional and adult CS-major students answered Research Question 3. The results in Table 47 show there is no significant difference between traditional and adult CS-major students regarding Factors 2, "Possesses an attitude that motivates students to learn"; 3,"Good public speaking and communication skills"; 5,"Specify clear lesson objectives and teach only those objectives"; 7,"Provids different examples which reinforce theory"; 10, "Adequate number of assignments to reinforce instruction"; 11, "Frequent student faculty contact in and out of class"; and 14, "Facilitates learning activities." However, there were significant differences between these two groups regarding other factors in the table.

Table 47

Summary of t-Test to Determine Whether Significant Differences Existed Between Traditional and Adult CS-Major Students (RQ3)

Characteristics of an effective CS instructor	Traditional CS-major (TCS, n = 85)		Adult CS-major (ACS, n = 60)		t-value	df	p-value	95% Confidence interval of the mean difference	
	Mean (m_t)	SD	Mean (m_a)	SD				Lower	Upper
1. Has in-depth knowledge of the subject	4.86	.467	4.53	.965	2.697	143	.008	.087	.564
2. Possesses an attitude that motivates students	4.74	.601	4.55	.769	1.680	143	.095	-.034	.416
3. Has good communication skills	4.60	.658	4.38	.804	1.779	143	.077	-.024	.457
4. Provides energy	4.48	.734	4.12	.958	2.601	143	.010	.088	.644
5. Specifies clear lesson objectives and . . .	4.05	1.112	3.77	1.110	1.497	143	.137	-.090	.651
6. Introduces materials at a pace ..	4.21	.927	3.78	1.059	2.583	143	.011	.101	.756
7.Provides different examples which reinforce theory	4.59	.695	4.33	.914	1.906	143	.059	-.009	.519
8.Clas room rules and norms ….	4.02	.951	3.60	1.028	2.554	143	.012	.096	.751
9.Flexible and well instructional plan	4.62	.597	4.13	1.065	3.532	143	.001	.216	.765
10.Adequate number of assignments to …..	4.28	.854	4.20	.708	.613	143	.541	-.183	.348
11.Frequent student-faculty contact in and out of class	4.20	.828	3.95	.910	1.718	143	.088	-.038	.538
12.Identifies problems that can be solved as a result of ….	4.46	.749	4.12	.940	2.435	143	.016	.064	.620
13.Focuses on practical skills and ..	4.68	.582	4.33	.877	2.882	143	.005	.110	.588
14.Facilitates learning activities	4.34	.894	4.20	.860	.952	143	.343	-.152	.434
15.Friendly and approachable to students	4.73	.625	4.40	.978	2.474	143	.015	.066	.593
16.Has a good rapport with …..	4.52	.766	4.15	1.039	2.454	143	.015	.072	.664

The minimum *p*-value of 0.001 for Factor 9, "An instructional plan that is well defined, but flexible as class interests dictate," indicates that there was a significant difference between traditional and CS-major students regarding this factor. However, since the mean value for traditional students (m_t) is greater than the mean value for adult students (m_a) in regard to Factor 9, this inequality indicates that traditional students disagreed less than adults on this factor. As one traditional student wrote, "Comprehensive instructional strategy that tailors instruction to all groups of students is a vital characteristic of an effective teacher." The highest *p*-value of .541 for Factor 10, "Adequate number of assignments to reinforce instruction," indicates that this group of students is strongly supportive of this factor.

Data in Table 48 represent the result of a two-tailed independent *t*-test when traditional and adult CS-major students answered Research Question 4. The data in this table indicate that there is a significant difference between traditional and adult CS-major students relative to Factor 12, "Increase marketability." However, since the mean value for adult students (m_a) is less than the mean value for traditional students (m_t) in regard to Factor 12, traditional students disagreed less than adult students regarding this factor. There were no significant differences between these groups of students regarding other factors.

Table 48

Summary of t-Test to Determine Whether Significant Differences Existed Between Traditional and Adult CS-Major Students (RQ4)

Motivation factors	Traditional CS-major (TCS, $n = 85$)		Adult CS-majors (ACS, $n = 60$)		t-value	df	p-value	95% Confidence interval of the mean difference	
	Mean (m_t)	SD	Mean (m_a)	SD				Lower	Upper
1.Requirements for continued employment	4.00	1.300	3.70	1.183	1.420	143	.158	-.118	.718
2. Be better positioned in the event of downsizing	4.05	1.224	3.75	1.310	1.398	143	.164	-.123	.717
3. Family pressure	2.98	1.431	2.70	1.465	1.135	143	.256	-.205	.758
4. Friends/relatives	3.15	1.314	2.78	1.303	1.674	143	.096	-.067	.806
5. Joy of learning	4.19	.906	4.28	.804	-.651	143	.516	-.384	.193
6. Personal fulfillment	4.59	.729	4.38	1.027	1.406	143	.162	-.083	.493
7. Acquire knowledge/skills required for self-employment	4.24	1.076	4.03	1.164	1.076	143	.284	-.169	.573
8.Career/job advancement	4.59	.863	4.38	.993	1.322	143	.188	-.101	.511
9.Career change	2.92	1.449	3.35	1.205	-1.894	143	.060	-.884	.019
10.Better positioning for a promotion at work	3.64	1.421	3.78	1.195	-.659	143	.511	-.592	.296
11.Better positioned to obtain a higher paying job	4.51	.983	4.30	1.094	1.185	143	.238	-.138	.549
12.Increase marketability	4.54	.864	4.13	1.171	2.410	143	.017	.073	.742
13.Keep up-to-date on new technology	4.31	1.124	4.10	1.231	1.044	143	.298	-.184	.596

Factor 5,"Joy of learning," with highest *p*-value and $m_t < m_a$ indicates that although there was no significant difference subject to this factor, traditional students disagreed more than adults. Factor 9, "Career change," with a *p*-value of .060, which is very close to the .05 level of risk, provides moderate evidence that these two groups of students disagree that this factor motivates them to come back to college.

Research Question 5 Findings

This study found the following in response to Research Question 5. Data in Table 45 reveal that there were significant differences between the traditional and adult CS-major students on *teaching techniques* relative to Factors 1,"Internship," 4, "Hands-on," 8, "100% online courses," and 9, "Hybrid." However, for remaining teaching technique methods there were no significant differences between these two groups.

Regarding *instructional resources*, data in Table 46 indicate that there was a significant difference between traditional and adult CS-major students on Factor 13, "Hands-on," or experimenting examples in classroom or computer labs. Other instructional resources were highly supported by both groups. The results in Table 46 indicate that there were no significant differences between traditional and adult CS-major students on other instructional resources.

Considering the *characteristics of an effective CS faculty*, the data in Table 47 indicate that there were no significant differences between traditional and adult CS-major students relative to Factors 2, "Possesses an attitude that motivates students to learn"; 3, "Has a good public speaking and communication skills"; 7, "Provides examples which

reinforce theory"; 10, "Has adequate number of assignments to reinforce instruction"; 11, "Promotes frequent student faculty contact in and out of class"; and 14, "Facilitates learning activities." However, there were significant differences between these two groups regarding other characteristics of an effective computer science faculty.

Relative to all *motivational* factors, the only factor with a significant difference between traditional and adult CS-major students was Factor 12, "Increase marketability." The data also indicate that for factors other than 12 there were no significant differences between these groups of students (Table 48).

Analysis of Research Question 6

Are there significant differences between the needs of traditional (18-24 years old) and adult (25 years and older) not CS-major students in computer science classes, relative to all factors in Questions 1-4?

This research question examined the significance differences between the needs of adult and traditional not CS-major students in CS classes. A two-tailed, independent-samples *t*-test with 95% confidence interval was conducted to analyze each of the first four research questions to determine whether a significant difference existed at the 0.05 level between these two groups.

The results of a two-tailed independent-sample *t*-test for traditional and adult not CS-major students who answered Research Question 1 are tabulated in Table 49.

Table 49

Summary of *t*-Test to Determine Whether Significant Differences Existed Between Traditional and Adult Not CS-Major in Research Question 1

Teaching techniques	Traditional not CS-major (TNCS, $n = 31$)		Adult not CS-major (ANCS, $n = 15$)		*t*-value	*df*	*p*-value	95% confidence interval of the mean difference	
	Mean (m_t)	*SD*	Mean (m_a)	*SD*				Lower	Upper
1. Internship	4.35	.661	3.87	1.246	1.744	44	.088	-.076	1.052
2. Mentorship	4.03	.875	3.53	.915	1.786	44	.081	-.064	1.062
3. Computer-based learning	4.13	.922	3.87	1.060	.862	44	.393	-.351	.876
4. Hands-on	4.58	.502	4.53	.743	.255	44	.800	-.326	.421
5. Traditional classroom lecture	3.52	1.061	3.27	1.163	.725	44	.472	-.44	.943
6. PowerPoint presentation with textbooks . . .	3.52	.962	3.67	.976	-.495	44	.623	-.763	.462
7. Brief lecture followed by class participation	3.61	.955	3.07	1.163	1.693	44	.097	-.104	1.196
8. 100% online	2.29	1.071	2.40	1.121	-.321	44	.750	-.799	.579
9. Hybrid courses	3.23	1.146	3.40	1.056	-.495	44	.623	-.883	.535

The data in Table 46 show that there were no significant differences on the type of teaching techniques among all traditional and adult not CS-major students. However, the highest *p*-value of .800 for Factor 4, "Hands on," or practical activities in classroom or computer labs indicates that both group of students strongly support this teaching technique. The mean for both groups for this question was almost the same, which indicates that both groups prefer "Hands on" teaching technique equally. The minimum *p-value* in Table 49 was for Factor 2, "Mentorship," with m_t (4.03) > m_a (3.53), which indicates that traditional students disagreed less with this factor.

Table 50 represents the results of a two-tailed independent-sample *t*-test for traditional and adult not CS-major students who answered Research Question 2. The results in Table 50 indicated that there were no significant differences between adult and traditional not CS-major students relative to all instructional resource factors. Even though there are no significant differences relative to Factors 1 and 10, but for both factors the mean value of traditional students (m_t) is less than the mean value of adult students (m_a), this relationship between m_t and m_a indicates that traditional students agreed less in regard to Factors 1 and 10. In addition, Factor 6, "Comprehensive course syllabus," with highest *p*-value indicates $m_t > m_a$, that is adults agreed more on this factor than traditional not CS-major students.

