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The University of Southern Mississippi

ASSESSING ATTITUDES TOWARD COMPUTERS AND THE USE OF INTERNET RESOURCES AMONG UNDERGRADUATE MICROBIOLOGY STUDENTS

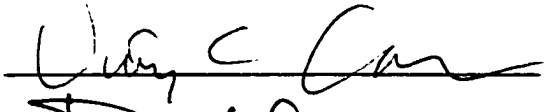
by

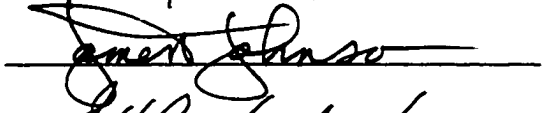
Delia Marie Castro Anderson

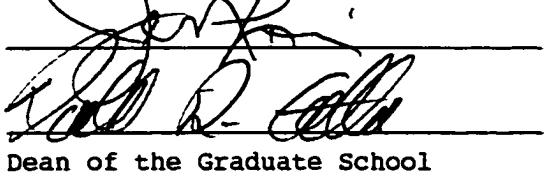
A Dissertation
Submitted to the Graduate School
of The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy

Approved:

Director







Dean of the Graduate School

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ASSESSING ATTITUDES TOWARD COMPUTERS AND THE USE OF INTERNET RESOURCES AMONG UNDERGRADUATE MICROBIOLOGY STUDENTS

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ABSTRACT

ASSESSING ATTITUDES TOWARD COMPUTERS AND THE USE OF INTERNET RESOURCES AMONG UNDERGRADUATE MICROBIOLOGY STUDENTS

by Delia Marie Castro Anderson

May 2001

Computer literacy and use have become commonplace in our colleges and universities. In an environment that demands the use of technology, educators should be knowledgeable of the components that make up the overall computer attitude of students and be willing to investigate the processes and techniques of effective teaching and learning that can take place with computer technology.

The purpose of this study is two fold. First, it investigates the relationship between computer attitudes and gender, ethnicity, and computer experience. Second, it addresses the question of whether, and to what extent, students' attitudes toward computers change over a 16 week period in an undergraduate microbiology course that supplements the traditional lecture with computer-driven assignments.

Multiple regression analyses, using data from the Computer Attitudes Scale (Loyd & Loyd, 1985), showed that, in the experimental group, no significant relationships were found between computer anxiety and gender or ethnicity or between computer confidence and gender or ethnicity. However, students who used computers the longest (p=.001) and who were self-taught (p=.046) had the lowest computer anxiety levels.

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Likewise students who used computers the longest (p=.001) and who were self-taught (p=.041) had the highest confidence levels. No significant relationships between computer liking, usefulness, or the use of Internet resources and gender, ethnicity, or computer experience were found.

Dependent T-tests were performed to determine whether computer attitude scores (pretest and posttest) increased over a 16-week period for students who had been exposed to computer-driven assignments and other Internet resources. Results showed that students in the experimental group were less anxious about working with computers and considered computers to be more useful. In the control group, no significant changes in computer anxiety, confidence, liking, or usefulness were noted. Overall, students in the experimental group, who responded to the Use of Internet Resources Survey, were positive (mean of 3.4 on the 4-point scale) toward their use of Internet resources which included the online courseware developed by the researcher.

Findings from this study suggest that (1) the digital divide with respect to gender and ethnicity may be narrowing, and (2) students who are exposed to a course that augments computer-driven courseware with traditional teaching methods appear to have less anxiety, have a clearer perception of computer usefulness, and feel that online resources enhance their learning.

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I would also like to thank the Chair of my department, Dr. Frank Moore, who encouraged and supported my efforts to complete this terminal degree and Dr. Brenda H. Loyd and Dr. Clarice P. Gressard for granting permission to use the Computer Attitude Survey (CAS).

Most of all, I thank my wonderful husband Gary and my children Rebecca and Mark. Their words of encouragement, their unending love and support, and their confidence in my abilities, enabled me to embark on this adventure to realize and accomplish one of my lifetime goals.

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CHAPTER I

INTRODUCTION

Technology has had a profound influence on our society and on education. This influence has been direct and significant. In higher education, technology has served as a valuable tool to enhance and expand learning (O'Banion, 1997). Resta (1992) stated that a new era of computing technology has appeared on college campuses, radically transforming the ways in which knowledge is created, managed and disseminated. "One can no longer afford to ignore technology and still maintain institutional health" (Ehrmann, 1995, p. 24). In a 1995 study conducted by the Institution for Research on Higher Education, one hundred and twelve institutions of higher education were surveyed. Among the nine issues repeatedly mentioned by campus leaders, technology was noted most frequently. Eighty-four percent of the campus leaders indicated "more effective use of technology in teaching and learning" was the most important issue on their campuses (O'Banion, 1997). In 1990, The Campus Computing Project was initiated. This project has been described as the largest continuing study of information technology in higher education in the United States (The Campus Computing Project, 1999). Survey data from 1999 has been provided by college officials, primarily technology officers, at 557 two-and-four year public and private institutions of higher education throughout the U.S. Data from this 1999 survey found that assisting faculty efforts to integrate technology into instruction remains the single most important information technology challenge confronting American higher education over the next two or three years. The Project's 1999 survey also noted

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that 39.2 percent of the institutions participating identified instructional integration as their single most significant instructional technology challenge. This figure was up from 33.2 percent in 1998 and 29.6 percent in 1997 (The Campus Computing Project, 1999).

With technology, instructors can individualize instruction, test for progress, transfer results to other sources, and record achievement (Gates, 1995; Green & Gilbert, 1995; Kulik & Kulik, 1991; Wheeler, 1996). Technology also provides access to great amounts of information including the most recently discovered knowledge (Green & Gilbert, 1995; O'Banion, 1997; Wheeler, 1996; Fletcher-Flinn & Gravatt, 1995) and makes distance and time irrelevant to teaching and learning (Moursund, 1997; O'Banion, 1997; Resnick, 1987; Schauble, 1996). Institutions of higher learning have widely adopted information technology for basic administrative functions to improve data management and productivity (Green & Gilbert, 1995; Nichols, 1998) and have used technology to expand the sense of community and connectedness (Alavi, 1994; Green and Gilbert, 1995; O'Banion, 1997; Miller, 1995; Pinheiro, 1998; Stewart, 1995). The power of technological advances has revolutionized education (Cetron, 1994; Davis & Botkin, 1995; Farrington, G, 1997; Hooker, 1997; Massy, 1997; Thorin & Sorkin, 1997) and has challenged many institutions of higher learning to rethink what they do (Hafner & Oblinger, 1998). Experimentation with reengineering educational institutions, new research on learning, innovative assessment and outcome measures, and new applications of technology have been developed to create more learning-centered institutions (O'Banion, 1997) and a new paradigm for teaching and learning in the age of technology (Koehler, 1998). Hence, the transformation of teaching and learning, via technology, has broad implications. Doucette (1994) noted that commonly applied technologies such as multimedia presentations, simulations, and computer adaptive

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testing are beginning to edge into the transformational category. According to O'Banion (1997), technology that is used for instruction can enhance communication between students and faculty, between students and students and among all participants in the learning process. Furthermore, computer technology provides instructors with the capabilities to access valuable resources and to tailor these educational materials to the diversity of learning styles, cultural differences, skill levels, motivations, disabilities, and educational objectives of an increasingly pluralistic student body.

The key to the effectiveness of computer-driven instructional strategies lies in the recognition by the student and the instructor that there are learning strengths and weaknesses (Edwards, 1995). According to Doucette (1994):

> The emphasis is on the assessment of student learning, not on teaching methodology. The focus is not on content but on transferable skills that are the learning outcomes of courses and programs - the ability to gain access to information, to interpret it, to give it context, to use information to solve problems, and to collaborate with others in problem solution. (p. 23)

The best methodology for fostering learning should incorporate the strengths of all the available methods (including lectures). An interactive multiplicity, that incorporates creativity, technology, information, and collaboration, serves to enhance the learning process (Koehler, 1998). The Campus Computing Project, 1999, highlighted the following:

> Two decades after the first desktop computers arrived on college campuses, we have come to

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> recognize that the campus community's major technology challenges involve human factors - assisting students and faculty to make effective use of new technologies in ways that support teaching, learning, instruction and scholarship. (p. 2)

The Campus Computing survey (The Campus Computing Project, 1999) has revealed that user support in both two and four year colleges and universities is well below that found in organizations and corporations of similar size and technological complexity. However, the use of technology in higher education is rising. Data from The Campus Computing Project (1999) found that more college courses are using more technology resources. About 54 percent of all college courses make use of electronic mail, up from 44 percent in 1998 and 20.1 percent in 1995. The percentage of college courses using Web resources in the syllabus rose from 10.9 percent in 1995 to 33.1 percent in 1998 to 38.9 percent in 1999. Additionally, more than 24 percent of all college courses have a Web page, compared to 22.5 percent in 1998 and 9.2 percent in 1996. The Campus Computing Survey also noted that approximately 75.8 percent of campuses have instructional technology development programs and 65 percent have campus support centers to assist faculty who wish to integrate technology into their courses. However, only 13.7 percent of colleges and universities have a formal institutional plan to reward and recognize faculty who use technology resources in their courses.

Numerous studies have consistently found that many individuals exhibit negative reactions to computers (Gardener, Young, & Ruth, 1989; Gos, 1996; Rosen & Weil, 1990). In a competitive society that demands the use of technology, instructors and course curricula must provide

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strategies to successfully overcome the negative attitudes that exist with respect to computer use (Gos, 1996; Hakkinen, 1994-1995; Rosen & Weil, 1990; Woodrow, 1990). It follows, therefore, that educators should be knowledgeable of the components that make up the overall computer attitude of students - computer anxiety, computer confidence, computer liking, and computer usefulness (Loyd & Loyd, 1985).

The purpose of the proposed study was two fold. First, the study was an effort to provide a meaningful contribution to the knowledge-base by addressing the relationship between computer attitudes and gender, ethnicity, and computer experience. Second, the researcher addressed the question of whether, and to what degree, students' attitudes toward computers changed over a 16 week period in a course that supplemented the traditional lecture with computer-driven assignments.

Statement of the Problem

This study was guided by the following problem statement: What are the relationships between students' attitudes toward computers (anxiety, confidence, liking, usefulness, and Internet resources) and the variables of gender, ethnicity, and computer experience, among undergraduate microbiology students and do these attitudes change over a 16-week period as a result of computer-driven course assignments?

Hypotheses

For the purpose of this study, the following hypotheses were tested:

H1: There are significant relationships between the attitude of computer anxiety and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students.

H2: There are significant relationships between the attitude of computer confidence and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students.

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H3: There are significant relationships between the attitude of computer liking and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students.

H4: There are significant relationships between the attitude of computer usefulness and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students.

H5: There are significant relationships between the students' attitudes toward the use of Internet resources and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students.

H6: Students' computer attitude scores regarding anxiety, confidence, liking, and usefulness will increase over a 16-week period as a result of computer-driven assignments.

Definitions of Terms

The following definitions pertain to terms that were referred to throughout this study:

computer anxiety - a fear or a prejudice that appears when one is using computer technology or when one is thinking about the consequences of its use (Marcoulides, 1989)

computer attitude - an internal state that affects an individual's choice of action toward the computer

computer attitude scale - an instrument that measures the direction and intensity of attitudes toward learning about and using computers

computer confidence - trust in the ability to learn about or use computers

computer-driven assignments - assignments that require access to a computer for research and development of case studies, written reviews, critiques, or other narratives

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computer experience - using or learning to use computers in various settings including self-taught, computer courses, computer training sessions, academic, and work places

computer liking - one's enjoyment and appreciation of computers

computer usefulness - the degree to which a person believes that using a particular computer system would enhance his or her job performance (Davis, 1989)

digital divide - the disparities in access to computers and the Internet across various demographic groups

Identibacter interactus - an interactive CD-ROM used to identify unknown bacteria

Internet resources - courseware developed by the researcher including coursenotes, QuickTime movies, graphs, tables, animations, study questions, links to remote Web sites located at the researcher's Website, or any microbiology resources available on the World Wide Web (WWW)

Limitations of the Study

The following were limitations of this study:

1. The study was confined to selected variables that might influence students' attitudes toward computers.

2. There was no random selection or assignment of subjects. The subjects consisted of intact groups of students enrolled in an undergraduate microbiology course, during the fall semester, at a four year comprehensive university.

3. When two instructors teach different sections of the same course, there are personality and teaching style considerations that may play a part in student responses to survey questions. These variables were not considered in this study.

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4. Students' attitudes toward computers may be influenced by many different factors. Hence, any other subjects, variables, or conditions not so specified were considered to be beyond the scope of this study.

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CHAPTER II

REVIEW OF RELATED LITERATURE

Students and Computers

Computer technology has become a way of life for the young and is increasingly important to older adults (Levy, 1995; Green, 1996). Most kindergarten and first-grade students are able to use simple technology applications by the time they start school (Iomega Corp, 2000). For quite some time, computer literacy and competency has been considered to be a prerequisite for success in many college degree programs and careers (Furste-Bowe, Boger, Franklin, McIntyre, Polansky, & Schlough, 1995-1996). According to Cronbach and Snow (1977), the goal of a "true" education is to accommodate the individual by tailoring instruction to his/her needs. Taraban and Brothen (1999) noted that new technologies provide students with unique opportunities for scheduling and pacing their study time within the context of Internet delivery, while allowing them the opportunity to practice and review course material until they reach a level of mastery. Hence, technology has become, not a new teacher, but a new and decidedly different presence in the classroom (Koehler, 1998).

There has been widespread introduction of computers into the schools in recent years. The *Digest of Education Statistics* (1998) reported that in 1997, the average public school contained 75 computers. Along with computer technology has come the introduction of the Internet. The proportion of schools with Internet connectivity has increased dramatically from 35 percent in 1994 to 89 percent in 1998. This same report noted that the total computer usage rate of students at

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school increased from 59 percent in 1993, to 69 percent in October, 1997, the rate for grades 1 to 8 increased from 69 percent in 1989 to 79 percent in 1997, and the computer usage rate in 1997 was 70 percent for students in high school and 55 percent for students in college. Approximately 43 percent of elementary school children used computers at home and about 24 percent used them for schoolwork. The report added that high school students and college undergraduates were much more likely than elementary school children to use home computers for schoolwork. Findings in this report also showed that students in higher income families were more likely to use computers at home and use them for schoolwork than students from lower income families. In addition, the survey reported that 13 percent of high school students in households with incomes between $25,000 to $29,999 used computers at home for school work compared to 45 percent with household income levels of $75,000 (*Digest of Education Statistics*, 1998).

Given the rapid growth in the acceptance of technology in the educational arena, spending for this technology has increased dramatically. According to a report from Quality Educational Data Inc. (QED), during the 1998-1999 school year, school districts spent a record $6.7 billion on educational technology, up from $5.4 billion the previous school year. This is the highest percentage increase in growth since QED began tracking technology budgets a decade ago (*Education Technology News*, 2000).

Attitudes Toward Computers

Computer attitude is complex and multi-dimensional. In general terms, attitudes are " learned predispositions to respond positively or negatively to certain objects, situation, concepts, or persons" (Aiken, 1980, p.2). In addition, attitudes vary in intensity, with respect to the level of commitment to which the attitude is held (Fleming & Levie,

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1978). According to Zimbardo and Ebbesen (1970) attitudes are thought to have three components: affective, cognitive, and behavioral. The affective component consists of the emotional response or the person's liking of, or evaluation of, some object or person. The cognitive component is associated with a person's knowledge or factual beliefs about an object or person. The behavioral component refers to the person's overt behavior toward the object or person (Thompson, Simonson & Hargrave, 1996). By applying these tenets, several researchers have attempted to evaluate the impact that various educational technology strategies have had on attitude formation, particularly on computer attitudes, and change among students (Reed & Overbaugh, 1993; Reed & Liu, 1994, Thompson et al. 1996). Computer attitudes represent a specific subset within the overall construct of attitude, with the computer serving as the object (Weizenbaum, 1984). Although attitudes are latent and not directly observable, they do act to organize or provide direction to actions and behaviors that are observable (Davis, 1989). Fishbein and Ajzen (1975) suggested that attitudes influence behavior, including performance. Their Theory of Reasoned Action (TRA) holds that attitudes will influence behavior, including performance. In the Technology Acceptance Model (TAM), Davis (1989) notes that attitudes toward use directly influences intentions to use the computer and ultimately actual computer use. Davis, Bagozzi, and Warshaw (1992) showed that an individual's initial attitudes toward the computer's ease of use and its usefulness influence the attitude one has toward its use. In addition, Hakkinen (1994-1995) noted that the first experiences with computer technology have strong effects on attitudes toward computers.

Several researchers have shown that students may display negative attitudinal and affective reactions to computers (Gardner, Young, & Ruth, 1989; Reed & Palumbo, 1987-1988; Reed & Overbaugh, 1993; Reed &

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Liu, 1994, Palumbo & Reed, 1987-1988). Lambert (1991) has characterized these negative attitudinal reactions as computer aversion.

Thompson et al. (1996) noted that although the relationship between attitudes and learning is unclear, students are more likely to remember information, seek new ideas, and continue studying when they react favorably to an instructional method and a particular content area. Hence, it is important for educators to be aware of those factors that influence attitudes in one direction or another so that bias may be reduced (Thompson et al., 1996). Attitude, then, plays an important role in instructional design and implementation.

Loyd and Gressard (1984a) noted that positive attitudes will increase the prospect for achievement in any academic endeavor, while negative attitudes make achievement or competency less likely. For some students, this negative attitude toward computer use has been shown to interfere with personal and career choices (Weil, Rosen, & Wugalter, 1990). Decreasing computer anxiety, then, is an important goal in the educational setting. Loyd and Gressard (1984b) identified three attitudes toward computers that are of importance: anxiety toward or fear of computers or learning to use computers; confidence in the use of or ability to learn about computers; and liking or enjoying the use of computers. A fourth attitude subscale, computer usefulness, was added by Loyd and Loyd (1985). Whiteside, Lang, and Whiteside (1989) referred to attitudes toward computers as "internal factors" that play a major role in a person's willingness to use computers. The study by Anderson, Hansen, Johnson, and Klassen (1979) indicated that attitudes toward new technologies are predictive of their adoption and Delcourt and Kinzie (1993) provide evidence that teachers must have positive attitudes about computers before they will embrace new technologies.

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Computer Anxiety

Computers are an integral part of our society and knowing how to use them has become a basic skill (Mauer & Simonson, 1993-1994). Reticence, apprehension, or fear about using computers are components of what has been called computer anxiety (Widmer & Parker, 1984). In general, anxiety has been identified as consisting of two components, trait anxiety and state anxiety. Trait anxiety is a rather stable condition and is personality related. State anxiety, on the other hand, is situation specific, usually resulting from some stress-producing situation over a period of time (Jonassen, 1986). Cambre and Cook (1985) have suggested that computer anxiety is a state, rather than a trait anxiety. Hence, computer anxiety could be changed over a period of time. Hakkinen (1994-1995) has pointed out that computer anxiety may have connections to trait anxiety because various trait characteristics such as fear of failure do exist within the construct of the anxiety.

Computer anxiety has also been interpreted as a form of test anxiety when computer use is seen as a performance situation and/or one in which users are comparing themselves to others (Hakkinen, 1994-1995). There have been numerous studies to support the hypothesis that computer anxiety is a measurable and distinct construct. These studies include research on the relationship of computer anxiety to computer-related instruction (Cambre & Cook, 1987; Chapline & Turkel, 1986; Hakkinen, 1994-1995; Honeyman & White, 1987; Lambert & Lenthall, 1989; Pope-Davis & Vispoel, 1993; Thompson, 1985), the development of measures of computer anxiety (Loyd & Gressard, 1984b), the psychometric properties of these measures (Bandalos & Benson, 1990; Dukes, Discenza, & Couger, 1989), and the relationship between computer anxiety and math anxiety, general anxiety and computer experience (Dambrot, Watkins-Malek, Silling, Marshall, & Garver, 1985; Gos, 1996; Gressard & Loyd, 1984;

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Kernan & Howard, 1990; Torkzadeh & Angulo, 1992). In addition, numerous studies have reported relationships between computer anxiety and learning styles, learning disabilities, demographic factors, and personality variables (Ayersman & Reed, 1995-1996; Bozionelos, 1997; Hawk, 1989; Loyd & Gressard, 1987; Rosen, Sears, & Weil, 1987; Suthakaran & Sedlacek, 1999).

Negative interactions with computers may cause reactions similar to other types of phobias. Jay (1981) described computer phobia as a resistance to talking about computers or even thinking about them, fear or anxiety toward computers, and hostile or aggressive thoughts about computers. Hence, when the real reason for the anxiety is actually the computer and the response is uncontrollably fearful, the condition has been described as a computer phobia (Hakkinen, 1994-1995). Studies by Rosen and Weil (1990) showed that for some students these phobias may be so severe as to cause students to have difficulty performing even simple tasks. Such negative influences obstruct confidence and diminish the students' ability to learn.

The interactions that exist between humans and computers are complex. Responses to computers may differ depending on many factors. Learning style, demographics, previous experience, social support that is received, and various coping strategies are among the variables that must be considered (Hakkinen, 1994-1995). Hence, what one individual may experience as a negative reaction, and resistance to change in one situation, may not be the same for another individual.

Computer Confidence

The confidence variable, or self-efficacy, may be especially important (Bandura, 1977; Delcourt & Kinzie, 1993). Bandura (1977) defines self-efficacy as an individual's confidence in his or her ability to perform the behavior required to produce specific outcomes.

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Computer confidence may then be an important indicator of the willingness of students to use the computer. In 1987, Hill, Smith, and Mann noted that actual experience with computers has been shown to enhance an individual's personal sense of self-efficacy with computers. Larson and Smith (1994) found that even the most experienced students entering college still avoided courses requiring computer use. Sherry and Sherry (1997) conducted a study of community college students to determine whether a significant relationship existed between college retention and the confidence expressed toward using one or more types of computer application programs. They found that those students who indicated that they were confident using spreadsheets for college assignments were significantly more likely to persist in college than those who did not indicate such an ability.

In 1998, Karsten and Roth designed a study to identify the relationships between computer experience, computer self-efficacy, and computer-dependent performance in an introductory computer literacy course. They noted that only computer self-efficacy was found to be significantly related to computer-dependent course performance. Thus, according to Karsten and Roth (1998), perhaps introductory courses play an important, confidence-building role in confirming, as well as in developing, the skills necessary for successful computer use in later college courses and careers.

Computer Usefulness

The Pew Research Center for The People and The Press (January, 2000) stated that sixty-eight percent of adults use a computer at work, school or home, at least occasionally. Both males and females believe computers will be important to their futures (Lockheed, 1985). A survey conducted in 1994, found that ninety-eight percent of the schools in the

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United States make computers available for instruction (Quality Education Data, QED, 1994b). Anderson (1987) and Harrington (1991) both noted that the major presence of computers is justified in terms of providing access to information resources and in terms of their functioning as research tools and motivators.

The reported literature finds that the perceived usefulness of computers, access to computers, and some knowledge of computers leads to positive attitudes and anticipated future use (Sherry & Sherry, 1997). Malaney and Thurman (1989) also found that computer use before entering college, if combined with access to computers and anticipated future use, identified computer use (and its usefulness) for the participants in their study. In addition, Wu and Morgan (1989) found that a student's perception of the computers' educational benefits, or its usefulness, was related to the amount of computer use. In their 1988 study, Carroll and Rosson identified two phenomena related to computer use. The first indicates that individuals often have difficulty using computers. The second, highlights the fact that the users' computer skills may be mediocre. Often the users' concepts about learning to use computers cause illusions about the benefits. Hence, when individuals begin to use computers, they expect their work to be made easier. Unfortunately, they may also become less motivated to learn a new system or software. When this occurs, users may continue to use older systems and not explore new possibilities.

Gender

Much of the literature that has been written in the 1980s and early 1990s on the relationship between gender and computer attitudes reported that males had a more positive attitude toward computers than did females (Anderson, 1987; Chen, 1985; Farina, 1991; Johanson, 1985; Merchant & Sullivan, 1983; Nickell & Pinto, 1986; Okebukola, 1993;

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Rosen, Sears, & Weil, 1987). Johanson (1985) also noted that females tended to express less confidence in working with computers than did males. Miura (1987) found that male students most often viewed the computer and classified its skills as masculine rather than feminine and noted that male students showed a greater interest in computers and their use than did females. Murphy, Coover, and Owen (1989) conducted a study of college students that showed greater accuracy of skills in males, in conjunction with their higher level of self-efficacy, than females. Williams and Johnson (1990) reported that female students majoring in computer science and students (males and females) majoring in education showed higher levels of computer anxiety than male students majoring in computer science.