Table 51 represents the results of a two-tailed independent *t*-test for traditional and adult not CS-major students who answered Research Question 3.

Table 50

Summary of t-Test to Determine Whether Significant Differences Existed Between Traditional and Adult Not CS-Major Students in Research Question 2

Instructional Resources	Traditional not CS-major (TNCS, $n = 31$)		Adult not CS-major (ANCS, $n = 15$)		*t*-value	*df*	*p*-value	95% Confidence interval of the mean difference	
	Mean (m_t)	SD	Mean (m_a)	SD				Lower	Upper
1. Handouts	4.06	.854	4.13	1.060	-.237	44	.814	-.655	.517
2. Note taking	3.74	1.154	4.13	.834	-1.171	44	.248	-1.065	.282
3. Textbook(s)	3.39	1.145	3.93	.884	-1.625	44	.111	-1.224	.131
4. Library books, journals,…	2.97	1.197	3.27	1.033	-.828	44	.412	-1.026	.428
5. Tutorial service center	3.71	1.006	3.87	1.060	-.488	44	.628	-.806	.492
6. Comprehensive course syllabus	4.19	.946	4.13	.990	.199	44	.843	-.548	.669
7. Use of whiteboard for lecture	4.10	.908	3.93	1.100	.534	44	.596	-.453	.780
8. Use of Blackboard as a source of communication	4.13	.991	3.87	1.125	.805	44	.425	-.394	.919
9. Electronic resources to lecture	4.23	.717	4.13	.915	.374	44	.710	.092	-.405
10. Computer software and Internet resources for learning	4.00	.966	4.07	.884	-.225	44	.823	-.663	.530
11. Reference and other printed materials	3.26	1.290	3.60	1.056	-.891	44	.378	-1.116	.432
12. Internet posted of the instructor lecture	3.35	1.279	3.13	1.356	.540	44	.592	-.605	1.048
13. Hands-on	4.61	.803	4.40	.910	.807	44	.424	-.319	.745

Table 51

Summary of t-Test to Determine Whether Significant Differences Existed Between Traditional and Adult Not CS-Major Students in Research Question 3

Characteristics of an effective CS instructor	Traditional Not CS-major (TNCS, $n = 31$)		Adult Not CS-major (ANCS, $n = 15$)					95% Confidence interval of the mean difference	
	Mean (m_t)	*SD*	Mean (m_a)	*SD*	*t*-value	*df*	*p*-value	Lower	Upper
1. Has in-depth knowledge of the subject	4.58	.770	4.67	.617	-.397	44	.693	-.523	.351
2. Possesses an attitude that motivates students	4.68	.541	4.73	.594	-.319	44	.752	-.410	.298
3. Has good communication skills	4.71	.461	4.60	.632	.668	44	.508	-.221	.441
4. Provides energy	4.26	.729	4.27	.884	.786	44	.436	-.289	.659
5. Specifies clear lesson objectives and ….	4.26	.729	4.27	.884	-.035	44	.972	-.504	.487
6. Introduces materials at a pace ..	4.35	.915	4.33	8.16	.077	44	.939	-.539	.582
7. Provides different examples which reinforce theory	4.39	.989	4.67	.617	-1.001	44	.322	-.842	.283
8. Has class room rules and norms ….	4.16	.860	4.13	.915	.101	44	.920	-.529	.585
9. Follows well-defined plan but flexible as class interest…	4.39	.615	4.40	.737	-.063	44	.950	-.429	.403
10. Has adequate number of assignments to reinforce…	4.26	.682	4.47	.640	-.992	44	.327	-.632	.215
11. Promotes frequent student-faculty contact in and ….	4.13	.718	3.80	.862	1.364	44	.180	-.157	.815
12. Identifies problems that can be solved as a result of …….	4.39	.558	4.13	.834	1.225	44	.227	-.164	.671
13. Focuses on practical skills and knowledge that can be....	4.45	.850	4.53	.743	-.318	44	.752	-.600	.437
14. Facilitates learning activities	4.55	.624	4.40	.828	.678	44	.501	-.292	.589
15. Is friendly and approachable to students	4.71	.529	4.33	.900	1.787	44	.081	-.048	.801
16. Has good rapport with students and other faculty . .	4.58	.620	4.40	.737	.871	44	.389	-.238	.599

The data in Table 51 reveal that there are no significant differences between traditional and adult not CS-major students relative to all factors listed for the characteristics of an effective CS faulty in this table. The maximum *p*-value of .971 belongs to Factor 5, "Specifies clear lesson objectives and teaches only those objectives," with the mean value ($m_t = 4.26$), which is almost equal to the mean value of adult students ($m_a = 4.27$). This relationship between m_t and m_a indicates that both groups agreed with Factor 5 equally. However, the minimum *p*-value belongs to Factor 15, "Is friendly and approachable to students and their questions, both in class and office hours." However, for this factor $m_t\,(4.71) > m_a\,(4.33)$ indicates that adult students agreed more than traditional not CS-major students in regard to Factor 15.

Table 52 represents the results of a two-tailed independent *t*-test for traditional and adult not CS-major students who answered Research Question 4. The results in Table 52 indicate that Factor 11, "Better positioned to obtain a higher paying job," was the only factor with *p*-value less than 0.05. This result provides strong evidence that there is a significant difference between traditional and adult not CS-major students on this motivational factor. However, other *p*-values in this table indicate that there are no other significant differences between these two groups of students.

Table 52

Summary of t-Test to Determine Whether Significant Differences Existed Between Traditional and Adult Not CS-Major Students in Research Question 4

Motivation factors	Traditional not CS-major (TNCS, n = 31)		Adult not CS-major (ANCS, n = 15)		t-value	df	p-value	95% Confidence interval of the mean difference	
	Mean (m_t)	SD	Mean (m_a)	SD				Lower	Upper
1. Requirements for continued employment	4.48	.890	4.20	.775	1.056	44	.297	-.258	.826
2. Be better positioned in the event of downsizing	4.35	.877	4.67	.724	-1.192	44	.240	-.839	.215
3. Family pressure	3.55	1.261	2.87	.915	1.865	44	.069	-.055	1.418
4. Friends/relatives	3.26	1.316	3.13	.915	.330	44	.743	-.638	.887
5. Joy of learning	4.06	1.093	4.47	.743	-1.284	44	.206	-1.033	.229
6. Personal fulfillment	4.68	.541	4.47	.834	1.033	44	.307	-.200	.622
7. Acquire knowledge/skills required for self employment	4.48	.769	4.13	1.187	1.208	44	.234	-.234	.936
8. Career/job advancement	4.77	.617	4.93	.258	-.955	44	.345	-.495	.177
9. Career change	3.42	1.523	4.20	1.265	-1.717	44	.093	-1.697	.136
10. Better positioning for a promotion at work	3.74	1.390	4.40	.828	-1.689	44	.098	-1.443	.127
11. Better positioned to obtain a higher paying job	4.71	.529	4.27	.884	2.126	44	.039	.023	.863
12. Increase marketability	4.61	.615	4.40	.373	1.031	44	.308	-.203	.629
13. Keeping up-to-date on new technology	4.13	.846	4.47	1.060	-1.167	44	.249	-.921	.245

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Research Question 6 Findings

The data in Table 49 revealed that there were no significant differences on the type of *teaching techniques* among traditional and adult not CS-major students.

The results in Table 50 indicated that there were no significant differences between adult and traditional not CS-major students relative to all *instructional resources* factors.

The data in Table 51 provided that there were no significant differences between traditional and adult not CS-major students relative to all factors listed for the *characteristics of an effective CS faulty*.

The results in Table 52 indicated there is a significant difference between traditional and adult not CS-major students relative to *motivational* Factor 11, "Better positioned to obtain a higher paying job." However, there were no significant differences between these two groups of students relative to other motivational factors.

Findings Summary

When all factors are considered, the following conclusions can be drawn:

Research Question 1

Traditional CS-major students strongly preferred the "Hands-on" teaching technique over the other techniques. The same group of students reported that their least undesirable teaching technique was "100% online classes" (Table 5).

Adult CS-major students strongly preferred the "Hands-on" teaching technique. The same group of students reported that their least desirable teaching technique was "Classroom PowerPoint presentation with textbooks, handouts, and additional resources as necessary" (Table 6).

Traditional not CS-major students were in strong support of the factor, "Hands-on," or practical activities. However, the same group of students rated factor, "100% online classes," as their least desirable teaching technique (Table 7).

Adult not CS-major students were strongly supported the "Hands on" factor, but they weakly supported factor, "100% online classes" (Table 8).

Traditional undeclared-major student's most desirable teaching techniques were a cluster of three techniques: "Computer-based learning," "Hands on," and "Traditional classroom lecture" (Table 9).

Adult undeclared-major students rated factors "Computer-based learning," "Hands-on," and "Traditional classroom lecture" as strongly desirable teaching techniques. The same group of students ranked "Classroom PowerPoint presentation," "A brief lecture followed by class participation," "100% online classes," and "Hybrid courses" as their least desired factors (Table 10).

Research Question 2

Traditional CS-major students marked "Hands-on" or experimenting examples in classroom or computer labs as most strongly desirable factor. However, the most

undesirable cited factor for this group of students was found to be Factor 4, "Library books and journals" (Table 15).

Adult CS-major students also cited "Hands-on" more frequently than any other factor. Other factors marked high by this group of students were Factors 6, "Comprehensive course syllabus," and 10, "Use of computer software and Internet resources for learning." The most undesirable instructional resources cited by adult CS-major students were Factors 5, "Tutorial service center," and 12, "Internet posted video of the instructor presenting a traditional classroom type lecture" (Table 16).

Traditional not CS-major students most preferred instructional resource was "Hands-on." The least desirable factor for this group of students were Factors 3, "Textbooks," and Factor 4, "Library books and journals," as the highest and lowest instructional resources respectively. Factors cited as most undesirable instructional resources included Factors 1, "Handouts"; 2, "Note taking"; 5, "Tutorial service center"; 7, "Use of whiteboard to present information in class"; 8, "Use of Blackboard as a source of communication"; 11, "Textbooks and reference books available in the library"; and 12, "Internet posted of the instructor lecture" (Table 18).

Traditional undeclared-major students' most desirable instructional resources were again the factor "Hands-on" or experimenting examples in classroom or computer labs. "Internet posted of the instructor presenting a traditional classroom type lecture" and "Textbooks which also serve as future reference" were the most undesirable factors for the same group of students (Table 19).

Adult undeclared-major students selected "Hands-on" as their most desirable instructional resource. However, "Use of whiteboard to present information in class" was rated their least desirable factor (Table 20).

Research Question 3

Traditional CS-major students ranked Factor 1, "Has in-depth knowledge of the subject material," as their most desirable characteristic of an effective CS instructor. This group also ranked Factor 2, "Possesses an attitude that motivates students," and Factor 15, "Friendly and approachable to students and their questions, both in class and office hours," as their most strongly desirable factors. However, "Has classroom rules and norms that allow students to mentally engage and disengage from classroom awareness" ranked the least desired factor by the same group of students (Table 25).

Adult CS-major students ranked "Has in-depth knowledge of the subject material" with the highest percentage and "Has classroom rules and norms that allow students to mentally engage and disengage from classroom awareness" with the lowest percentage as their most and least desirable characteristics of an effective CS instructor respectively. A cluster of factors, "Specify clear lesson objectives and teach only those objectives," "Paces materials for the average learner," and "Has adequate number of assignments to reinforce instruction," received low percentage ranking by this group of students (Table 26).

Traditional not CS-major students strongly supported Factor 15, "Friendly and approachable to students and their questions, both in class and office hours," but their

least characteristic factor was, “Promotes frequent student faculty contact in and out of class” (Table 27).

Adult not CS-major students strongly supported the factor, “Possesses an attitude that motivates students,” as a characteristic of an effective CS instructor. The same group of students ranked the factor, “Promote frequent student faculty contact in and out of class,” as their least desirable factor (Table 28).

Traditional undeclared-major students ranked factors, “In depth knowledge of the subject material,” and “Possesses an attitude that motivates students,” as the most desirable characteristics of an effective CS instructor. However, the same group of students rated factor, “Promotes frequent student faculty contact in and out of class,” as their least desirable factor (Table 29).

Adult not CS-major students strongly supported “Possesses an attitude that motivates students,” “Good communication skills,” and “Provides energy” for a CS instructor to be effective in class (Table 30).

Research Question 4

Traditional CS-students ranked factor “Career and job advancement” as their most desirable motivational factor for coming back to college. Factors “Friends and relatives,” ”Family pressure,” and “Career change” were marked the least desirable by the same group of students (Table 35).

Adult CS-major students' most desirable motivational factor was factor "Personal fulfillment." For this group of students, the factor "Friends and relatives" ranked the lowest (Table 36).

Traditional not CS-major students cited "Career and job advancement" as a *strongly desirable* factor. However, the least-cited factors for this group were "Family pressure" and "Friends and relatives" (Table 37).

Adult not CS- major students strongly agreed that the factor, "Career and job advancement," was a reason for them to come back to college. Factors, "Family pressure" and "Friends and relatives," were selected by this group of students as the least *strongly desirable* choices of motivation to come back to college (Table 38).

Traditional undeclared-major students selected "Career or job advancement" as their highest motivational factor to attend college. The second highest motivation factor by this group of students was the factor "Increase marketability." Motivational factors with minimum percentages were "Family pressure" and "Friends and relatives" for the same group (Table 39).

Adult undeclared-major students marked a cluster of Factors 8-13 as the highest motivational factors; however, Factors 1, 3, and 4 were marked the lowest desirable reasons for coming back to college (Table 40).

Research Question 5

For traditional and adult CS-major students, there were significant differences between these two groups on teaching techniques relative to factors "Internship,"

"Hands-on classes," and "Hybrid courses." The data show that both adult and traditional CS-major students were not strongly supportive of "100% online courses." However, the mean value of adult students (m_a) for this factor is greater than the mean value of traditional students (m_t). This relationship between m_a and m_t indicate that adult students disagreed less than traditional CS-major students in regard to Factor 8. The data reveal that there were no significant differences between these two groups of students regarding other teaching technique factors (Table 45).

Regarding instructional resources, data indicate that there was a significant difference between traditional and adult CS-major students on the factor "Hands-on" or experimenting examples in classroom or computer labs. Other instructional resources were highly supportive by both groups (Table 46).

There were no significant differences between traditional and adult CS-major students on factors, "Possesses an attitude that motivates students to learn," "Has a good public speaking and communication skills," "Provides different examples which reinforce theory," "Has adequate number of assignments to reinforce instruction," "Frequent student faculty contact in and out of class," "Facilitates learning activities" of an effective characteristics of a CS faculty. However, there were significant differences between these two groups regarding other characteristics of an effective CS faculty (Table 47).

There was a significant difference between traditional and adult CS-major students relative to the motivational factor, "Increase marketability." There were no

other significant differences between these groups of students in regard to motivational factors.

The data indicate that there were significant differences between adult and traditional CS-major students relative to characteristic of an effective CS faculty, such as "Provides energy," "Introduces materials at a pace for the average learner," "Has classroom rules and norms," "Follows well-defined plan that is flexible as class interest dictate," "Identifies problems that can be solved as a result of instruction," "Is friendly and approachable to students, and their questions, both in class and office hours," and "Has a good rapport with students" (Table 48).

Research Question 6

On the type of teaching techniques, the data reveal that there were no significant differences between not CS-major traditional and adult students in CS classes (Table 49).

Considering all factors of instructional resources, data in Table 50 indicated there were no significant differences between adult and traditional not CS-major students.

There were no significant differences between not CS-major traditional and adult students relative to all factors listed for the characteristics of an effective CS faulty in Table 51.

The results in Table 52 indicated that there is a significant difference between traditional and adult not CS-major students relative to the factor "Better positioned to obtain a higher paying job." However, there were no significant differences between these two groups of students relative to other factors.

Chapter Summary

Chapter IV included an introduction, the purpose statement of the study, the research questions, a description of the sample population, and description and survey results for each research question. For Research Questions 1-4, the first seven tables in Chapter IV analyzed data for each individual group: traditional CS-major, adult CS-major, traditional not CS-major, adult not CS-major, traditional undeclared-major and adult undeclared-major students. The last four tables in Chapter IV compared and analyzed student data when they were grouped by age and CS-major, age and not-CS-major, and age and undeclared-major. Finally, traditional and adult students were compared regardless of their major.

The results and interpretations of these findings, conclusions, and recommendations for further research are presented in Chapter V.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

Computers and information technology have changed the world rapidly and irreversibly. As the new generation rushes into the information age, its future depends on computers and its ability to understand and use them in productive and positive ways. There is a significant increase in the number of adult students in computer science classes at higher education institutions. The researcher's specific goal was to find out what adult students want and need in computer classes and how faculty can help them to achieve their goals and maintain their retention.

The results of this study will be beneficial to higher educational institutions, as they will better understand the impact of education on adult students. Higher education will also have an opportunity to develop a more responsive system that attracts and retains more adult students and helps them to meet their educational goals. In addition, the study provides recommendations that will help the faculty and the administration at colleges and universities to understand how to best nurture and capitalize upon adult learners' needs, expectations, and motivation.

This chapter discusses the findings of the study and the conclusions derived from the data collected. Also included in this chapter are recommendations for action and for further research, and concluding remarks.

General research questions in guiding this study include:

1. What teaching techniques are considered desirable by students in computer science classes, relative to the following nine factors:
   a) Internship (to give students the opportunity to experience practical applications of the knowledge learned in academic courses)
   b) Mentorship (more experienced or more knowledgeable student helps a less experienced or less knowledgeable student)
   c) Computer-based learning (structured environment in which computers are used for teaching purposes. Minimum use of white-board)
   d) Hands-on or practical activities (a brief lecture followed by completing tasks using computers in the classroom or computer lab)
   e) Traditional classroom lecture utilizing a white-board, textbooks, handouts, and additional instructional resources as necessary.
   f) Classroom PowerPoint presentation, with textbooks, handouts, and additional resources as necessary.
   g) A brief lecture followed by classroom participation via peer and group discussion.
   h) 100% online classes
   i) Hybrid courses (courses that blend in-class sessions with web-based activities or virtual classes)
2. What types of instructional resources are considered desirable by students in computer science classes, relative to the following 13 factors:
   a) Handouts

b) Note-taking

c) Textbook(s)

d) Library books and journals

e) Tutorial service center (offers students and faculty assistance with the teaching and learning of academic courses)

f) Comprehensive course syllabus

g) Use of whiteboard to present information in class

h) Use of Blackboard as a source of communication

i) Computers and other electronic resources (audio/video, links, PowerPoint, slides, and websites) to present information faculty wants students to know

j) Use of computer software and Internet resources for learning

k) Reference book(s) and other printed materials

l) Internet posted video of the instructor presenting a traditional classroom type lecture

m) Hands-on (experimenting with examples in classroom or computer labs)

3. What are the characteristics of an effective computer science instructor at the higher education level, relative to the following 16 factors:

a) Has in-depth knowledge of the subject material

b) Possesses an attitude that motivates students to learn

c) Has good public speaking and communication skills

d) Provides energy

e) Specifies clear lesson objectives and teaches only those objectives

f) Paces materials for the average learner

g) Provides examples which reinforce theory

h) Has classroom rules and norms that allow students to mentally engage and disengage from classroom awareness

i) Follows well-defined instructional plan which is flexible as class interests dictate

j) Has adequate number of assignments to reinforce instruction

k) Promotes frequent student faculty contact in and out of class

l) Identifies problems that can be solved as a result of the instruction

m) Focus on practical skills and knowledge that can be used in solving problems

n) Facilitates learning activities

o) Is friendly and approachable to students and their questions, both in class and office hours

p) Has good rapport with students and other faculty members

4. What motivates students to come back to college, relative to the following 13 factors:

a) Requirement for continued employment

b) Be better positioned in the event of downsizing

c) Family pressure

d) Friends or relatives

e) Joy of learning

f) Personal fulfillment

g) Acquire knowledge required for self employment

h) Career/job advancement

i) Career change

j) Better positioning for a promotion at work

k) Better positioned to obtain a higher paying job

l) Increased marketability

m) Keeping up to date on new technology

5. Are there significant differences between the needs of adult (25 years and older) and traditional (18-24 years old) computer science major students in computer science classes, relative to all factors in Questions 1-4?
6. Are there significant differences between the needs of traditional (age 18-24 years) and adult (25 years and older) not CS-major or undecided major students in computer science classes, relative to all factors in Questions 1-4?