Numerous studies have tried to explain why males have a more positive attitude toward computers than do females (Butler, 2000). The idea that there is a cultural bias with technology being a "male" domain was suggested by Lage (1991); Sanders (1985); Stalker (1983); and Thurston (1990). The thought that computer technology is linked to math, and identified more closely with males was studied by Culley (1988); Eastman and Krendl (1987); and Thurston (1990). Culley (1988); Lockheed (1985); Stalker (1983); and Wilder (1985), noted that software was biased in favor of male interests and Culley (1988) and Nelson and Cooper (1989); showed the tendency of females to use computers less than males at home. Collis, Kass and Kieren (1989); Linn (1985); and Sanders (1989); found female students using technology significantly less than males in science classes. Koontz (1991) found gender inequities favoring males during classroom instruction related to technology. In addition, Stalker (1983) commented on the fact that during the 1980's there was a lack of women teachers as role models in computer science. Culley (1988) and Sanders (1985) found that males tended to favor games

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and random play on the computer, whereas females preferred goal-oriented computer use. Males were also found to be more aggressive in a classroom situation, sitting at computer stations first (Elliot, 1990; Sanders, 1985; Stalker, 1983). Studies by Fish, Gross, & Sanders, (1986); Hawkins (1985); and Sanders (1985), noted that females, especially during the early teen years, prefer group work and collaboration to working alone and did not find the social setting of the computer lab particularly attractive.

From the mid-1990s to the present, there have been mixed reviews with respect to gender differences (Butler, 2000). Many researchers believe that technology inequities still exist. According to a study by the American Association of University Women (1999), "...girls of all ethnicities consistently rated themselves...lower than boys on computer ability" (p 71). The report also stated:

> As a whole, research shows that girls have developed an appreciably different relationship to technology than boys, and that as a result, technology may exacerbate rather than diminish inequities by gender as it becomes more integral to the K-12 curriculum. (p. 72)

According to Durndell, Glissov and Siann (1995) and AAUW (1999), female enrollment in computer programming courses still lags behind that of males, women are underrepresented in computer technology careers, and females comprise only seventeen percent of the AP computer science test takers in public high schools. Selby and Ryba (1993) found females using technology significantly less than males in science and mathematics classes. Cooper and Stone (1996) found that females tend to experience greater computer anxiety. Boser, Daugherty and Palmer (1996); Durndell

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et al. (1995); and Hodes (1995-1996) found that females rated themselves lower on computer ability than did males. Reinen and Plomp (1993) noted that there are fewer female computer science instructors, and that teachers may be unconsciously giving females the message that women do not need to participate in computer technology (Koch, 1994). In addition, males use the computer more at home than do females (Koch, 1994; Durndell et al., 1995; Reinen & Plomp, 1993). Swanson (1997) and Koch (1994) reported that socioeconomic conditions in the United States tend to reinforce female's negative attitudes toward computers. In one of the most recent studies, involving 15,577 tenth grade students, researchers found that female students were less likely to use computers in both science and mathematics than males, although females were more likely to use calculators in their mathematics class than males (Owens & Waxman, 1998).

Other studies, however, have suggested that the gender gap may be narrowing (Smith & Necessary, 1996; Ayersman, & Reed, 1995-1996), although a study of computer skills at Sultan Qaboos University by Qutami and Abu-Jaber (1997) showed significant differences in some specific low-level computer skills in favor of males. No significant differences, however, were found in the advanced skills. Ayersman and Reed (1995-1996) investigated the effects of learning style, programming, and gender on computer anxiety and found that females significantly outperformed males on the hands-on (programming) component of the exam. Females also outperformed males on the written performance measure. Huang and Waxman (1996), in a study of middle school students, found that there were no significant differences between males and females on technology use in mathematics.

Historically, some women have excelled in the computer world. According to Lockheed (1985) one of the first computer programmers was

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Augusta Ada Lovelace, who wrote instructions for Babbages's early computing machine of the 1800's. Adele Goldstine wrote the first computer programs for the ENIAC in the 1940's, and Grace Hooper pioneered work with COBOL.

The literature suggests that researchers are looking at ways to enhance the computer experiences of females (Butler, 2000). Koch (1994) has indicated that collaborative activities tend to increase females' computer use. Cooper and Stone (1996) and Boser, Daugherty, and Palmer (1996) have used various inquiry techniques and communication schemes, and Elliott (1990) has recommended software that requires collaboration and communication, which females prefer. In addition, Eastman and Krendl (1987) found that the type of computer task that is initiated contributes to female attitudes. The work of Valenza (1997) and Koch (1994) highlight the importance of exposing middle school students to computers. It is their belief that computer attitudes and use are influenced most during the adolescent years.

Ethnicity

Our educational system must ensure that students are prepared for our technologically demanding society. Unfortunately, several conceptual articles, reviews of the research, and personal accounts have found that access and use of technology has not been equitably distributed in schools and among all students (Owens & Waksman, 1998). Cole and Griffin (1987) found that elementary and secondary students from higher income families used computers in school and in their homes more frequently than did students from lower-income families. Piller (1992) noted that African American and Hispanic students in urban schools were found to have less access to computers than did white students. Studies have also found that computers, used in urban schools where there are greater

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numbers of African American and Hispanic students, are mostly used for tutorial and rote-drill-and-practice routines. Suburban schools, on the other hand, where students are more affluent, use computers for programming and problem solving (Cole & Griffin, 1987; Sutton, 1991). This disparity is troublesome, because use of role-drill-and-practice is associated with low-level skills, while programming and problem solving involves higher-level thinking and learning (Picciano, 1994). In addition, Apple (1988, 1991); Cummins and Sayers (1990); Hativa (1988); Johnson and Maddux (1991); Kirby, Oescher, Smith-Gratto, and Wilson (1990); Sutton (1991), found that technology use in schools widens the achievement gaps between African American, Hispanic, and White students.

Marriott and Brant (1995) noted that non-whites are more likely to be reluctant to embrace computers because they feel that technology is a white, male dominated sphere. Non-whites, young and old, view computers with suspicion, fearing that technology in their homes may invade their privacy (Marriott & Brant, 1995; Ervin & Gilmore, 1999). With respect to responses by African American college students, Ervin amd Gilmore (1999) found that 35 percent of African American males believed that the Internet and World Wide Web were government tracking devices, while 58.8 percent of African American females believed this to be true. Marriott and Brant (1995) contend that software rarely reflects the non-white cultures, and until recently, there have been few Internet sites devoted to non-white issues or topics.

A review of data on electronic access by households in the U.S. has been collected by the U.S. Department of Commerce's Bureau of the Census (U.S. Department of Commerce, 2000). The Census data reveal the following trends:

·Those with a college degree are more than eight times as likely to have a computer at home, and

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> nearly sixteen times as likely to have home Internet access, as those with an elementary school education.
>
> ·A high-income household in an urban area is more than twenty times as likely as a rural, low-income household to have Internet access.
>
> ·A child in a low-income White family is three times as likely to have Internet access as a child in a comparable Black family, and four times as likely to have access as children in a comparable Hispanic household.
>
> ·A wealthy household of Asian/Pacific Islander descent is nearly thirteen times as likely to own a computer as a poor Black household, and nearly thirty-four times as likely to have Internet access.
>
> ·Finally, a child in a dual-parent White household is nearly twice as likely to have Internet access as a child in a White single-parent household, while a child in a dual-parent Black family is almost four times as likely to have access as a child in a single parent Black household. (p.1)

The data show that the so called digital divide still exists and, in many cases, has widened significantly. The gap, with respect to technology, has grown larger by categories of race, income, and education, however, some gaps for computer ownership and access (among certain income and education levels) are closing (U.S. Department of Commerce, 2000). For example, ownership of computers and access to the Internet has soared since 1994 for all demographic groups in all

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locations, although certain minority or low-income households in rural America still have low connectivity rates. The role of ethnic origin is pronounced when looking at similarly situated families. A White, two-parent household earning less than $35,000 is nearly three times as likely to have Internet access as a comparable Black household and nearly four times as likely to have Internet access as Hispanic households in the same income category (U.S. Department of Commerce, 2000).

The Census also notes that the chief concern is the growing digital divide. Groups that were already connected (higher-income, more educated, White and Asian/Pacific Islanders) are now far more connected, while those with lower rates of use and access (low-income, Black or Hispanic or Native American, less educated, single-parent families, young heads-of-households, those who live in the South, rural areas or inner cities) have increased less quickly. Hence, the result is that the gap between the "haves" and the "have nots" is growing over time (U.S. Department of Commerce, 2000).

Ronald Roach (1999) states:

> In recent years, the federal government, community groups, and other organizations have warned Americans about the growing "digital divide" occurring as Internet and computer usage increases in society. Government agencies, such as the National Telecommunications and Information Administration, and private organizations, such as the Benton Foundation, have advised that a failure to ensure broad access to the Internet and computers will lead to a highly stratified society separated by "information haves and information have-nots". (p. 33)

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Individuals who are not computer literate will have difficulty finding their way in the world (Racial Differentials in Computer Usage, 1995). Hence, all students should have access to, and use of, this technology.

One of the few studies recently reported in the literature involving the perceptions of various ethnic groups and their use of computer technology was reported by Ervin and Gilmore (1999). This study does not support the notion that African American college students are using computers, the Internet, and the World Wide Web less than non-African American college students. Their data reveal that there were no differences in Internet and World Wide Web use among African American students and non-African American students when both groups owned their own computers. Studies of African American, Hispanic, Asian Pacific American, and Native American college students found that regardless of race, 56.1 percent of the students owned computers and 22.2 percent planned to buy one in the near future. In addition, 95.8 percent of those who did not own a computer, used a computer at school, work, or at a friend's house. Most students, 89.6 percent believed that a knowledge of computers, the Internet and the World Wide Web were important to their careers, although 50.1 percent did not have a lot of knowledge about the technology. The researchers also found that Asian Pacific American students used the computer most (71.4 percent), African Americans (63.2 percent), and White students (61.0 percent).

According to the 1997 American Internet User Survey and the Georgia Tech Research Corporation's World Wide Web User Survey (1998), approximately 31 million American adults were using computers, the Internet, and the World Wide Web, 5 million of whom were African Americans (Hoffman & Novak, 1998). Interestingly, in 1998, Hoffman and Novak found that African American students who did not own computers

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used computers less often than White students who did not own computers. Ervin and Gilmore (1999) noted the opposite - they found that African American students who were non-owners of computers used computers more than White students who were non-owners. Hence, the findings of Ervin and Gilmore (1999) contradict the idea of a digital divide with respect to use of the Internet and World Wide Web among college students.

Ervin and Gilmore (1999) also looked at gender and computer use. They found that African American males (54.5 percent) were using the computer, the Internet, and the World Wide Web 1 to 4 times per day, whereas African American females (47.1 percent) were using this same technology only a few times a week.

The Forrester Research study of 80,000 U.S. households reported that the digital divide, although real, is an economic issue, not a racial one (Edupage, 2000). This research group contends that politicians are mistakenly viewing the digital divide along racial lines, when it is an income issue. Their findings revealed that Asian Americans are on-line the most (69%), Hispanic Americans (47%), White Americans (43%), and African Americans (33%).

Computer Experience

A major portion of the literature on computer anxiety notes that students become less anxious with increased computer experience (Raub, 1981; Loyd & Gressard, 1984a; Howard & Smith, 1986; Glass & Knight, 1988). According to Taylor and Mounfield (1991) college students are very likely to possess a significant amount of computing experience. Grogan (1991) showed a significant relationship between student attitudes toward computers and experience level. Students with a higher level of experience were more confident and had less anxiety toward computer technology. In this same study, a significant relationship between students' attitudes toward computers and access to a home

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computer was noted. Students with a home computer had a more positive attitude toward computers. Okinaka (1992) also noted that ownership of a home computer was found to be statistically significant in influencing attitude. Additional research suggests that computer attitudes are related to experience with computers (Gardner, Discenza, & Dukes, 1993; Koohang, 1986, 1989). In a study by Hunt and Bohlin (1991) previous computer experiences correlated highly with positive attitudes towards using computers among classroom teachers, with recreational use of computers as the strongest predictor. Numerous other studies have indicated that computer experience reduced computer anxiety (Hakkinen, 1994-1995; Liu, Reed & Phillips, 1992; Marcoulides, 1988; Reed & Palumbo, 1987-1988; Reed & Overbaugh, 1993; Reed & Liu, 1994).