Methodology

This study used descriptive and ex post facto research to answer the research questions. Descriptive research procedures were applied to Research Questions 1, 2, 3, and 4. This procedure included frequency, percentage, mean, and standard deviations to show frequency distributions. A two-tailed independent-sample *t*-test was used to answer Research Questions 5 and 6. These two research questions focused on significant differences at the 0.05 level between two independent groups of students. Research Question 5 focused on differences between the needs of adult and traditional CS major students; while Research Question 6 focused on differences between the needs of traditional and adult students who are not CS major or undeclared. Participants' comments made in response to open-ended survey questions were considered by the

researcher to conduct an in-depth analysis of the participants' thoughts related to Research Questions 1-4.

Key Findings of the Study

This study reported data from seven private universities in Southern California. The findings are organized according to the six research questions.

Research Question 1

What teaching techniques are considered desirable by students in computer science classes [relative to the following 9 factors]?

a) Internship (to give students the opportunity to experience practical applications of the knowledge learned in academic courses)

b) Mentorship (more experienced or more knowledgeable student helps a less experienced or less knowledgeable student)

c) Computer-based learning (structured environment in which computers are used for teaching purposes. Minimum use of white board)

d) Hands-on or practical activities (a brief lecture followed by completing tasks using computers in the classroom or computer lab)

e) Traditional classroom lecture utilizing a white board, textbooks, handouts, and additional instructional resources as necessary

f) Classroom PowerPoint presentation, with textbooks, handouts, and additional resources as necessary

g) A brief lecture followed by classroom participation via peer and group discussion

h) 100% online classes

i) Hybrid (courses that blends in-class sessions with Web-based activities or virtual classes)

The most desirable cited factor for both traditional and adult CS-major students was, "Hands-on" or practical activities. The factors cited as strongly undesirable by this group of students include "100% online classes" and "Classroom PowerPoint presentation, with textbooks, handouts, and additional resources as necessary." The factor, "Hybrid courses," was ranked highly uncertain with traditional and adult CS-major students. This indicates that this new teaching technology still is not popular among CS-major students.

The strongly desirable factors for traditional and adult not CS-major students included the factors, "Hands-on," or practical activities, and "Internship." The factor, "100% online classes," was cited the most undesirable by these groups of students (Table 12).

The results of traditional undeclared-major students' responses to all factors in Research Question 1 indicate that the factor, "Classroom PowerPoint presentation with, textbooks, handouts, and additional resources as necessary," was cited most frequently. Other factors cited as occurring frequently were "Mentorship," "Hybrid courses," and "Internship." Among adult-undeclared-major students factors, "Computer-based learning," "Hands-on," or practical activities, and "Traditional classroom lecture utilizing a whiteboard, textbooks, handouts, and additional instructional resources as necessary" were cited most often (Table 13).

In each of the nine factors that made up the first question, the factor, "Hands-on," was marked the highest among all groups of students. However, traditional students whether they were CS-majors or not and adult students not majoring in CS ranked the factor, "100% online," as least frequently. Among adult students majoring in CS the factor, "Classroom PowerPoint presentation, with textbooks, handouts, and additional resources as necessary," was rated the lowest (Table 14).

Research Question 2

What types of instructional resources are considered desirable by students in computer science classes [relative to the following 13 factors]?

a) Handouts

b) Note taking

c) Textbook(s) which also serve as future reference

d) Library books, journals, and other printed materials

e) Tutorial service center (offers students and faculty assistance with the teaching and learning of academic courses)

f) Comprehensive course syllabus

g) Use of whiteboard to present information in class

h) Use of Blackboard (course management system) as a source of communication

i) Computers and other electronic resources (audio/video, links, PowerPoint, slides, and websites) to push information from faculty to students

j) Use computer software and Internet resources for learning

k) Textbook(s) and reference book(s) available in the library

l) Internet posted video of the instructor presenting a traditional classroom type lecture

m) Hands-on (experimenting examples in classrooms or computer labs)

The most desirable factors cited by traditional and adult CS-major students were the factors "Hands-on," or experimenting with examples in classroom or computer lab, and "Use of computer software and Internet resources for learning." The least desirable factor by both groups was "Library books, journals, and other printed materials."

Traditional CS-major students ranked the factors "Handouts" and "Note taking" much higher than adult CS-major students. This difference indicates that adult students are not happy with note taking or receiving handouts in CS classes as much as traditional students. However, adult CS-major students rated the factors, "Use of Blackboard as a source of communication" and "Internet posted video of the instructor presenting a traditional classroom lecture," more frequently than traditional CS-major students (Table 21).

The factors cited strongly desirable by both traditional and adult not CS-major students were the factors, "Hands-on," or experimenting with examples, and "Comprehensive course syllabus." The most undesirable factors by this group of students were the factors, "Library books, journals, and other printed materials," and "Textbook(s) and reference book(s) available in the library." The adult not CS-major students cited the factor, "Internet posted video of the instructor presenting a traditional classroom type lecture," as their most undesirable factor (Table 22).

The factors cited most desirable by traditional undeclared-major students included the factors, "Hands-on," or experimenting with examples by traditional students, and

"Internet posted video of the instructor presenting a traditional classroom type lecture," by adult students. The factor cited least desirable by traditional undeclared-major students were factors, "Internet posted video of the instructor presenting a traditional classroom type lecture," and "Text book(s) and reference book(s) available in the library." The factor cited undesirable by adult undeclared-major students was "Tutorial service center" (Table 23).

Considering all factors in Research Question 2, the factor, "Hands-on," or experimenting with examples, was rated more frequently by both traditional and adult students regardless of their major when compared with other students. The factor, "Use computer software and Internet resources for learning," was the highest rated factor among traditional and adult CS-major students. However, the factor, "Comprehensive course syllabus," was cited most desirable by traditional and adult not CS-major students. The least frequently cited factor by almost all students was "Library books, journals, and other printed materials" (Table 24).

Research Question 3

What are the characteristics of an effective computer science faculty at the higher education system [relative to the following 16 factors]?

a) Has in-depth knowledge of the subject material

b) Possesses an attitude that motivates students to learn

c) Has good public speaking and communication skills

d) Provides energy

e) Specifies clear lesson objectives and teaches only those objectives

f) Paces materials for the average learner

g) Provides examples which reinforce theory

h) Has classroom rules and norms that allow students to mentally engage and disengage from classroom awareness

i) Follows well-defined instructional plan which is flexible as class interests dictate

j) Has adequate number of assignments to reinforce instruction

k) Promotes frequent student faculty contact in and out of class

l) Identifies problems that can be solved as a result of the instruction

m) Focus on practical skills and knowledge that can be used in solving problems

n) Facilitates learning activities

o) Is friendly and approachable to students and their questions, both in class and office hours

p) Has good rapport with students and other faculty members

The survey results indicated that the most desirable factor by traditional and adult CS major students was the factor, "Has in-depth knowledge of the subject material." The same group of students ranked the factor, "Has classroom rules and norms that allow students to mentally engage and disengaged from classroom awareness," as the least desirable factor for a CS instructor to be effective in the classroom (Table 31).

Traditional not CS-major students ranked the factor, "Is friendly and approachable to student and their questions, both in class and office hours," as the most desirable characteristic of an effective CS instructor. However, the same group of students marked the factor, "Promotes frequent student faculty contact in and out of

class," as the least characteristic of an effective CS instructor. Adult not CS-major students ranked the factor, "Has in-depth knowledge of the subject material," as the most desirable characteristics of a CS faculty member. The least desirable factor by this group of students was "Promotes frequent student faculty contact in and out of class" (Table 32).

All characteristics of an effective CS faculty considered, factors, "Has in-depth knowledge of the subject material," "Possesses an attitude that motivates students to learn," and "Is friendly and approachable to students and their questions, both in class and office hours," were rated more frequently by all groups of students. The factors, "Has adequate number of assignments to reinforce instruction," and "Promotes frequent student-faculty contact in and out of class," were rated least frequently by almost all students.

Research Question 4

What motivates students to come back to college [relative to the following 13 factors]?

a) Requirement for continued employment

b) Be better positioned in the event of downsizing

c) Family pressure

d) Friends or relatives

e) Joy of learning

f) Personal fulfillment

g) Acquire knowledge required for self employment

h) Career and job advancement

i) Career change

j) Better positioning for a promotion at work

k) Better positioned to obtain a higher paying job

l) Increased marketability

m) Keeping up to date on new technology

The factors, "Career and job advancement," and "Personal fulfillment," were marked the highest desirable motivational factors by traditional and adult CS-major students. Both groups marked the factors, "Family pressure," "Friends and relatives," and "Career change," as lowest among all other factors (Table 41).

The most desirable motivational factor for traditional and adult non-CS-major students was the factor, "Career and Job advancement." Traditional not CS-major students ranked the factors "Friends and relatives" and "Career change" as the least-desired motivational factors to return to college. However, adult non-CS-major students ranked the factors "Family pressure" and "Friends and relatives" as the least-deciding motivational factors (Table 42).

The most desirable motivational factors among traditional undeclared-major students were the factors "Career and job advancement" and "Increase marketability." The same group of students ranked the factor, "Friends and relatives," as the least-desirable motivational factor. The highest ranked factors by adult undeclared-major students was a cluster of factors, "Career and Job advancement," "Career change," "Better positioning for a promotion at work," "Better positioned to obtain a higher paying

job," "Increase marketability," and "Keeping up-to-date on new technology." However, the least-desirable motivational factors by adult undeclared-major students were the factors "Family pressure" and "Friends and relatives" (Table 43).

Among all 13 factors, the factor "Career and job advancement" was rated the highest among all students except adult CS-major students. The adult CS-major students gave their highest priority to the factor "Personal fulfillment." Among all factors, the factors, "Family pressure" and "Friends and relatives," were ranked the lowest by all groups of students.

Traditional and adult CS-major students ranked motivational factors, "Be better positioned in the event of downsizing," "Acquire knowledge/skills required for self employment," and "Keeping up-to-date on new technology," the same.