Reed and Palumbo (1987-1988) found a statistically significant negative relationship between prior computer experience and computer anxiety indicating that many people who lack computer experience show high levels of computer anxiety. In her study of university students in Finland, Hakkinen (1994-1995) noted that experience with computer equipment and the use of computers reduced anxiety. She found that completion of a computer science course had a positive effect on student attitudes toward new technology and on students' feelings toward computers. The course not only reduced the students' fear of computers and their desire to escape, but it also increased their knowledge of computers. A study by Okinata (1992) found that attitudes of teacher education students, enrolled in a basic computer literacy course, were related to years of experience using computers, interest in and intention to take other computer courses, and personal ownership of a computer.

Other studies, however, have not supported these findings. Raub (1981) studied students in a computer literacy course and noted that

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they became more adverse to computers as the semester progressed in spite of increases in their computer experiences. Rosen, Sears, and Weil (1987) found no change in computer anxiety when students used computers for one to five hours per week and Marcoulides (1988) found that the effect of prior computer experience on computer anxiety was small. Weil, Rosen and Wugalter (1990) noted that computerphobia was not eliminated by experience alone, and in many instances, experience actually intensified the existing anxiety. Their findings suggested that the benefits of computer experience may depend on how the experience is viewed by the individual. A negative experience, they concluded, may lead to increased computer anxiety. In another study, Rosen and Maguire (1990) investigated the relationship between past experiences and computer anxiety. They noted that individuals who were computerphobic took more time, made more errors, and generally performed more poorly than those who were not computerphobic. They surmised that additional computer experience strengthens negative affective reactions and promotes additional computer avoidance.

In a study by Ertmer, Evenbeck, Cennamo, and Lehman (1994), a direct relationship between experience and levels of confidence was found, indicating that quality rather than quantity of computer experience may be an important factor. Gos (1996) studied undergraduate students in writing courses in computer classrooms and found that there was a substantial correlation between the pleasantness of prior experience and computer anxiety. Students with unpleasant experiences tended to be computerphobic. In addition, Karsten and Roth (1998) suggested that it is the relevance rather than the quantity of computer experience that is most predictive of later performance. In their study to identify the relationships between computer experience, computer

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self-efficacy and computer-dependent performance in an introductory computer literacy course, they found only self-efficacy significantly related to computer-dependent course performance.

In the study by Hill, Smith, and Mann (1987) it was noted that although an individual might have substantial computer experience, computer experience itself does not guarantee successful performance with a computer. Hill et al., (1987) and Larson and Smith (1994) concluded that although *incoming* students are more likely to have computer experience and perceive themselves as computer literate, such experience is often limited to word processing and not necessarily predictive of one's desire to learn about or use computers. Hakkinen (1994-1995) noted that individuals may use computers in their occupation and are still anxious because of the continuing development of computer technology. Even though they may have computer experience, workers may lack the necessary skills until they learn the new system or software requirements. Brock, Thomsen, and Kohl (1992) showed that multiple types of computer exposures were significantly related to student computer literacy levels and Karsten and Roth (1998) suggested that it is the relevance rather than the quantity of computer experience students bring to class that is most predictive of performance. In a study by Todman and Lawrenson (1992) higher levels of computer anxiety were found among first-year university students than among 9 year old children of comparable intelligence. The authors noted that the 9 year olds became familiar with computers in a relaxed environment, as young children. The university students, however, lacked this casual introduction to computers. It is not known if this early relaxed introduction protects students from later, more demanding requirements, with respect to computer use. Hence, several factors may contribute to the overall dimension that is referred to as computer experience.

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CHAPTER III

METHODOLOGY

Subjects

The subjects in this study were undergraduate students enrolled in two sections of general microbiology, a course taught during the fall semester of 2000, at a four year comprehensive university in the southeast. The majority of students who participated in this study were pursuing a bachelor of science degree in biological sciences (control, 73.3%; experimental, 78.9%). They included both genders and were racially mixed. No students under the age of eighteen took part in the study. A total of 126 students participated in this study.

Treatment Protocol

Experimental Group

In the study, the researcher, who was the instructor for the experimental section of an undergraduate microbiology course, provided the students with an array of instructional resources at a password protected Internet Web site. This Web site was designed to serve as a gateway to additional learning material. The researcher's Web site allowed students in the experimental section access to specific course content, curricular resources, and opportunities for critical thinking, collaborative learning, and expert opinion with scientists. On-line course notes, syllabi, test banks, and study questions were developed by the researcher and animations, graphics, photos, and QuickTime movies were downloaded from the Internet and from a Microbiology Presentation Manager (CD-ROM) and integrated into the aforementioned site. In addition, updated information on microbe-human interactions, highlighted

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on various Internet mailing lists, including ProMed, were incorporated into the course notes as a resource "package". Students made use of a CD-ROM called *Identibacter interactus*, collaborated (with a partner) on a research project and reviewed/responded to five case studies (individual assignments). The research project and writing assignments required the use of Internet resources. Over the 16-week semester, the researcher presented the traditional lecture in the classroom using an overhead projector with transparencies. Students later were able to access the interactive multimedia created by the researcher to supplement and/or reinforce the lecture material. Using the computer to create interactive and responsive on-line instruction that could be accessed at any time or place, provided students in the experimental section with multiple learning options within one instructional environment. The computer-driven assignments, developed by the researcher, together with the traditional lecture, resulted in a hybrid learning experience that used technology as a supplement, not a replacement, for the content and substance that has always been a part of this more traditional, lecture-based microbiology course.

Control Group

The control group consisted of undergraduate students in a second section of the general microbiology course, scheduled during the fall semester of 2000, and taught by an instructor other than the researcher. Both the control and experimental groups used the same textbook and were exposed to an equal amount of lecture time. The instructors in both sections made use of an overhead projector with transparencies. The students in the control group did not have access to the password protected Internet Web site nor were they required to collaborate on a research project, submit written reviews of case studies, or respond to other computer-driven assignments.

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Data Collection

The researcher obtained written permission to carry out this research in the fall semester of 1999 from the Human Subjects Protection Review Committee at the university (Appendix E).

Data were collected for a pilot study in the fall semester, 1999 (n=36) and spring semester, 2000 (n=115) using samples of undergraduate microbiology students representing the experimental and control groups. This study was performed to rule out the possibility of a ceiling effect with respect to the subscores of anxiety, confidence, liking and usefulness and to obtain a measure of reliability for the instrument that would be used to measure the attitudes of students toward the use of Internet resources. The students participating in the fall, 1999 pilot study completed the instrument that was developed to measure attitudes toward the use of Internet resources. The reliability coefficient of this instrument, was found to be acceptable - the Cronbach's Standardized Scale alpha coefficient was .7460. Students participating in the spring, 2000 pilot study completed the Computer Attitude Survey (pretest) instrument. Results showed that the scores for computer attitudes (anxiety, confidence, liking and usefulness) were not so high as to prevent individual differences from being measured. The Cronbach's Standardized Scale alpha coefficients for anxiety, confidence, liking, and usefulness were .90, .88, .88, and .81 respectively. Hence, the study could proceed. The participants who took part in the pilot study followed the same guidelines as those that follow.

On the first day of class of the fall semester, August 21, 2000, The Computer Attitudes Scale (CAS) pretest was administered to two class sections of General Microbiology. Students were instructed to place an

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identifying number at the top of the survey form so that the pretest and posttest data could later be matched. This identification number was one that was randomly assigned to the student at the beginning of the course and used throughout the course in laboratory investigations. A proctor delivered an oral presentation to the participants of the study, as per the requirements of the Human Subjects Review Committee. This presentation explained the purpose of the study, the length of time needed to complete the instrument, the opportunity to withdraw without penalty, and assured the participants of confidentiality. In addition the Authorization to Participate in Research Project Consent Form was administered. Each student was then instructed to complete The Computer Attitudes Scale (CAS) pretest.

During the last week of class of the fall semester, December 4-8, 2000, the Computer Attitudes Scale (CAS) posttest, the Use of Internet Resources Survey, and the demographic questionnaire were administered to both the control and experimental groups according to the above mentioned guidelines.

No one, other than the proctor, had access to the survey forms. The surveys were placed in a locked and secure filing cabinet until the study was completed. Once final course grades were submitted, only the researcher had access to the survey forms. These forms were destroyed (shredded) upon completion of the study.

Instrumentation

Two instruments and a demographic questionnaire were used for data collection in this study. The Computer Attitudes Scale (CAS) was used to collect data relating to the computer attitudes of anxiety, confidence, liking and usefulness. The Use of Internet Resources Survey, developed by the researcher, was the instrument of choice for gathering data about the students' attitudes toward the use of Internet resources.

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A demographic questionnaire provided information regarding the subjects' gender, ethnicity, and computer experience. These factors were used in the study as independent variables.

The Computer Attitudes Scale (CAS)

The Computer Attitudes Scale (CAS), developed by Dr. Brenda Loyd and Dr. Douglas E. Loyd in 1985 as a means to measure attitudes toward computers, was the instrument used in this study (Appendix A). The original version of the CAS, a 30-item scale, was developed in 1984 by Dr. Brenda Loyd and Clarice P. Gressard. The revised CAS is a 40-item instrument and is identical to the original except for the addition of a fourth 10-item subscale, which was added to analyze the attitudes toward usefulness of computers. The CAS is divided into four, 10-item subscales: computer anxiety, computer confidence, computer liking, and computer usefulness (Table 1). The questions are coded so that the higher the score, the more positive the attitude. Hence, the four factors are interpreted as follows: individuals scoring high on anxiety are less anxious and more positive toward computers; individuals scoring high on confidence, liking, or usefulness are more positive toward computers. In addition, when scores on the subscales are combined, a higher score corresponds to a more positive attitude toward working with and learning about computers (Loyd & Gressard, 1984a; Loyd & Loyd, 1985).

The CAS has been widely used with administrators, teachers, college students, and pre-college students to assess the attitudes of individuals toward computers and has been established as a valid and reliable measure of computer attitudes (Gressard & Loyd, 1984; Gressard & Loyd, 1985b; Hignite & Echternacht, 1992; Kluever, Lam, Hoffman, Green, & Swearingen, 1992; Koohang, 1986, 1987b; Loyd & Gressard, 1984a;

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Loyd & Gressard, 1987; Loyd & Loyd, 1985; Massoud, 1991; Pinto, Calvillo, & Nickell, 1985; Pope-Davis & Vispoel, 1993; Woodrow, 1991). Factor analyses in these studies showed that the subscales were sufficiently stable and the instrument could be used confidently and effectively in research and program assessment. The four basic subscales of anxiety, confidence, liking, and usefulness all show high internal reliability. The CAS was also found to be sensitive to attitude changes resulting from computer experience and instruction.

Loyd and Loyd (1985) reported Cronbach alpha reliabilities of .90, .89, .89, and .82 respectively for the subscales of computer anxiety, confidence, liking, and usefulness. In addition, Gressard and Loyd (1985a) used a multiple matrix sampling technique to test the instrument and subscales. Their results showed that the CAS was also reliable and valid when group size varied.

Pinto et al., (1985) used operators and computer programmers at a public utility company to test the validity of the CAS. The subscales were shown to measure attitude either positively or negatively when correlated with age, experience and gender. Hence, CAS was identified as a valid and reliable instrument for predicting behaviors related to computer attitudes.

Pope-Davis and Vispoel (1993) performed studies using CAS on college education students. Their reliability analyses revealed coefficient alpha estimates on the four subscales of computer anxiety, confidence, liking, and usefulness as .91, .88, .88, and .92, respectively. These estimates closely resembled the reliability coefficients in the range of .80 to .90, as reported by other workers (Grogan, 1991; Loyd & Gressard, 1984a; Woodrow, 1990).

Permission to use this instrument was granted by Dr. Douglas E. Loyd with credit given to the authors, Dr. Brenda H. Loyd and

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Dr. Clarice P. Gressard (Appendix D). The instrument was sent to the researcher along with explanations of the scoring and coding methods.