A cluster of two factors, "Family pressure" and "Friends and relatives," was ranked and cited as occurring least frequently by traditional and adult undeclared-major students.

Research Question 5

Are there significant differences between the needs of traditional (18-24 years old) and adult (25 years and older) CS-major students, relative to all factors in Questions 1-4?

Findings for Research Question 1. The data reveal that there were significant differences between the traditional and adult CS-major students on teaching techniques relative to the factors, "Internship," "Hands-on classes," "100% online courses," and

”Hybrid courses.” However, for the remaining teaching techniques, there were no significant differences between these two groups (Table 45).

Findings for Research Question 2. Data indicate that there was a significant difference between traditional and adult CS-major students on the factor, “Hands-on” or experimenting with examples in classroom or computer labs. Other instructional resources were highly supported by both groups (Table 46).

Findings for Research Question 3. The results indicate there were no significant differences between traditional and adult CS-major students on the factors, “Possesses an attitude that motivates students to learn,” “Has good public speaking and communication skills,” “Provides examples which reinforce theory,” “Has adequate number of assignments to reinforce instruction,” “Promotes frequent student faculty contact in and out of class,” and “Facilitates learning activities.” However, there were significant differences between these two groups regarding other characteristics of an effective CS instructor (Table 47).

Findings for Research Question 4. Regarding motivational factors, the only factor with a significant difference between traditional and adult CS-major students was the factor, “Increase marketability.” However, the data indicate that there were no significant differences between these groups of students relative to other factors in Research Question 4 (Table 48).

Research Question 6

Are there significant differences between the needs of traditional (18-24 years old) and adult (25 years and older) who are not CS-major or undeclared major students in computer science classes, relative to all factors in Questions 1-4?

Findings for Research Question 1. The data reveal that there were no significant differences on the type of teaching techniques among traditional and adult not CS-major or undecided major students taking CS classes (Table 49).

Findings for Research Question 2. The results indicated there were no significant differences between adult and traditional not CS-major or undecided major students relative to all instructional resource factors (Table 50).

Findings for Research Question 3. The data reveal that there were no significant differences between traditional and adult not CS-major or undecided major students relative to all factors listed for the characteristics of an effective CS faulty (Table 51).

Findings for Research Question 4. The data reveal that there is a significant difference between traditional and adult not CS-major or undecided major students relative to the factor, "Better positioned to obtain a higher paying job." However, there were no significant differences between these two groups relative to the other motivational factors (Table 52).

Conclusions

The goal of the researcher was to identify the details of what students want and need in computer classes and how faculty can assist students in achieving their goals and

maintaining retention. These conclusions present a summary of findings and interpretations based on data collected from seven private universities in Southern California of students engaged in higher education CS classes. The data in this study were divided into categories that could be identified as institutional and faculty-driven teaching techniques, instructional resources, and characteristics of effective CS faculty. On the student side, the study queried students on motivational factors of returning to college, including the differences between the needs of CS-major traditional and adult students, and the needs of non CS-major or undecided major traditional and adult students.

Teaching Techniques

Findings. The data strongly revealed that "Hands-on" or practical activities and "Internship" were strongly desirable by all students regardless of their age and major. All students' perceptions indicated that "Classroom PowerPoint presentation, with textbooks, handouts, and additional resources as necessary," "100% online classes," and "Hybrid courses," were not strongly desirable teaching techniques.

Interpretation. The preferred outcome of "Hands on" and "Internship" indicate that the student preferred an experiential learning experience rather than what could be considered traditional classroom activities. Therefore, computer classes or computer labs with enough computers should be implemented at each campus. Conducting CS courses in the lab or classrooms with computers gives the students the opportunity to experience practical applications of the knowledge learned in the lecture. An internship which is a work-related learning experience for students who wish to develop hands-on work

experience in the CS occupational field was recommended highly by all students. Internship provides real-world experience to those looking to explore or gain the relevant knowledge and skills required to enter into a particular career field. Internship helps students become experienced job applicants, practice teamwork skills, and exercise individual responsibility when seeking employment after graduation.

Students have different learning styles and PowerPoint is a helpful tool for students who have a visual learning style. While one student may learn by just listening to a lecture, others need to see pictures or read text to grasp the concepts. Faculty who use a PowerPoint presentation are able to convey theories and information visually that often keeps the students' attention and stimulates discussion. PowerPoint, however, has notable weaknesses. Often, PowerPoint simply masks the fact that the presentation does not have enough intrinsic attention factors in itself. In other words, an effective presentation should keep the audience's attention without depending on visuals. "The visual should be aids, not commanders. The aids should reinforce the structure, not replace it. This is particularly troublesome for student presentations since students need to learn how to communicate structure verbally without visuals. If they rely on visuals for structure, they never learn how to do it themselves," according to Steve Kaminski, Bob Jones University.

Some faculties rely too much on the visual slide to make the connection, which makes some students unhappy. One student noted, "My instructor's PowerPoints are not well designed, he does not look at us and we don't look at him. There are too many texts

in each slide!" Another student wrote, "My professor is an audio aid for her PowerPoint slides. She just reads [her] lecture from slides."

Choosing online education or hybrid courses over the traditional model depends on the needs of the prospective student. It is an exciting new trend, and one that certainly brings new results. According to those students who liked online courses, the following comments were notable: "Save me time on travel to or from campus," "Comfortable to work at home," "Interacting with classmates," and "Save me money on gasoline." Those who were not happy with their online courses wrote comments, such as, "Lack of personal contact with instructor and classmates," "Lack of immediate help from instructor," "Not everyone loves to sit through a webinar," "The presentation needs a human connection to bring in outside material, comments and anecdotes," "Required to type everything," "Group activities are awkward," "Problems with computers, Internet, servers, and power are avoidable."

In all, the pros and cons of online learning seem to be a matter of individual perception and attitude rather than a matter of the medium or technology. As online learning becomes increasingly accepted as a legitimate learning format, the question of its advantages and disadvantages may also become arguable.

Instructional Resources

Findings. All students, regardless of their age and major, perceived that "Hands-on" or experimenting with examples in the classroom or computer labs is their most desirable instructional resource. The data strongly indicated that, for almost all students,

"Library books and journals" and "Reference book(s) and other printed materials" are the least important instructional resources.

Interpretation. Any instructional method a faculty member uses has advantages, disadvantages, and requires some preliminary preparation. Which instructional method is "right" for a particular lesson depends on many factors; among them are the age and developmental level of the students, what the students already know, and what they need to know to succeed with the lesson, the subject-matter content, the objective of the lesson, the available people, time, space and material resources, and the physical setting (Adprima, 2010). There is no one "right" method for teaching a particular lesson, but there are some criteria that pertain to each that can help a faculty member make the best decision possible. According to this research data, regardless of the student's identification as a CS-major or non-CS-major or adult versus traditional student, students prefer the practical approach in CS classes. Therefore, again conducting CS courses in the computer lab or classrooms equipped with computers supports the instruction of a subject or a course.

As data indicate, library books, journals, and reference books do not have enough demand in CS courses at the undergraduate level, perhaps because students develop analytic and problem-solving skills in class. Faculty lectures and textbooks allow students to apply new knowledge and skills for the exploration of solutions for complex project issues. Therefore there is not much need for a CS-major student to go to the library. But, this lack of interest must be changed. It is not easy for the faculty to ask students to spend time in the library to do homework, but it is easy to require students to

use the library as part of their research. Students are more willing to follow faculty suggestions than anything else regarding library use, so if the faculty assigns research projects and requires students to use books and journals as their references, they are more likely to do so. To teach students effective research strategies and resources and use more relevant articles in their research papers, faculty must encourage students to use the library. Better yet, a teacher could invite a librarian who is specialized in the subject to come to class and work with students as a group to improve their library research. More interaction with librarians and knowing the resources in the library will encourage students to spend time using the library. Facilities, furniture, and book selection are other important aspects of encouraging students to utilize libraries.

Characteristics of an Effective CS Faculty Member

Findings. Almost all students' perceptions indicated that "Has in-depth knowledge of the subject material" and "Is friendly and approachable to students and their questions, both in class and office hours" are the two essential characteristics of an effective CS faculty member. Factors, such as "Classroom rules and norms," "Has adequate number of assignments to reinforce instruction," and "Promotes frequent student-faculty contact in and out of class," were rated low by most students.

Interpretation. The value of the student experience is increased with the perception of the faculty member being prepared in the subject matter as well as making themselves available via a variety of modes of communication (i.e., in class, office hours,

or via e-mail). The second characteristic of "Ten Characteristics of Good Teaching" as pointed out by Richard Leblanc is a good interpretation of this finding. He noted,

> Good teaching is about substance and treating students as consumers of knowledge. It's about [a] faculty [member] doing his/her best to keep on top of his/her field, consulting reading sources, inside and outside of his/her areas of expertise, and being at the leading edge as often as possible. But knowledge is not confined to scholarly journals. Good teaching is also about bridging the gap between theory and practice. It's about leaving the ivory tower and immersing oneself in the field, talking to, consulting with, and assisting practitioners, and liaisoning with their communities. (See Appendix D, no. 2)

Motivational Factors for Coming Back to College

Findings. Traditional CS-major students indicated that "Career and job advancement" was their most desirable motivational factor for coming back to college. However, adult CS-major students' most desirable factor was "Personal fulfillment." The data showed that both non-CS-major traditional and adult students agreed strongly that "Career/job advancement" is an integral part of their decision for continuing college.

The highest motivational factor by traditional undeclared-major students was "Career/Job advancement" and "Increase marketability." The highest ranked factor by adult undeclared-major students was a cluster of factors "Career/Job advancement," "Career change," "Better positioning for a promotion at work," "Better positioned to obtain a higher paying job," "Increase marketability," and "Keeping up-to-date on new technology."

It is important to note that the least-desired factor by the majority of all students was "Family pressure" and "Friends and relatives."

Interpretation. The indicators referring to students' attending a university to realize better career opportunities through updating their technology skills is a universal theme for traditional and adult students. Among all students, education seems to be the answer to some goal. According to the literature review, employers need employees who have new competencies to meet the changes in science and technology and the new workforce demands. Employees learn when their current skills no longer work. The major purpose for undeclared-major adult students returning to college is to acquire career skills; the career motive outweighs all other factors combined.

Students in this research see self-motivation and not relational demands as their motivation for reentering college-level coursework.

Differences Between the Needs of Adult and Traditional CS-Major Students

The data revealed three specific areas of significant differences between the traditional and adult CS-major students on *teaching techniques*. The three areas in which students responses differed regarding teaching techniques were "Internship," "Hands-on," and "Hybrid courses" techniques. The data also revealed that the age difference between adult CS-major students and traditional students may play a factor in how teaching techniques are best serving the specific age group.

In regard to the factors, "Internship" and "Hands-on," the survey results in Table 45 indicate $m_t > m_a$ which indicates traditional CS-major students disagreed less than adult CS-major students on both of these factors. Students of both groups were not strongly supportive that 100% online courses were effective. In addition, data reveal that the

"Hybrid courses" factor for these two groups has created an opposite result with adult CS-major students more accepting of this type of course offering. As pointed out by some adult students, factors, such as, "Save me time on travel to or from campus," "Comfortable to work at home," and "Save me money on gasoline," are a few reasons for them taking online and/or hybrid courses.

Choosing online education or hybrid courses over the traditional model depends on the needs of the prospective student. It is an exciting new trend, and one that certainly brings new results.

There was a significant difference between traditional and adult CS-major students on *instructional resources* relative to the factor "Hands-on." However, since the mean value for traditional CS-major students has a greater value than the mean value for adult students in regard to this factor (Table 46), this relationship between the two means indicates that traditional CS-major students are more supportive of this factor in comparison with the adult CS-major students. The experiential factor remains a common preferred method of learning with both of these groups.

It was determined through statistical analysis that there were significant differences between traditional and adult CS-major students on *characteristics of an effective CS faculty member* in regard to the factors: "Has in-depth knowledge of the subject material," "Provides energy," "Introduces material at a pace for the average learner," "Has classroom rules and norms that allow students to mentally engage and disengage from classroom awareness," "Follows well-defined instructional plan that is well defined and flexible as class interests dictate," "Identifies problems that can be

solved as a result of the instruction," "Focus on practical skills and knowledge that can be used in solving problems," "Is friendly and approachable to students and their questions, both in class and office hours," and "Has a good rapport with students and other faculty members." For all of the above factors, the survey results in Table 46 indicate that the mean value of traditional CS-major students has a greater value than the mean value of adult students. Again, this relationship between the two means indicates that traditional CS-major students disagreed less than adult students regarding the above characteristics of an effective CS instructor.

As noted by some adult students, the following opinions are significant to be mentioned in regard to CS faculty members' knowledge of the subject:

> The faculty who has passion for the subject and compassion for the students, will be the teacher that everyone remembers.
>
> You can be a great faculty if you know how to talk about your subject matter.
>
> I had many professors who were either strong in the theoretical side [computational theory] but were weak in the practical side or vice versa, but a few with balance the two sides.

Faculties at a more advanced level spend time researching, publishing papers, and chasing grants. Conversely, at a more basic level, faculty members give emphasis to teaching. These archetypes can overlap in one person; that person would be the faculty member who has a good balance of the theoretical and practical, explicit and patient, like the age group of students he plans to teach, a good communicator, and one who welcomes questions and answers them as they come.

The only factor identified as showing a significant difference between traditional and adult CS-major students on *motivation* to come back to college was "Increase

marketability." The data in Table 48 reveal that the mean value for traditional CS-major students is greater than the mean value for adult students responding to this factor. This relationship between the means indicates that traditional students disagreed less than adult students in regard to this factor. The age and life experience of the student indicates that the importance of adding education to a résumé plays an important factor in seeking a job or seeking a better job. Traditional students may not have the employment experience to appreciate the need for marketability when searching for employment.

Differences Between the Needs of Traditional and Adult Students Who Are Neither CS-Major nor Undecided-Major Students

The data suggested that there were no significant differences between traditional and adult not CS-major or undecided-major students in regard to all factors of *teaching techniques*. Moreover, there were no significant differences between these two groups relative to all *instructional resources* factors

Further data analysis revealed that there were no significant differences between traditional and adult not CS-major or undecided-major students relative to all *characteristics of an effective CS faculty* factors.

It was determined that there was a significant difference between traditional and adult students in this group relative to *motivational* factor, "Better positioned to obtain a higher paying job." However, since the mean value of adult students' responding to this factor is greater than the mean value of traditional students, this difference indicates that traditional not CS-major students agreed less than adult not CS-major students in regard to this factor.

The survey results for this question indicate that regardless of the student's declaration of a major or whether the student can be categorized as a traditional or adult student, the teaching techniques of the faculty and the instructional resources are important characteristics. The knowledge and teaching techniques of the faculty member are important factors in how students characterize an effective CS faculty member.

Overall, there were few significant differences with regard to student needs in CS courses, regardless of whether the student is an adult returning student, traditional, CS-major, or undeclared-major when it comes to student needs in the classroom. Experiential learning is indicated as an important factor in learning as well as the instructor's knowledge of the subject and approachability either in the classroom or outside of the classroom. Experiential learning is about creating an experience where learning can be facilitated. As stated by Aristotle, "For the things we have to learn before we can do them, we learn by doing them." And according to one of the ancient Chinese philosopher, "Tell me and I will forget, show me and I may remember, involve me and I will understand."

Experiential learning is learning by doing; creating an experiential learning environment can be challenging for faculty who have been taught through traditional classroom techniques. In traditional classrooms where lectures with PowerPoint slide sets are standard, faculty needs to be creative to engage students get involved in experiments.

Surprises

Since no previous studies were conducted in regard to this subject, a number of findings came as a surprise. There were unexpected responses from both the CS-major and not CS-major adult and the traditional students.

As the researcher expected, online classes and hybrid courses are not still the favorite teaching techniques in CS classes regardless of a student's age and major. Students of both categories see the traditional classroom coursework as more acceptable in their learning in the area of CS. It appears that the face-to-face element between faculty and student remains an important factor in teaching techniques.

The most alarming finding in this study was the lack of interest in going to library and use journals, reference books, and other printed materials as instructional resources. Students appreciated access to online instructional and research material rather than going to the traditional libraries. This lack of interest must be changed by the CS faculty to require ~~that~~ students to use the library as part of their research and ~~use~~ books and journals as their references.

Unsurprisingly, note taking and handouts have enough demand in CS classes. Faculty members have to be more innovative and flexible to be able to provide handouts and require students to take notes in a traditional manner. Blackboard is a tool that faculty can use so that students are able to access course material online.

Surprisingly, among all motivational factors for coming back to college, almost all students indicate "Career and job advancement" as their first choice. In addition, unpredictably, factors, such as "Joy of learning" or "Keeping up-to-date on new

technology," were ranked least frequently. Students who were interested in the CS field, unexpectedly marked the ability to keep up with new technology as lower than anticipated. And as the researcher expected, students surveyed were much more motivated by being employed or becoming employed and having their coursework lead them to jobs.

The survey did not examine the number of students who were employed or the impact of the current economy on the job market; however, as it was expected, both age groups were clearly motivated by their marketability with leverage in having completed CS coursework.

Another unexpected surprise was the low rating of "Promotes frequent student-faculty contact in and out of class" as one of the characteristics of an effective CS faculty by most students. Students are eager to complete coursework rather than meet with the instructor unless there's a significant need. Traditionally, the colleges emphasize the availability of faculty members through office hours and other college activities. It appears that students do not maintain the need for the traditional office hour availability as much as the college or university's emphasis.

Recommendations for Action

The following recommendations are based on the results of this study, the conclusions of the study, and the review of the literature.

Both adults and traditional CS-major students have strongly voiced the need for "Hands-on" or practical activities as *teaching techniques*. Therefore, computer classes or computer labs with enough computers should be implemented at each campus. Conducting CS courses in the lab or classrooms with computers gives the students the opportunity to

experience practical applications of the knowledge learned in the lecture. As one of the students wrote, "I am a visual learner; therefore, I like the hands-on approach. I better understand something if I do it myself rather than [have] someone show me what to do." Traditional and adult students not majoring in CS most desirable teaching technique included the factors, "Hands-on or practical activities" and "Internship."

The study revealed that "Hands-on or experimenting with examples in classrooms or computer labs" and "Computer software and Internet resources for learning" were two of the *instructional resources* that were strongly recommended by all students regardless of their age and major. Therefore, again conducting CS courses in the computer lab or classrooms equipped with computers supports the instruction of a subject or a course. One student wrote, "The presence of a variety of instructional resources allows us with varying learning styles and preferences to learn." It has been said that exceptional teaching can be hard work, but great teaching is challenging and nurturing.

The study has affirmed that a level of instructor's course knowledge was one of the essential *characteristics of an effective* CS faculty for traditional and adult CS-major students. Moreover, non-CS-major adult students also strongly considered a faculty member's being prepared in the subject matter. Non-CS-major traditional students' most desirable characteristic was "Friendly and approachable to student and their questions, both in class and office hours." Therefore, institutions must consider the knowledge and attitude of a faculty during the hiring processes. Faculty who succeed with all students allocate as much time and effort as possible to counseling, inspiring, and engaging students. If the instructor wants to build and sustain good relationships with students,

focusing on what is important to them is a great place to start. Endo and Harpel (1982) have found that informal contact, in which faculty members develop more friendly relationships with students and exhibit a personal and broad concern with their emotional and cognitive growth has more influence not only on students' personal and social outcomes but also on their intellectual gains.

Traditional CS-major and traditional and adult non-CS-major students indicated that a *motivational* factor, such as "career or job advancement," was the main reason for them to come back to college. However, adult CS-major students agreed strongly that "Personal fulfillment" is an integral part of their decision for continuing college. Therefore, CS faculty must raise their realistic expectation to have students learn and perform better. High expectations are expressions of confidence that give students the best chance to perform academically. Research has shown that a teacher's realistic expectations have a powerful effect on students' performance. "Realistic" means that faculty standards are high enough to motivate students to do their best work but not so high that students will inevitably be frustrated in trying to meet those expectations.

The highest motivational factors by undecided traditional students were "Career or job advancement" and "Increase marketability." However, undecided adult students ranked a cluster of factors, "Career or job advancement," "Career change," "Better positioning for a promotion at work," "Better positioned to obtain a higher paying job," "Increase marketability," and "Keep up-to-date on new technology," strongly.