The Use of Internet Resources Survey

The Use of Internet Resources Survey was developed by the researcher and was used to gather information concerning the attitudes of students toward their use of Internet resources, including the online courseware, developed by the researcher (Appendix C). This instrument consisted of eleven items using a four-point Likert-type scale with a list of options of Strongly Agree, Slightly Agree, Slightly Disagree, and Strongly Disagree. The reliability of this instrument was determined by internal consistency measures (coefficient alpha) analysis. The Cronbach's Standardized Scale alpha coefficient was .7460. The instrument was examined by three faculty members in the fields of instructional technology, microbiology, and biology, all of whom agreed that the instrument did appear to measure the use of Internet resources, was readable, left no terms undefined, and included items that were representative of the content and subject matter covered in the course.

Demographic Questionnaire

A demographic questionnaire provided information regarding the students' gender, ethnicity, and computer experience (Appendix B). These factors were used in the study as independent variables.

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Table 1

Computer Attitudes Scale Survey (Subscales Scores)

Item	Question No.	Cronbach α {Loyd & Loyd (1985)}	Cronbach α {this study}
Anxiety	1,5,9,13,17 21,25,29,33,37	.90	.90
Confidence	2,6,10,14,18 22,26,30,34,38	.89	.88
Liking	3,7,11,15,19 23,27,31,35,39	.89	.88
Usefulness	4,8,12,16,20 24,28,32,36,40	.82	.81

Use of Internet Resources Survey

	1 to 11	.7460

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Analysis of Data

All processing of data was conducted on a PC using the SPSS for Windows version 10.0. Multiple regression analyses were used to determine the relationship between students' computer attitudes of anxiety, confidence, liking, and usefulness as they relate to gender, ethnicity and, computer experience. Dependent T-tests were performed to determine whether computer attitude scores (pretest and posttest) of anxiety, confidence, liking, and usefulness increased over a period of 16-weeks for students who had been exposed to computer-driven assignments.

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CHAPTER IV

RESULTS

Introduction

This study was conducted to assess the attitudes of undergraduate microbiology students toward computers and to evaluate the use of Internet resources. The undergraduate students who were the subjects of this study were composed of two groups (control and experimental). The experimental group was exposed to an array of instructional resources at a password protected Internet Web site, developed by the researcher; the control group was not. The research questions that were posed for the purpose of statistical description and analysis were stated as:

1. Are there significant relationships between the attitude of computer anxiety and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students?

2. Are there significant relationships between the attitude of computer confidence and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students?

3. Are there significant relationships between the attitude of computer liking and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students?

4. Are there significant relationships between the attitude of computer usefulness and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students?

5. Are there significant relationships between the students' attitudes toward the use of Internet resources and the variables of

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gender, ethnicity, and computer experience among undergraduate microbiology students?

6. Will the students' computer attitude scores of anxiety, confidence, liking, and usefulness increase over a 16-week period as a result of computer-driven assignments?

Description of the Control and Experimental Groups

Descriptions of the control and experimental groups with respect to age, gender, ethnicity, socioeconomic level, Grade Point Average (GPA), commuter status, major, transfer status, computer ownership, and use of and experience with working with computers are provided in the following sections.

Age

There were no significant differences in age between the two groups who were surveyed. The majority of students in both the control and experimental groups were between the ages of 18 to 22 (Table 2).

Table 2

Count and Percentage of Students by Age

Age	Control		Experimental	
	Count	Percentage	Count	Percentage
18 to 22	30	88.2	60	74.1
23 to 25	2	5.9	13	16.0
26 to 30	2	5.9	4	4.9
31 to 35	0	0	3	3.7
36 to 40	0	0	1	1.2
Total	34	100.0	81	100.0

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Gender

There were no significant differences in the distribution of males and females in the control and experimental groups (Table 3).

Table 3

Count and Percentage of Students by Gender

Gender	Control		Experimental	
	Count	Percentage	Count	Percentage
Male	13	38.2	26	32.1
Female	21	61.8	55	67.9
Total	34	100.0	81	100.0

Ethnicity

No significant differences in ethnicity were found among the control and experimental groups (Table 4).

Table 4

Count and Percentage of Students by Ethnicity

Ethnicity	Control		Experimental	
	Count	Percentage	Count	Percentage
Black	9	26.5	22	27.2
Hispanic	1	2.9	1	1.2
Pacific	0	0	1	1.2
White	23	67.6	54	66.7
Other	1	2.9	3	3.7
Total	34	100.0	81	100.0

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Grade Point Average (GPA)

Control and experimental groups were similar with respect to their Grade Point Averages. No significant differences were found (Table 5).

Table 5

Count and Percentage of Students by GPA

GPA	Control		Experimental	
	Count	Percentage	Count	Percentage
less than 2.5	3	8.8	7	8.6
2.5 to 2.8	10	29.4	16	19.8
2.9 to 3.2	11	32.4	18	22.2
3.3 to 3.6	4	11.8	18	22.2
3.7 to 4.0	6	17.6	22	27.2
Total	34	100.0	81	100.0

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Socioeconomic Status (SES)

Respondents from both the control and experimental groups had similar socioeconomic backgrounds (Table 6).

Table 6

Count and Percentage of Students by SES

SES	Control		Experimental	
	Count	Percentage	Count	Percentage
No Response	1	2.2	0	0
Lower	6	13.3	7	9.9
Middle	35	77.8	59	83.1
Upper	3	6.7	5	7.0
Total	45	100.0	71	100.0

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Major

The majority of the students in both the control (73.3%) and the experimental (78.9%) groups were majoring in biological science (Table 7).

Table 7

Count and Percentage of Students by College Major

Major	Control		Experimental	
	Count	Percentage	Count	Percentage
Biology	33	73.3	56	78.9
Biochemistry	1	2.2	6	8.5
Nursing	2	4.4	3	4.2
Med. Technology	4	8.9	1	1.4
Coaching	0	0	2	2.8
Biology ed.	0	0	2	2.8
Elementary ed.	1	2.2	0	0
Chemistry	1	2.2	0	0
Political Sci.	1	2.2	0	0
Anthropology	2	4.4	0	0
Total	45	100.0	71	100.0

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Commuter Status

No significant differences were found between the control and experimental groups with respect to their commuter status (Table 8) or distance traveled (Table 9).

Table 8

Count and Percentage of Students by Commuter Status

Commuter Status	Control		Experimental	
	Count	Percentage	Count	Percentage
Yes	25	55.6	38	53.5
No	20	44.4	33	46.5
Total	45	100.0	71	100.0

Table 9

Count and Percentage of Students by Miles Traveled

Miles Traveled	Control		Experimental	
	Count	Percentage	Count	Percentage
No miles	20	44.4	32	45.7
.25 to 5 miles	16	35.5	23	32.8
6 to 10 miles	3	6.6	6	8.6
11 to 20 miles	1	2.2	0	0
21 to 50 miles	4	8.9	5	7.1
over 50 miles	1	2.2	4	5.6
Total	45	100.0	70	100.0

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Transfer Status

There were no significant differences between the control and experimental groups with respect to the percentage of students who had transferred from a community or four year college (Table 10).

Table 10

Count and Percentage of Students Who Transferred from Another Institution of Higher Education

Transfer Status	Control		Experimental	
	Count	Percentage	Count	Percentage
yes	17	37.8	31	43.7
no	28	62.2	40	56.3
Total	45	100.0	71	100.0

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Computer Ownership

There was a significant difference in computer ownership between the control and experimental groups with a greater percentage of students in the control group owning their own computers (Table 11).

Table 11

Count and Percentage of Students Who Owned Computers

Computer Ownership	Control		Experimental	
	Count	Percentage	Count	Percentage
yes	30	88.2	48	60
no	4	11.8	32	40
Total	34	100.0	80	100.0

* c^2(N=14, df=1) = 8.80, p=.003

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Problems with Computer Access

Students in both the control and experimental groups had similar problems accessing or using computers on campus (Table 12).

Table 12

Count and Percentage of Students Who Had Problems with Access or Using Computers on Campus

Problems	Control		Experimental	
	Count	Percentage	Count	Percentage
always	3	8.8	4	4.9
sometimes	24	70.6	56	69.1
never	7	20.6	21	25.9
Total	34	100.0	81	100.0

E-Mail Account

Both the control and experimental groups had high percentages of students who had e-mail accounts (Table 13).

Table 13

Count and Percentage of Students Who Had E-Mail Accounts

Have E-Mail	Control		Experimental	
	Count	Percentage	Count	Percentage
yes	42	93.3	68	95.8
no	3	6.7	3	4.2
Total	45	100.0	71	100.0

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Use of E-Mail

Responses from students in both the control and experimental groups indicated that most students used e-mail nearly every day or at least 2 to 3 times per week (Table 14).

Table 14

Count and Percentage of How Often E-mail Was Used Among Students

Use of E-Mail	Control		Experimental	
	Count	Percentage	Count	Percentage
none	3	6.7	3	4.2
nearly each day	22	48.9	36	50.7
2 to 3 times/wk	11	24.4	14	19.7
less than twice/wk	5	11.1	10	14.1
rarely	4	8.9	8	11.3
Total	45	100.0	71	100.0

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Use of Home Computer

Responses given as to the ways in which the home computer was used in high school revealed a higher percentage of use in the control group versus the experimental group, for all categories of use (Table 15).

Table 15

Count and Percentage of Ways in Which the Home Computer Was Used

Ways Computer Is Used	Control		Experimental	
	Count	Percentage	Count	Percentage
e-mail	16	61.5	16	35.6
games	20	76.9	21	46.7
word processing	19	73.1	30	66.7
programming	4	15.4	3	6.7
record keeping	12	46.2	13	28.9
graphics/drawing	6	23.1	6	13.3
job/school tasks	23	88.5	36	80.0

* Multiple responses were possible.

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Access to a Home Computer in High School

Students in both the control and experimental groups had equal access to a home computer in high school (Table 16).

Table 16

Count and Percentage of Students Who Had Access to a Home Computer in High School

Access to Home Computer	Control		Experimental	
	Count	Percentage	Count	Percentage
yes	26	57.8	43	60.6
no	19	42.2	28	39.4
Total	45	100.0	71	100.0

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Length of Time Using Computers

There were no significant differences between the control and experimental groups with respect to the length of time each had been using the computer for any reason (Table 17).

Table 17

Count and Percentage of Students by Length of Time Each Had Been Using the Computer

Time	Control		Experimental	
	Count	Percentage	Count	Percentage
1 to 6 months	2	4.4	0	0
6 mo. to 1 yr.	0	0	1	1.4
1 to 2 years	2	4.4	4	5.6
2 to 3 years	3	6.7	3	4.2
3 to 5 years	15	33.3	19	26.8
More than 5 years	23	51.1	44	62.0
Total	45	100.0	71	100.0

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Experience in Learning to Use Computers

Students in the control group (97.1%) had learned how to use computers in a high school computer class whereas 70.0% of students in the experimental group had this experience. Students in the control group (52.9%) had learned how to use computers in a college setting while 70.0% of students in the experimental group had done so. Both groups had little experience using computers in another biology or science course and both the control group (64.7%) and the experimental group (66.3%) were self-taught with respect to their experiences in learning about computers (Table 18).

Table 18

Count and Percentage of Students by Their Experience in Learning How to Use Computers

Time	Control		Experimental	
	Count	Percentage	Count	Percentage
H.S. Computer Course	33	97.1	56	70.0
College Computer Course	18	52.9	56	70.0
Other Biology Course	1	2.9	5	6.3
Computer Workshop	2	5.9	12	15.0
Self-Taught	22	64.7	53	66.3

* Multiple responses were possible.

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Tests of Hypotheses

H1. There are significant relationships between the attitude of computer anxiety and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students.

A multiple regression analysis was used to determine the relationship between student anxiety toward computers and the variables of gender, ethnicity, and computer experience (Table 19). Results from the Computer Attitude Survey (CAS) pretest showed that, in the experimental group, no significant relationships were found between the dependent variable, computer anxiety, and gender or ethnicity. However, statistically significant differences were found when the variables, computer experience and use, were examined. Those students who used computers for the longest period of time (p=.001) and who were self-taught (p=.046), had the lowest computer anxiety levels. (Table 20).