It is important to note that the least-desired motivational factors by majority of all students were "Family pressure" and "Friends and relatives." Students in this research

see self-motivation and not relational demands as their motivation for reentering college-level coursework. Regardless of their age or major, almost all students learn what they need to know in order to be successful in their new status.

Recommendations for Further Research

This study is the first research focusing specifically upon CS classes. Based on the findings of this study, the researcher offers the following suggestions for additional research:

- A replication study should be conducted to compare the results of this study in private and public universities.
- A replication study should be conducted to clarify the differences in opinion that exists between male and female students.
- This study could be replicated in other states/countries CS departments in order to expand and/or clarify the results of this study.
- A replication study should be conducted to compare the results of this study in other departments that are required computers as a teaching aid.
- This study could be replicated using a larger sample. This may give further information as to the differences in opinion that exist between traditional and adult students.
- Another area for ~~the~~ future research could be to evaluate the impact of note taking and the use of the library as an instructional resource aid.
- Finally, it may be important to study the influence of a student's family on how to motivate their child to go back to college.

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APPENDICES

APPENDIX A

SEVEN PRINCIPLES OF GOOD PRACTICE

Seven Principles of Good Practice
(Chickering & Ehrmann, 1987)

1. *Good practice uses active learning techniques*. "Learning is not a spectator sport. Students don't learn much just sitting in classes listening to teachers, memorizing prepackaged assignments, and spitting out answers. They must talk about what they are learning, write reflectively about it, relate it to past experiences, and apply it to their daily lives" (p. 3).
2. *Good practice gives prompt feedback*. "In getting started, students need help in assessing their existing knowledge and competence. Then, in classes students need frequent opportunities to perform and receive feedback on their performance. At various points during college, and at its end, students need chances to reflect on what they have learned, what they still need to know, and how they might assess themselves" (p. 4).
3. *Good practice emphasizes time on task*. "Time plus energy equals learning. Learning to use one's time well is critical for students and professionals alike. Allocating realistic amounts of time means effective learning for students and effective teaching for faculty" (p. 4).
4. *Good practice communicates high expectations*. "High expectations are important for everyone—for the poorly prepared, for those unwilling to exert themselves, and for the bright and well motivated. Expecting students to perform well becomes a self-fulfilling prophecy" (p. 5).
5. *Good practice respects talents and ways of learning*. "Many roads lead to learning. Different students bring different talents and styles to college. Brilliant students in a seminar might be all thumbs in a lab or studio; students rich in hands-on experience may not do so well with theory. Students need opportunities to show their talents and learn in ways that work for them. Then they can pushed to learn in new ways that do not come so easily" (p. 5)
6. *Good practice encourages contacts between students and faculty.* "Frequent student-faculty contact in and out of class is a most important factor in student retention, motivation, and involvement. Knowing a few faculty members well enhances students' intellectual commitment and encourages them to think about their own values plans" (p. 1).
7. *Good practice develops reciprocity and cooperation among students.* "Learning is enhanced when it is more like a team effort *than a solo race.*
8. *Good learning, like good work, is collaborative* and social, not competitive and isolated. Working with others often increases involvement in learning" (p. 2).

APPENDIX B

GREENBERG'S 12-POINT LIST

The Twelve-Point List
(E. Greenberg, 1978, pp. 50-51)

1. *Individualization of Each B.A. Program*. Need: autonomy, directing one's own path, permission to be one's self, respect for each individual's goals, and an "adult" response to the adult learner. Intended outcomes: increased trust of one's own decisions, match of each program to the unique background and goals of each individual, non-competitive learning, and ego development support.

2. *One-to-one Faculty Advisor/Student Relationship.* Need: intimacy in an adult relationship, values clarification, time and attention from a valued person, potential mentor relationship. Intended outcome: experience with a non-judgmental, supportive, non-family adult, provision of mentor and potential role model, mutual trust.

3. *Degree Plans Approved at Four Points in the Program.* Need: establishing priorities and directions, giving one's self permission to proceed with affirmation and approval from respected others, vision for the future, career direction. Intended outcomes: increased planning, time management, financial, and resource allocation skills, clarification of career or graduate school plans, explicit commitments to future long-range goals.

4. *Learning Contracts (written each semester for each learning experience).* Need: recognition of resources and energies; goal and objective clarification; mutual commitments of others writing competency; conceptual skill development; consciousness of own learning skills, purposeful action, explicitness, writing skills, conceptual skills, selection of manageable objectives and tasks within resource constraint.

5. *Learning Stipends* (a portion of tuition used to pay for off-campus learning resources). Need: experience in financial management and budgeting within constraints, consumer attitudes regarding getting "the best value" for each dollar. Intended outcome: improved budgeting skills, getting best buy in the educational marketplace, confidence in the use of money, control over the purchase of one's own learning resources, trust in one's own judgment reaffirmed by others.

6. *Use of the Entire Community as a Learning Resource*. Need: gaining knowledge of the academic world and of the world of work, identifying options, understanding community systems and new career opportunities, widening learning options, meeting new people. Intended outcome: potential job or career entry, building contacts and relationships for career direction, building self confidence in seeking what one needs.

7. *Use of Adjunct Faculty and Resource Persons*. Need: needs for mentors and role models, for gaining new knowledge and competence, and for widening circle of

contacts. Intended outcomes: confidence in calling upon important persons and asking for what one needs, new opportunities for mentoring and role-model selection, gaining a professional advocate, insight into careers and needed education, contacts for new jobs and careers.

8. *Personalized Evaluation*. Need: evaluation of achievement, affirmation by others, self evaluation, gaining support of respected others, models for making judgments, Intended outcome: assessment of one's own competence and achievement, awareness of cognitive and affective learning as seen by self and others, coordinating skills.

9. *Transcript Supplements* (course descriptions written by the students for each learning experience each semester). Need: writing skills, gaining ability to review and state what has occurred, documentation skills. Intended outcomes: explicitness, consciousness of what one had done, skill in reporting one's own behalf, development of record for graduate schools and employers.

10. *Advanced Standing Credit Evaluation.* Need: identification of those aspects of one's life which are valued by others and by an institution in the form of academic credit, self-confidence building, practical ability to document and report about one's life, time and money saving. Intended outcomes: self-assessment skills, appreciation of one's own competence, skill in writing a resume in both chronological and competency term and in converting activities into competencies and learning, reduce time for degree completion.

11. *Pre-Degree Review* (session to evaluate the B.A. program in terms of its balance of theoretical and practical learning and use of a variety of learning methods). Need: technique for reflection and analysis, match of personal view to "world view." synthesis of theory and practice, knowledge of one's own learning styles. Intended outcomes: increased skills of critical thinking, written and oral communication, coordination, organization, and analysis; cognitive and affective growth, increased career competence and job potential; development of lifelong learning habits.

12. *Degree Review*. Need: closure, integration, celebration, ritual and "marker event," sharing accomplishments with caring and significant others, "fit" of self with activities and world. Intended outcomes: integration, prioritization, synthesis, reflection on meaning of activities, self-confidence, sense of wholeness, assumption of responsibility for self-directed lifelong learning.

APPENDIX C

TWENTY ORGANIZING PRINCIPLES FOR
GOOD PROGRAM DESIGN

Twenty Organizing Principles for Good Program Design

E. Greenberg (1978, pp. 104-105)

Aims and Goals

1. Programs should have as their aims both the acquisition of new knowledge and credentials and enhancement of the *quality* and *meaning of life*.

2. A match between program design and learners' developmental needs is essential to achieve *quality of outcomes.*

3. Programs can and should accommodate a *wide variety of learner motivations, life transitions, and developmental stages.*

Learning

4. Change should be viewed as a precondition for learning. The most potent *"teachable moments"* for learning are periods of internal developmental transition and external marker event-generated transition.

5. In addition to insights gained from research and literature on adult development and learning, *our own lives* and those of our colleagues and friends hold significant indicators for program design.

Program Content

6. The external events and internal developments of adulthood have the potential to root educational programs in issues of major concern to students and can define the content of liberal studies (breadth) while career and vocational needs can define curriculum content for *areas of concentration or majors* (depth).

7. *Liberal learning and career preparation and advancement are mutually dependent.* Programs should meet learners where they are and aid in the acquisition of knowledge and skills needed for the future.

8. Programs must be *enabling and flexible and should provide for maximum individualization* of learning.

9. The wide diversity of learners' motivations and backgrounds require flexible approaches to *how, when, where, and with whom* learning take place. In particular, *time and calendar* are especially important variables in designing programs for adult.

10. Programs must be offered in convenient *locations* and appropriate *physical environments*.

11. If education is viewed as a process and is on-going throughout life, then programs must be *process-oriented*. Their methodologies should help persons learn generic skills which will be of value throughout life, such s planning, coordinating, selecting, communicating, decision making, critical thinking, value selecting, resourcing, and confidence and competence building.

12. Programs built around processes which trust and rely on learners to be *self-directed and responsible* for their own learning support growth and development and can lead to greater autonomy, competence and maturity.

13. Programs must provide for *theoretical* as well as *experiential* learning opportunities, in varied sequences, in order to meet younger and older adults developmental needs.

14. Programs must find a balance between serving only middle-class learners of high competence, who exhibit life styles and values much like our own, and *taking risk with persons who are different*. This principle rests on a belief in the human potential for change and growth through education. This population balance must insure high standards of achievement while providing avenues of access for persons who have been previously disenfranchised from the benefits of higher education.

15. The changing nature of women's lives and the high proportion of women returning to college require that programs account both for the *socialization effects and the value orientations of women,* in order to meet the changing educational needs of adult women.

16. Program should not negatively reinforce some traditional female characteristics and skills which have value for entire culture, even as women seek *increased access and quality* in education and in the world of work.

Faculty and Staff

17. Attitudes of *mutuality and shared learning* are necessary ingredients for successful relationships between program faculty, staff, and students, in contrast to strict hierarchical relationships.

18. The ability *to take abuse and also say no* must be developed by adult program faculty and staff.

19. Faculty and staff must be alert to persons who view *institutions as objects to be manipulated* for their own private purposes and who may have little regard for the integrity of institutional missions and programs.

20. Faculty and staff must deal in sophisticated ways with basic developmental and philosophical issues which encompass the very meaning of life itself.

APPENDIX D

TEN CHARACTERISTICS OF GOOD TEACHING

Ten Characteristics of Good Teaching

(R. Leblanc, 1998)

1. Good teaching is as much about passion as it is about reason. It's about not only motivating students to learn, but teaching them how to learn, and doing so in a manner that is relevant, meaningful, and memorable. It's about caring for your craft, having a passion for it, and conveying that passion to everyone, most importantly to your students.

2. Good teaching is about substance and treating students as consumers of knowledge. It's about doing your best to keep on top of your field, reading sources, inside and outside of your areas of expertise, and being at the leading edge as often as possible. But knowledge is not confined to scholarly journals. Good teaching is also about bridging the gap between theory and practice. It's about leaving the ivory tower and immersing oneself in the field, talking to, consulting with, and assisting practitioners, and liaisoning with their communities.

3. Good teaching is about listening, questioning, being responsive, and remembering that each student and class is different. It's about eliciting responses and developing the oral communication skills of the quiet students. It's about pushing students to excel; at the same time, it's about being human, respecting others, and being professional at all times.

4. Good teaching is about not always having a fixed agenda and being rigid, but being flexible, fluid, experimenting, and having the confidence to react and adjust to changing circumstances. It's about getting only 10 percent of what you wanted to do in a class done and still feeling good. It's about deviating from the course syllabus or lecture schedule easily when there is more and better learning elsewhere. Good teaching is about the creative balance between being an authoritarian dictator on the one hand and a pushover on the other.

5. Good teaching is also about style. Should good teaching be entertaining? You bet! Does this mean that it lacks in substance? Not a chance! Effective teaching is not about being locked with both hands glued to a podium or having your eyes fixated on a slide projector while you drone on. Good teachers work the room and every student in it. They realize that they are the conductors and the class is the orchestra. All students play different instruments and at varying proficiencies.

6. This is very important—good teaching is about humor. It's about being self-deprecating and not taking yourself too seriously. It's often about making innocuous jokes, mostly at your own expense, so that the ice breaks and students learn in a more relaxed atmosphere where you, like them, are human with your own share of faults and shortcomings.

7. Good teaching is about caring, nurturing, and developing minds and talents. It's about devoting time, often invisible, to every student. It's also about the thankless hours of grading, designing or redesigning courses, and preparing materials to still further enhance instruction.

8. Good teaching is supported by strong and visionary leadership, and very tangible continually reinforced by an overarching vision that transcends the entire organization—from full professors to part-time instructors—and is reflected in what is said, but more importantly by what is done.

9. Good teaching is about mentoring between senior and junior faculty, teamwork, and being recognized and promoted by one's peers. Effective teaching should also be rewarded, and poor teaching needs to be remediated through training and development programs.

10. At the end of the day, good teaching is about having fun, experiencing pleasure and intrinsic rewards . . . like locking eyes with a student in the back row and seeing the synapses and neurons connecting, thoughts being formed, the person becoming better, and a smile cracking across a face as learning all of a sudden happens. Good teachers practice their craft not for the money or because they have to, but because they truly enjoy it and because they want to. Good teachers couldn't imagine doing anything else.

APPENDIX E

SURVEY LETTER

STUDENT SURVEY

Dear Participants:

Thank you for considering participating in this study. This study will be used to identify and describe: (1) teaching techniques and instructional resources that will improve adult students' retention in computer science classes at the higher education level, (2) the characteristics of an effective computer science instructor at the higher education level, and (3) what motivates students to come back to college. This information will be used to plan more effective teaching strategies for adult students.

As a participant you have the following rights:

- Your participation is requested, but not required. You may refuse to answer any questions or stop participating at any time.
- Your answers and your name will be kept confidential.
- This research project has been approved by the Human Subjects Committee in the Department of Education, as requested by the Institutional Review Board (IRB) at the University of La Verne.

Thank you in advance for your cooperation.

I,……., agree to participate in this study. I understand that:

1. My answers will be used for research study.
2. My participation is voluntary.
3. I may refuse to answer any question.
4. I may stop participation at any time.
5. My answers and identity will be kept in the strictest confidentiality.

I certify that I am of the age 25 and older. I hereby give my voluntary consent to participate in this activity, realizing that I may withdraw at any time without prejudice or penalty.

Signed: …….. Date: ……

APPENDIX F

STUDENT SURVEY QUESTIONS

Student Survey Questions

Please use the provided scaling to answer each question. Circle the number for which you agree with the statements listed below:

1. **What teaching techniques are considered desirable by students in computer science classes, relative to the following 9 factors?**

1	2	3	4	5
Strongly not Desirable	Undesirable	Uncertain	Desirable	Strongly undesirable

1 2 3 4 5 Internship (to give students the opportunity to experience practical applications of the knowledge learned in academic courses

1 2 3 4 5 Mentorship (more experienced or more knowledgeable student helps a less experienced of knowledgeable students)

1 2 3 4 5 Computer-based learning (structured environment in which computers are used for teaching purposes. Minimum use of Whiteboard)

1 2 3 4 5 Hands-on or practical activities

1 2 3 4 5 Traditional classroom lecture utilizing a whiteboard, text books, handouts, and additional instructional resources as necessary

1 2 3 4 5 Classroom PowerPoint presentation, with text books, handouts, and additional instructional resources

1 2 3 4 5 A brief lecture followed by classroom participation via peer and group discussion

1 2 3 4 5 100% online classes

1 2 3 4 5 Hybrid courses

Comments/suggestions:

2. **What types of instructional resources are considered desirable by students in computer science classes, relative to the following 12 factors?**

1	2	3	4	5
Strongly not Desirable	Undesirable	Uncertain	Desirable	Strongly undesirable

1 2 3 4 5 Handouts

1 2 3 4 5 Note-taking

1 2 3 4 5 Textbook(s), journals, and other printed materials

1 2 3 4 5 Tutorial service center

1 2 3 4 5 Comprehensive course syllabus

1 2 3 4 5 Use of whiteboard to present information in class

1 2 3 4 5 Computer and other electronic resources (audio/vide, links, PowerPoint, slides, and websites)

1 2 3 4 5 Use of computer software and Internet resources for learning

1 2 3 4 5 Textbook(s) and reference books available in the library

1 2 3 4 5 Internet posted video of the instructor presenting a traditional classroom type lecture

1 2 3 4 5 Hands-on (experimenting examples in classroom or computer labs)

Comments/suggestions:

3. What are the characteristics of an effective computer science instructor at the higher education level, relative to the following 16 factors?

1	2	3	4	5
Strongly not Desirable	Undesirable	Uncertain	Desirable	Strongly undesirable

1 2 3 4 5 In-depth knowledge of the subject material

1 2 3 4 5 Possesses an attitude that motivates you to learn

1 2 3 4 5 Good public speaking and communication skills

1 2 3 4 5 Provides energy

1 2 3 4 5 Specify clear lesson objectives and teach only those objectives

1 2 3 4 5 Introduces material at a pace required for the average learner

1 2 3 4 5 Provides different examples which reinforce theory

1 2 3 4 5 Classroom rules and norms that allow students to mentally engage and disengage from classroom awareness

1 2 3 4 5 An instructional plan that is well defined, but flexible as class interests dictate

1 2 3 4 5 Adequate number of assignments to reinforce instruction

1 2 3 4 5 Frequent student faculty contact in and out of class

1 2 3 4 5 Identifies problems that can be solved as a result of the instruction

1 2 3 4 5 Focuses on practical skills and knowledge that can be put to in solving problems

1 2 3 4 5 Facilitates learning activities

1 2 3 4 5 Friendly and approachable to students and their questions, both in class and office hours

1 2 3 4 5 Has a good rapport with students and other faculty members

Comments/suggestions:

Thank You Very Much!

APPENDIX G

LETTER TO FACULTY MEMBERS

Dear Colleague,

I am an associate professor of computer science at the University of La Verne ~~and~~ doing ~~a~~ research to identify how to improve students' retention in computer science classes at the higher educational level. The population to be surveyed consists of students who are taking computer science courses in seven private universities in Southern California. Your university is chosen to be one of those seven institutions.

The questionnaire consists of the following four questions:

1. What teaching techniques are desired by students?
2. What types of instructional resources are desired by students?
3. What are the characteristics of an effective computer science faculty?
4. What motivates you as a student to come to college?

I have provided answers to each question and students must mark their preferences from *strongly not desirable* to *strongly desirable*.

I respectfully invite you to participate in this study. I need your permission to come to your class, distribute the questionnaires, and collect them in less than 10 minutes. The data collected will be confidential, and will not be made available to anyone other than the researcher. Upon conclusion of the study, all documents will be destroyed.

Your cooperation and willingness to participate in this study is gratefully appreciated.

Respectfully,

APPENDIX H

IRB APPROVAL LETTER

University of La Verne
Institutional Review Board

March 22, 2010

TO: Ray Ahmadnia

FR: University of La Verne, Institutional Review Board

RE: Application Number **#879-Amadnia- ADULT STUDENTS' RETENTION IN COMPUTER SCIENCE CLASSES AT THE HIGHER EDUCATION LEVEL**

The research project, cited above, was reviewed by the College of Education and Organizational Leadership IRB Representative and was subsequently available for comments by the entire IRB. The college review determined that the research activity has minimal risk to human participants, and the application received an expedited review and approval with no additional comments from the entire IRB.

The project may proceed to completion, or until the **date of expiration of IRB approval, March 22, 2011.** Please note the following conditions applied to all IRB submissions:

No new participants may be enrolled beyond the expiration date without IRB approval of an extension.

The IRB expects to receive notification of the completion of this project, or a request for extension within two weeks of the approval expiration date, whichever date comes earlier.

The IRB expects to receive prompt notice of any proposed changes to the protocol, informed consent forms, or participant recruitment materials. No additional participants may be enrolled in the research without approval of the amended items.

The IRB expects to receive prompt notice of any adverse event involving human participants in this research.

There are no further conditions placed on this approval.

The IRB wishes to extend to you its best wishes for a successful research endeavor. If you have any questions, please do not hesitate to contact me.

Approval Signature | Fred L. Yaffe, Ph.D., IRB Chairman | March 22, 2010, Date

For the Protection of Human Participants in Research

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