Table 19

ANOVA Summary Table of the Pretest Computer Attitude Scale (Subscale Anxiety) and the Predictors of Gender, Ethnicity, and Computer Experience

Source	SS	DF	MS	F	Sig.	R^2
Regression	5.753	8	.719	2.242	.034	.199
Residual	23.096	72	.321			
Total	28.849	80				

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Table 20

Beta Coefficients of the Pretest Computer Attitude Scale (Subscale Computer Anxiety) and the Predictors of Gender, Ethnicity, and Computer Experience

Variable	Beta coefficient	Sig.
Gender	.088	.446
Ethnicity	-.042	.716
Use	. 400	.011*
H.S. Course	-.120	.310
College Course	.017	.884
Biology Course	.006	.961
Workshop	-.101	.398
Self-taught	.232	.046*

* $p<.05$

H2: There are significant relationships between the attitude of computer confidence and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students.

A multiple regression analysis was used to determine the relationship between the attitude of computer confidence and the variables of gender, ethnicity, and computer experience (Table 21). Results from the Computer Attitude Survey (CAS) pretest showed that, in the experimental group, no significant relationships were found between the dependent variable, computer confidence, and gender or ethnicity. However, statistically significant differences were found when the variables, computer experience and use, were examined. Those students

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who used computers for the longest period of time (p=.001) and who were self-taught (p=.041), had the highest computer confidence levels. (Table 22).

Table 21

ANOVA Summary Table of the Pretest Computer Attitude Scale (Subscale Confidence) and the Predictors of Gender, Ethnicity, and Computer Experience

Source	SS	DF	MS	F	Sig.	R^2
Regression	4.345	8	.543	2.087	.048	.188
Residual	18.740	72	.260			
Total	23.085	80				

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Table 22

Beta Coefficients of the Pretest Attitude Scale (Subscale Computer Confidence and the Predictors of Gender, Ethnicity, and Computer Experience

Variable	Beta coefficient	Sig.
Gender	.075	.519
Ethnicity	.020	.862
Use	.395	.001*
H.S. Course	-.086	.473
College Course	.112	.341
Biology Course	.128	.278
Workshop	-.125	.298
Self-taught	.239	.041*

* $p<.05$

H3: There are significant relationships between the attitude of computer liking and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students.

A multiple regression analysis was used to determine the relationship between the attitude of computer liking and the variables of gender, ethnicity, and computer experience. Results from the Computer Attitude Survey (CAS) pretest showed that, in the experimental group, no significant relationships, between the dependent variable computer liking, and gender, ethnicity, or computer experience were found (Table 23).

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Table 23

ANOVA Summary Table of the Pretest Computer Attitude Scale (Subscale Liking) and the Predictors of Gender, Ethnicity, and Computer Experience

Source	SS	DF	MS	F	Sig.	R^2
Regression	2.184	8	.273	.603	.773	.063
Residual	32.623	72	.453			
Total	34.808	80				

H4: There are significant relationships between the attitude of computer usefulness and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students.

A multiple regression analysis was used to determine the relationship between the attitude of computer usefulness and the variables of gender, ethnicity, and computer experience. Results from the Computer Attitude Survey (CAS) pretest showed that, in the experimental group, no significant relationships, between the dependent variable computer usefulness, and gender, ethnicity, or computer experience were found (Table 24).

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Table 24

ANOVA Summary Table of the Pretest Computer Attitude Scale (Subscale Usefulness) and the Predictors of Gender, Ethnicity, and Computer Experience

Source	SS	DF	MS	F	Sig.	R^2
Regression	2.006	8	.251	1.629	.132	.153
Residual	11.085	72	.154			
Total	13.091	80				

H5: There are significant relationships between the students' attitudes toward the use of Internet resources and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students.

A multiple regression analysis was used to determine the relationship between the students' attitudes toward the use of Internet resources and the variables of gender, ethnicity, and computer experience. Results from the Use of Internet Survey showed that, in the experimental group, no significant relationships, between the dependent variable use of Internet resources, and gender, ethnicity, or computer experience were found (Table 25).

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Table 25

ANOVA Summary Table of the Use of Internet Resources Survey and the Predictors of Gender, Ethnicity, and Computer Experience

Source	SS	DF	MS	F	Sig.	R^2
Regression	1.466	8	.183	.821	.587	.102
Residual	12.937	58	.223			
Total	14.403	66				

H6. Students' computer attitude scores of anxiety, confidence, liking, and usefulness will increase over a 16-week period as a result of computer-driven assignments.

Dependent T-test were performed to determine whether computer attitude scores (pretest and posttest) of anxiety, confidence, liking, and usefulness increased over a period of 16-weeks for students who had been exposed to computer-driven assignments. Results revealed significant differences in the experimental group with respect to the subscales of anxiety and usefulness. After exposure to computer-driven assignments and Internet Resources, students in the experimental group (Table 26) were less anxious about working with computers and considered computers to be more useful. In the control group, no significant changes in computer anxiety, confidence, liking or usefulness were noted (Table 27).

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Table 26

Dependent T-Test Summary Table of Computer Attitude Scores (Pretest and Posttest) for the Experimental Group

Subscales	Mean	Std. Deviation	t	df	Sig. (2 tailed)
Pretest Anxiety	3.3109	.6257			
Posttest Anxiety	3.4809	.5221	-3.464	67	0.001*
Pretest Confidence	3.2699	.5456			
Posttest Confidence	3.3338	.4673	-1.430	67	0.157
Pretest Liking.	2.9328	.6810			
Posttest Liking	2.9250	.6033	0.152	67	0.879
Pretest Usefulness	3.5162	.4192			
Posttest Usefulness	3.6147	.3378	-2.537	67	0.014*

* $p<0.05$

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Table 27

Dependent T-Test Summary Table of Computer Attitude Scores (Pretest and Posttest) for the Control Group

Subscales	Mean	Std. Deviation	t	df	Sig. (2 tailed)
Pretest Anxiety	3.3219	.5116			
Posttest Anxiety	3.4813	.4624	-2.016	31	0.052
Pretest Confidence	3.1484	.5167			
Posttest Confidence	3.2719	.4794	-1.628	31	0.114
Pretest Liking	2.8948	.5844			
Posttest Liking	2.8219	.5655	0.851	31	0.401
Pretest Usefulness	3.4339	.3825			
Posttest Usefulness	3.4969	.3551	-1.288	31	0.207

Use of Internet Resources

The results of the survey conducted to provide information regarding the students' attitudes toward their use of Internet resources, including the online courseware developed by the researcher, showed that respondents in the experimental group were positive in their evaluation of these materials (Table 28), as evidenced by the mean of 3.4 on the 4-point scale. Every student took advantage of the coursenotes with the majority of students accessing study questions, using Internet links for writing papers and other assignments, and using

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the course Internet resources to access other information. Responses to questions that were posed on the Use of Internet Resources Survey indicated that 100 percent of the students used the online coursenotes for review, 91.3 percent of students accessed study questions, 69.6 percent used Internet links for writing papers and other assignments, and 55.1 percent used the Internet resources to access other information. In addition, 50 percent of the students responded that they had spent at least 3 to 5 hours per week using the Internet based resources related to the course.(Table 29). Students also responded in a positive way to the following questions on the Use of Internet Resources Survey: "As a result of using the Internet during the course, I am now more proficient in using online resources" (56 percent strongly agreed); "As the semester progressed, I used the online course materials more than I did at the beginning of the semester" (56 percent strongly agreed); "The course materials provided online by the instructor enhanced my understanding of microbiology" (71 percent strongly agreed).

Table 28.

Descriptive Statistics Summary Table Regarding the Value of Internet Resources

Internet Survey				
N	Minimum	Maximum	Mean*	Std. Deviation
70	1.73	4.00	3.4338	.4659

*Scale: 1=very low; 4=very high

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Table 29.

Percentage of How Online Courseware Was Used by Students in the Experimental Group

How On-line Courseware was Used	Percentage of Students
Review/Print Out Coursenotes	100.0
Access Study Questions	91.3
Access Links for Assignments	69.6
Access Other Information	55.1

* Multiple responses were possible

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CHAPTER V

SUMMARY, DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Summary

We are living in a rapidly changing and increasingly technology-based society and students must be able to not only learn the content of a course, but they must also be able to develop the skills to access course information and resources using the computer. We are already seeing examples of the types of changes that we can expect to become widespread. For instance, we are seeing a global demand for personal computers and computer networks, many colleges now require students to purchase laptop computers, wireless campuses are becoming commonplace, and distance education is bringing major competition into education. In today's world, college students are expected to have basic competency in using a word processor and other computer tools such as spreadsheets, databases, and graphics. The World Wide Web has become a powerful agent of change, providing access to information resources throughout the world. Individuals of all ages are spending a great deal of time "surfing" and creating interactive materials on the Web. Reflecting the growing reliance on technology in education, student use of personal computers has escalated in recent years. According to the latest survey conducted by the University of California, Los Angeles, in conjunction with the American Council on Education, a record 78.5 percent of college freshmen reported using a personal computer frequently during the year prior to entering college. This signifies a major increase in computer use, up from 68.4 percent from 1999 and 27.3 percent when this question

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was introduced to the survey in 1985. Further, the gender gap in use has nearly closed, with 77.8 percent of women and 79.5 percent of men reporting frequent computer use in 2000 (Higher Education Research Institute, 2000). There is no doubt that this new technology has had, and will continue to have, profound effects on our educational system. We are at the beginning of a major revolution in higher education. This study was conducted with these concerns in mind.

The purpose of this study was two-fold. First, to provide a meaningful contribution to the knowledge-base by addressing the relationship between the computer attitudes (of anxiety, confidence, liking and usefulness) and gender, ethnicity, and computer experience. Second, the study examined the question of whether, and to what degree, students' attitudes toward computers changed over a 16 week period in an undergraduate microbiology course that supplemented the traditional lecture with computer-driven assignments. Given the fact that students may have different attitudes toward using and working with computers, it was important to identify variables that may have influenced these attitudes. Hence, the following questions were used for analysis in this study:

1. Are there significant relationships between the attitude of computer anxiety and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students?

2. Are there significant relationships between the attitude of computer confidence and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students?

3. Are there significant relationships between the attitude of computer liking and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students?

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4. Are there significant relationships between the attitude of computer usefulness and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students?

5. Are there significant relationships between the students' attitudes toward the use of Internet resources and the variables of gender, ethnicity, and computer experience among undergraduate microbiology students?

6. Will the students' computer attitude scores of anxiety, confidence, liking, and usefulness increase over a 16-week period as a result of computer-driven assignments?

Multiple regression analyses were used to determine the relationships between the computer attitudes of anxiety, confidence, liking, and usefulness and the variables of gender, ethnicity, and computer experience (research questions 1 to 4) in the experimental group. For this analysis, Computer Attitude Scale (CAS) pretest survey data were used (n=80).

Multiple regression analyses were also used to determine the relationships between students' attitudes toward the use of Internet resources and the variables of gender, ethnicity, and computer experience among students in the experimental group (research question 5). In addition, the results of the Use of Internet Resources Survey were evaluated to provide information as to how the Internet resources, including the online courseware developed by the researcher, were being used by students in the experimental group.

A dependent T-test was performed to determine whether computer attitude scores (pretest and posttest) of anxiety, confidence, liking, and usefulness increased over a period of 16-weeks for students who had been exposed to computer-driven assignments (research question 6).

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Pretest and posttest scores from the CAS survey, using the control (n=32) and experimental (n=68) groups, were used in this analysis.

Discussion

The following section is divided into two discussion segments: (1) the demographic profile of the control and experimental groups and (2) the research questions.

Demographic Profile

Students in the control and experimental groups were evenly matched with respect to age, gender, ethnicity, grade point average, socioeconomic status, college major, commuter status, and miles traveled to campus, transfer status, access to computers on campus, access to e-mail accounts, e-mail usage, access to a home computer while in high school, and length of time each group had been using the computer. Both groups of students had similar backgrounds regarding their experiences in learning about computers. Neither group had many students who had enrolled in other biology or science courses with computer assignments as a requirement and both groups had a high percentage of students who were self-taught with respect to their computer skills.

There were some differences that were noted between the groups. A greater percentage of students in the control group owned their own computers compared to the experimental group. Responses given as to the ways in which the home computer was used in high school showed higher percentages of use in the control versus the experimental groups for: e-mail, games, word processing, programming, record keeping, graphics/drawing, and job/school tasks. Some differences in the ways in which students had learned about computers were also noted between the control and experimental groups. A greater percentage of students in the control group, versus the experimental group had learned about computers

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in high school computer. There were, however, greater percentages of students in the experimental group who had enrolled in college computer courses versus those in the control group. A greater percentage of students in the experimental group learned about computers in computer workshops, while a smaller percentage of students in the control group had this experience. These findings suggest that those in the control group tended to have a somewhat higher usage of the computer as high school students, whereas the experimental group had more exposure to computers via college courses and computer workshops.

The findings showed that both groups had similar experiences with respect to the length of time that they had used computers, to their ability to access and use e-mail, and to their access to campus computers, suggesting that both groups were equally skilled in the use of computer technology.

Research Questions

Computer attitudes toward computers continue to be a concern for educators. The acceptance and acquisition of computer skills is becoming an essential component in the learning process and instructors are being challenged to develop methods to incorporate this technology into their courses. Researchers at the Center for Technology in Learning (Edupage Listserv, 2001) have found that the most effective use of technology occurred when computer skills were integrated with content and teaching method. Educational technology, in itself, may not directly impact learning, but using technology does provide a way to effectively and efficiently store and deliver instructional messages (Thompson, Simonson & Hargrave, 1996). Hence, the power of technology lies in its ability to make education richer and more stimulating by presenting content in a new and dynamic way. Augmenting courses with computer-driven assignments to produce a "hybrid" course seems to inherently provide this

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stimulation and excitement. Designing strategies to lessen anxiety and enhance the perception of computer usefulness of students, who will require computer skills to compete in a global economy, is of utmost importance. The findings of this present study appear to substantiate the above statements with students in the experimental group showing a decrease in anxiety and an increase in the attitude of computer usefulness. Students in the control group, who had not been exposed to the hybrid course (on-line courseware developed by the researcher in conjunction with the lecture), did not show a significant decrease in anxiety nor did they show an attitude change with respect to the usefulness variable.

Gender.

Much of the literature dating from the 1980s and into the 1990s reported that males had a more positive attitude toward computers than did females (Anderson, 1987; Farina, 1991; Merchant & Sullivan, 1983; Nickell & Pinto, 1986; Okebukola, 1993). Mixed reviews have dominated the research findings with respect to gender differences during the past five years (Butler, 2000). Despite closing the gender gap in computer use, a recent survey by the Higher Education Research Institute, 2000, of 269,413 college freshman, noted that women lag far behind their male counterparts when asked about their computing self-confidence. This gap in self-confidence likely contributes to the fact that men are five times more likely than women are to pursue careers in computer programming (9.3 percent of men, versus 1.8 percent of women). Researchers also found that men were twice as likely as women to rate their computer skills as "above average" or "top 10%" relative to people their age (23.2 percent among women, versus 46.4 percent among men). Men also spent far more time on the Internet than did women. According to the findings in this study, in a society that is becoming increasingly

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dependent upon computer technology, women's lack of computer confidence is likely to place them at a disadvantage. It is important to note that although the gender gap in computer confidence has always favored men, the gap among the 2000 freshmen is the largest in the history of the survey (Higher Education Research, 2000).

In another study supported by the American Association of University Women (AAUW) (1999) researchers noted that female enrollment in computer programming courses still lags behind that of males, females comprised only seventeen percent of the AP computer science test takers in public high schools, and women were generally under represented in computer technology careers. On the other hand, studies have suggested that the gender gap with respect to computer technology may be narrowing (Ayersman & Reed, 1995-96; Huang & Waxman, 1996; Valenza, 1997). Findings in the present study appear to substantiate this trend. No differences in computer attitudes of anxiety, confidence, liking or usefulness, between male and female undergraduate microbiology students, were found. These results suggest that, at least among students in this study, females and males had similar computer attitudes with respect to the above mentioned variables.

Ethnicity.

As with gender, there appears to be mixed reviews on the issue of ethnicity as it relates to computer attitudes. In the 1980's and early 1990's, researchers found that computer use among Hispanic and African American students focused on tutorial and rote-drill-and practice skills, while in more affluent schools, students used computers for higher-level thinking and problem solving (Cole & Griffin, 1987; Sutton, 1991). In addition, Apple, 1988, 1991; Cummins and Sayers, 1990; and Johnson and Maddux, 1991, noted that technology use in schools widened

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the achievement gaps between African American, Hispanic, and White students. As recently as the year 2000, the U.S. Department of Commerce stated that the gap between the "haves" and the "have nots" was growing over time (U.S. Department of Commerce, 2000).

Interestingly, these differences, although real, may be more of an economic issue, rather than a racial one (Edupage, 2000). A recent report by the Morino Institute, a technology outreach group, suggested that social divisions in the U.S. may influence the adoption of technology. Access to technology is not the issue, rather, focusing on the skills needed to use the Internet effectively and to use the information once an individual is connected, are paramount (Morino, 2000).

In one of the few studies reported in the literature concerning ethnic perceptions of computer technology, Ervin and Gilmore (1999), noted that African American college students were not using the computer less than non-African American college students. Other studies support this finding. Surveys conducted by the U.S. Census Bureau showed that between 1998 and 2000, Whites had increased their usage of the Internet by 88 percent, Blacks by 218 percent, and hispanics by 172 percent (U.S. Census Bureau, 2000). Results from the present study suggest that the digital divide among whites and non-whites may be narrowing, at least among undergraduate microbiology students who participated in this study. There were no differences between whites and non-whites with respect to computer attitudes of anxiety, confidence, liking, or usefulness.

Computer Experience.

Many studies have suggested that computer experience and computer ownership are related to certain computer attitudes, particularly to lower computer anxiety (Grogan, 1991; Howard, 1986; Hunt & Bohlin, 1991;

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Liu, Reed, & Phillips, 1992; Okebukola, 1993). Unfortunately, these studies have not established a cause and effect relationship. Perhaps lower computer anxiety is a cause of greater computer experience and computer ownership, and not the reverse. In the present study, there was a statistically significant difference in computer ownership between the control and experimental groups with a greater percentage of students in the control group owning their own computers. In addition, students in the control group showed higher percentages, than the experimental group, in the ways in which their home computer had been used during their high school years (for e-mail, games, word processing, programming, record keeping, graphics/drawing, and job/school related tasks). This finding was somewhat surprising in light of the fact that the groups were so evenly matched otherwise.

Weil, Rosen and Wugalter (1990) suggested that experience alone may not eliminate computerphobia and in many cases may exacerbate the existing problems. The benefits of computer experience may depend upon how the experience is perceived or judged by the individual. Hence, a good experience is interpreted by the individual in a positive way, while a bad experience may contribute to increased anxiety.

In the present study, it was difficult to separate the "good" experience of the course (as evidenced by the positive student evaluation of the Use of Internet Resources Survey) and the suggestion that computer experiences may have reduced the student anxiety levels and increased the attitude of computer usefulness. Responses to questions that were posed on the Use of Internet Resources Survey indicated that students used the online coursenotes for review, to access study questions, to link to other sites for writing papers and assignments, and to use the Internet resources to access other information. Clearly, the majority of students found the on-line

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computer resources, and the computer technology that supported this experience, to be worthwhile. They indicated this by showing a significant change in the usefulness subscale over the course of the semester. Most of the students felt that their expectations for the course had been met.

Results from the present study, using the pretest CAS data from the experimental group, suggested that the length of time spent in working with computers and the self-taught variable influenced both anxiety and confidence levels in a positive way. Studies have shown a direct association between college retention and the confidence expressed toward using various types of computer application programs (Sherry & Sherry, 1997), the importance of introductory computer courses to building self-confidence in developing computer skills (Karsten & Roth, 1998), and positive correlations between computer experience and self-confidence in using computers (Hill, Smith, & Mann, 1987).

The confidence variable is often referred to as a "self-efficacy" variable (Bandura, 1977) and, as such, is an indicator of the willingness of an individual to use the computer. It would follow, then, that a student who has used the computer for an extended time and who is self-taught with respect to computer skills (as noted in the present study) would be more likely to have less anxiety and greater confidence in using the computer. These statements hold true in the present study.

Conclusions

Conclusions presented in this section are based on the research questions that were posed at the onset of the investigation.

Research Question 1

Findings from the Computer Attitude Survey (CAS) pretest revealed that the student attitude of anxiety was not influenced by gender or

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ethnicity. However, when the variables of computer experience and use were examined, findings showed that students who used computers for the longest period of time and who were self-taught had the lowest computer anxiety levels in using and working with computers.

Research Question 2

Results from the Computer Attitude Survey (CAS) pretest found that the student attitude of confidence was not influenced by gender or ethnicity. However, when the variables of computer experience and use were examined, findings showed that students who used computers for the longest period of time and who were self-taught had the highest confidence levels in using and working with computers.

These findings suggest that gender and ethnic differences toward computer technology may be changing and that the so called digital divide between males and females and between whites and non-whites may no longer exist, at least among colleges students in this study. It appears that computer experience and use (particularly the length of time an individual has used the computer and whether or not a person was self-taught) are important predictors of computer anxiety and confidence.

Research Questions 3 to 5

Findings from the Computer Attitude Scale (CAS) pretest showed that there were no relationships between the attitudes of computer liking, computer usefulness, or toward the use of Internet resources, and the variables of gender, ethnicity or computer experience. These findings suggest that these attitudes had not been influenced by these variables.

Research Question 6

Students' computer attitude scores (pretest and posttest) showed that changes took place over a 16-week period in the experimental group

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with respect to computer anxiety levels and to perceived usefulness of the computer. After exposure to computer-driven assignments, students in the experimental group were less anxious about working with computers and considered computers to be more useful, while those in the control group evidenced no changes. In addition, the Use of Internet Resources Survey revealed that students in the experimental group, who had used the on-line course materials, found these resources to be very helpful in learning about microbiology.

Students in the experimental group were required to spend more time using the computer to access e-mail and Listserves, navigate the Web to accessing courseware, and to search for information to complete research projects and case study assignments. These multi-faceted requirements contributed to developing more positive attitudes toward computers. At the completion of the 16 week semester, students in the experimental group experienced less anxiety, and felt that computers were more useful to them than did students who had not been exposed to the computer-driven assignments and instructional computer resources.

Implications for Practice

The results of this study have direct inmplications for educational practice. Clearly, integrating Internet resources into the traditional lecture course can serve as a catalyst for active engagement and learning. The processes of learning how to find relevant information, developing strategies to use that information, and making informed opinions on what is presented are valuable tools that will serve students throughout their lifetime. The use of technology is ubiquitous in our society and faculty should be encouraged to augment their courses with online resources that serve to enhance and motivate student interest and success.

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Recommendations

Suggestions for further research are presented below.

1. Attempts should be made to replicate the results of this study using students who are not science majors.

2. Research is needed to determine various teaching strategies that could be used to reduce anxiety in those who may be resistant to reduction in computer anxiety.

3. A long term study that would serve to follow-up on students' attitudes would provide information on whether or not attitudes changed as students were exposed to fewer or additional college courses that were computer-enhanced.

4. Larger numbers of undergraduate microbiology students should be included in a future study.

5. A study to compare computer attitudes of undergraduate white versus non-white females and white versus non-white males majoring in science and other fields should be conducted.

6. Additional studies, to include more information on socioeconomic status of students, specifically family income and parental educational levels, would be helpful in determining the relationship between economic factors and the digital divide.

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APPENDIX A

COMPUTER ATTITUDES SCALE

SURVEY OF ATTITUDES TOWARD LEARNING ABOUT AND WORKING WITH COMPUTERS No.____

Below are a series of statements. There are no correct answers to these statements. They are designed to permit you to indicate the extent to which you agree or disagree with the ideas expressed. Place a checkmark in the space under the label which is closest to your agreement or disagreement with the statements.

	Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
1. Computers do not scare me at all.	____	____	____	____
2. I'm no good with computers	____	____	____	____
3. I would like working with computers.	____	____	____	____
4. I will use computers many ways in my life.	____	____	____	____
5. Working with a computer would make me very nervous	____	____	____	____
6. Generally, I would feel OK about trying a new problem on the computer.	____	____	____	____
7. The challenge of solving problems with computers does not appeal to me.	____	____	____	____
8. Learning about computers is a waste of time	____	____	____	____
9. I do not feel threatened when others talk about computers.	____	____	____	____

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	Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
10. I don't think I would do advanced computer work.	___	___	___	___
11. I think working with computers would be enjoyable and stimulating.	___	___	___	___
12. Learning about computers is worthwhile.	___	___	___	___
13. I feel aggressive and hostile toward computers.	___	___	___	___
14. I am sure I could do work with computers.	___	___	___	___
15. Figuring out computer problems does not appeal to me	___	___	___	___
16. I'll need a firm mastery of computers for my future work	___	___	___	___
17. It wouldn't bother me at all to take computer courses	___	___	___	___
18. I'm not the type to do well with computers.	___	___	___	___
19. When there is a problem with a computer run that I can't immediately solve, I would stick with it until I have the answer.	___	___	___	___
20. I expect to have little use for computers in my daily life.	___	___	___	___
21. Computers make me feel uncomfortable.	___	___	___	___
22. I am sure I could learn a computer language.	___	___	___	___

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	Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
23. I don't understand how some people can spend so much time working with computers and seem to enjoy it.	____	____	____	____
24. I can't think of any way that I will use computers in my career.	____	____	____	____
25. I would feel at ease in a computer class.	____	____	____	____
26. I think using a computer would be very hard for me	____	____	____	____
27. Once I start to work with the computer, I would find it hard to stop.	____	____	____	____
28. Knowing how to work with computers will increase my job possibilities.	____	____	____	____
29. I get a sinking feeling when I think of trying to use a computer.	____	____	____	____
30. I could get good grades in computer courses.	____	____	____	____
31. I will do as little work with computers as possible.	____	____	____	____
32. Anything that a computer can be used for, I can do just as well some other way.	____	____	____	____
33. I would feel comfortable working with a computer.	____	____	____	____
34. I do not think I could handle a computer course	____	____	____	____

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	Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
35. If a problem is left unsolved in a computer class, I would continue to think about it afterward.	____	____	____	____
36. It is important to me to do well in computer classes.	____	____	____	____
37. Computers make me feel uneasy and confused.	____	____	____	____
38. I have a lot of self-confidence when it comes to working with computers.	____	____	____	____
39. I do not enjoy talking with others about computers.	____	____	____	____
40. Working with computers will not be important to me in my life's work.	____	____	____	____

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APPENDIX B

DEMOGRAPHIC SURVEYS

Demographic Survey (Pre) No._____

This survey is being administered at the beginning of the course to gather information concerning people's attitudes toward learning about and working with computers. It should take about ten minutes to complete. All responses are kept confidential. The proctor will collect the survey when you are finished.

Please check or record which applies to you.

1. Age { }

2. Race: { } Black, not of Hispanic Origin { } Hispanic { } American Indian/Alaskan Native { } Pacific Islander { } White, not of Hispanic Origin { } Other

3. Present GPA: { }

4. Your classification in college: { } Freshman { } Sophomore { } Junior { } Senior { } Other

5. Gender: { } Male { } Female

6. How long have you been using a computer (for ANY purpose)?
{ } 1 month to 6 months { } 6 months to 1 year { } 1 year or more
{ } 2 to 3 years { } more than 3 years

7. What has been your experience in learning about computers (check as many as apply to you):
{ } High school computer course(s) { } Computer workshop or short course
{ } 4-yr. college or community college computer course(s)
{ } Self-taught { } Biology or other science course

8. Do you use your own computer for coursework? { } Yes { } No

9. Are you comfortable using: { } Apple/Macintosh { } PC/IBM { } Either one

10. Have you had problems accessing or using computers on campus?
{ } always { } sometimes { } never

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Demographic Survey (Post) Number_____

This survey is being administered at the end of the course to gather information concerning people's attitudes toward learning about and working with computers. It should take about ten minutes to complete. All responses are kept confidential. The proctor will collect the survey when you are finished.

Please check or record which applies to you.

1. Age { }

2. Race: { } Black, not of Hispanic Origin { } Hispanic { } American Indian/Alaskan Native { } Pacific Islander { } White, not of Hispanic Origin { } Other

3. Present GPA: { }

4. Your classification in college: { } Freshman { } Sophomore { } Junior { } Senior { } Other

5. Gender: { } Male { } Female

6. Do you commute to campus? { } Yes { } No
   If Yes, how many miles (one way) do you commute? _____miles

7. Your major area of study? _____

8. Are you a transfer student? { } No
   { } Yes, transfer from _____
   (name of community college or university)

9. Did you have access to a home computer in high school? { } Yes { } No
   (If you answered No, go on to question 10. If Yes was your answer, please continue.)

   A. Who was the person who used the computer at home the most? Multiple answers are OK.

   { } Me { } Brother { } Sister { } Mother/Step mother
   { } Father/ Step father

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B. For what did he or she use the computer? Multiple answers are OK.

{ } e-mail { } Word Processing { } Personal Record Keeping
{ } Job/School Related Tasks { } games { } Programming
{ } Graphics/Drawing Programs

10. Do you now own your own computer? { } Yes { } No

11. Have you had problems accessing or using computers on campus?
{ } always { } sometimes { } never { } I do not use computers on campus

12. A. Do you have an e-mail account? { } Yes { } No

B. If Yes, how often do you use it?
{ } nearly every day { } 2-3 times a week { } less than twice a week
{ } rarely

13. How long have you been using a computer (for ANY purpose)?
{ } 1 month to 6 months { } 1 year to 2 years { } 3 - 5 years
{ } 6 months to 1 year { } 2 to 3 years { } More than 5 years

14. What has been your experience in learning about computers (check as many as apply to you): { } High school computer course(s) { } Self-taught
{ } 4-yr. college or community college computer course(s) { } Computer workshop or short course { } Biology or other science course

15. At school or at work, what have you done with computers? Multiple answers are OK.
{ } e-mail { } Graphics/Drawing programs
{ } Games { } Business/Record keeping/Spreadsheets/Database
{ } Word processing { } Programming

16. How many college courses have you taken where you were required to use a computer regularly?
{ } None { } 1 or 2 courses { } 3 or 4 courses { } 5 or 6 courses
{ } 7 or more courses

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17. What would you say your socio-economic level was during your middle school and high school years:

{ } lower socio-economic { } middle socio-economic { } upper socio-economic

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APPENDIX C
USE OF INTERNET RESOURCES SURVEY

Use of Internet Resources Survey No. _____

This survey is being administered at the end of the semester to gather information concerning people's attitudes toward learning about and working with computers. Place a checkmark in the space under the label which is closest to your agreement or disagreement with the statements.

	Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
1. The value of online resources in education is overemphasized.	____	____	____	____
2. AS A RESULT OF using the Internet during this course, I am now more proficient in using online resources than before.	____	____	____	____
3. Had I known that online materials were going to be used for this course,. I would not have signed up for it.	____	____	____	____
4. As the semester progressed, I used the online course materials more than I did at the beginning of the semester.	____	____	____	____
5. The course materials provided online by the instructor have enhanced my understanding of microbiology.	____	____	____	____
6. I would NOT like to take another course for which use of online course materials is encouraged.	____	____	____	____
7. I would like to see additional courseware be made available online for this course.	____	____	____	____
8. By using the online courseware DEVELOPED BY THE INSTRUCTOR, my understanding of microbiology has been enhanced.	____	____	____	____
9. During this semester, I have accessed numerous educational resources at REMOTE websites which were accessed as "links" from our instructor's online materials.	____	____	____	____
10. During this semester, I have spent considerable time exploring microbiology resources at remote sites OTHER THAN THOSE provided as "links" from our instructor's online materials.	____	____	____	____
11. By using the materials available AT REMOTE WEBSITES, my understanding of microbiology has been enhanced.	____	____	____	____

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A. What is your present grade in this course.{ }A { }B { }C { }D { }F

B. What is the AVERAGE TIME YOU SPENT WEEKLY using ALL Internet based resources related to this course (including time spent online AS WELL AS using downloaded and printed documents and time spent on accessing resources for class assignments/case studies/ papers)?

{ }1 hour { }2 hours { }3 hours { }4 hours { }5 hours

C. I used the online courseware in this course to: (check as many as apply):

{ } review and/or print out course notes

{ } access links for writing papers or other assignments

{ } access study questions

{ } access information I was interested in finding out about in general

D. Were your expectations for this course satisfied? _____ Yes _____ No

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APPENDIX D
LETTER OF PERMISSION TO USE THE COMPUTER ATTITUDE SURVEY

Subject: Loyd/Gressard Computer Attitude Scale
Date: Thu, 16 Sep 1999 10:19:38 -0400 (Eastern Daylight Time)
From: Doug Loyd <douglovd@virginia.edu>
To: Delia Anderson <delia.anderson@usm.edu>

Thank you for your inquiry about the Computer Attitude Scale.

As you may know, Brenda Loyd, author of the CAS, was President of the National Council on Measurement in Education (NCME) at the time of her death in 1995. Dr. Loyd's co-author, Clarice Gressard, has asked me to handle all requests for permission to use their survey, and to provide the CAS survey and scoring protocol to researchers who wish to use their scale.

Therefore, in response to your inquiry, I am attaching a copy of the Loyd/Gressard survey of attitudes towards computers, in an MSWord document (survey.doc). If you have any problem reading it please let me know. Unfortunately I have no further information about the use of the CAS beyond that provided in this message and the attached document.

The survey is scored according to the following:

For questions 1, 3, 4, 6, 9, 11, 12, 14, 16, 17, 19, 22, 25, 27, 28, 30, 33, 35, 36, 38 (Strongly Agree=4, Slightly Agree=3, Slightly Disagree=2, Strongly Disagree=1).

For questions 2, 5, 7, 8, 10, 13, 15, 18, 20, 21, 23, 24, 26, 29, 31, 32, 34, 37, 39, 40 (Strongly Agree=1, Slightly Agree=2, Slightly Disagree=3, Strongly Disagree=4).

The questions are coded so that the higher the score, the more positive the attitude.

Four subscores can also be obtained from the questions.

Anxiety:	1, 5, 9, 13, 17, 21, 25, 29, 33, 37
Confidence:	2, 6, 10, 14, 18, 22, 26, 30, 34, 38
Liking:	3, 7, 11, 15, 19, 23, 27, 31, 35, 39
Usefulness:	4, 8, 12, 16, 20, 24, 28, 32, 36, 40

Again, higher scores correspond to more positive attitude, e.g., a higher confidence score means more confidence and a higher anxiety score means less anxiety.

Permission is granted for use of this scale. In any publications arising from its use, please be sure to credit the authors, Brenda H. Loyd and Clarice P. Gressard.

Thanks for your interest. Best wishes.

Doug Loyd

Attachment: Survey.doc (MSWord)

Douglas E. Loyd, Ph.D. -- General Faculty at U.Va.

mailbox:/Macintosh%20HD/System%20Folder/Preferences/Netscape%20Users/

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APPENDIX E
LETTER OF PERMISSION FROM THE HUMAN SUBJECTS COMMITTEE

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

TO: Delia Anderson
113 West Lake Drive
Hattiesburg MS 39402

FROM: Gregory Eells, Ph.D. GE
HSPRC Co-Chair

PROTOCOL NUMBER: 99110802
PROJECT TITLE: Learning Styles and Attitudes Toward Computer Use Among Undergraduate Microbiology Students

Enclosed is The University of Southern Mississippi Human Subjects Protection Review Committee Notice of Committee Action taken on the above referenced project proposal. If I can be of further assistance, contact me at (601) 266-4829, FAX at (601) 266-5146, or you can e-mail me at Gregory Eells@usm.edu. Good luck with your research.

RESEARCH AND SPONSORED PROGRAMS
Box 5157 · Hattiesburg, MS · 39406-5157
Phone (601) 266-4119 · Fax (601) 266-4312
www.usm.edu

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THE UNIVERSITY OF SOUTHERN MISSISSIPPI

HUMAN SUBJECTS PROTECTION REVIEW COMMITTEE
NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Human Subjects Protection Review Committee in accordance with Federal Drug Administration regulations (21 CFR 26,111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- If approved, the maximum period of approval is limited to twelve months. Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: **99110802**
PROJECT TITLE: **Learning Styles and Attitudes Toward Computer Use Among Undergraduate Microbiology Students**
PROPOSED PROJECT DATES: **01/01/00 to 01/01/01**
PROJECT TYPE: **Dissertation or Thesis**
PRINCIPAL INVESTIGATOR(S): **Delia Anderson**
COLLEGE/DIVISION: **Education/Psychology**
DEPARTMENT: **Educational Leadership & Research**
FUNDING AGENCY/SPONSOR: **N/A**
HSPRC COMMITTEE ACTION: **Expedited - Approved**
PERIOD OF APPROVAL: **07/10/00 to 01/01/01**

Gregory Eells, Ph.D.
HSPRC Co-Chair
The University of Southern Mississippi

8-15-00
Date

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