5-2012

Student Success in Face-to-Face and Online Sections of Biology Courses at a Community College in East Tennessee

Deanna Essington Garman
East Tennessee State University

Student Success in Face-to-Face and Online Sections of Biology Courses at a Community College in East Tennessee

---

A dissertation

presented to

the faculty of the Department of Educational Leadership and Policy Analysis

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Doctor of Education in Educational Leadership

---

by

Deanna Essington Garman

May 2012

Dr. Donald W. Good, Chair
Dr. Joellen Edwards
Dr. Virginia Foley
Dr. Pamela Scott

Keywords: student success, completion, face-to-face, online, web-based, biology courses, community college

ABSTRACT

Student Success in Face-to-Face and Online Sections of Biology Courses
at a Community College in East Tennessee

by

Deanna Essington Garman

The purpose of this quantitative study was to determine if there were significant differences in student success in face-to-face and online biology courses as categorized by gender, major, and age; and as measured by lecture grades, lab grades, and final course grades. The data used for analyses included data from 170 face-to-face sections and 127 online sections from a biology course during the fall and spring semesters beginning fall 2008 through spring 2011.

Researchers have reported mixed findings in previous studies juxtaposing online and face-to-face course delivery formats, from no significant differences to differences in grades, learning styles, and satisfaction levels. Four research questions guided this study with data analysis involving *t*-tests for independent groups and chi-square tests.

This researcher noted significant differences in the results of this study: grades, success rates by gender, success rates by health and nonhealth majors, and nontraditional age (≥25) success rate were higher for students in the face-to-face courses; and the attrition rate was higher for students in the online course sections. There was no significant difference found in the success rate for traditional age (<25) students in the face-to-face sections compared to those in the online sections.

DEDICATION

This study is dedicated to my husband Butch for his love and patience; to my daughters Chelsea, Erin, and Nina, who have been my reasons for not giving up; to my parents for their unconditional love and support; and to Dr. Debra McCarter for being my mentor.

ACKNOWLEDGMENTS

I express my sincere thanks and appreciation to everyone who supported me throughout this journey including the ELPA cohort members, ETSU faculty, and WSCC administration (past and present), faculty, and staff.

I am grateful to Dr. Donald Good for serving as my committee chair along with Dr. Joellen Edwards, Dr. Virginia Foley, and Dr. Pamela Scott for graciously agreeing to serve on my committee and for providing guidance during qualifying and the dissertation process.

Without a doubt, I wouldn't have made it this far without the "gentle" persuasion, encouragement, pep talks, pre-SACS sit-in, and never-failing support from Dr. Debra McCarter at Walters State.

CONTENTS

Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

CHAPTER 1

INTRODUCTION

Technology has advanced rapidly during the last several years, with the Internet and web-based applications drastically influencing the way by which people communicate and access information. Organizations have embraced these changes in part due to the demand of consumers by enhancing the delivery of their services to accommodate the technological developments. According to statistics from Internet World Stats (2010), 77.4% of the population in North America (266,224,500) uses the Internet. This represents a 146.3% growth in usage from the year 2000 to 2010.

Higher education institutions are among the organizations to respond to societal needs by changing the way programs and services are delivered to students (Kazis, 2006). Colleges and universities are no longer uniquely defined by a physical campus with classrooms occupied by students and instructors, as they are increasingly delivering distance education courses through a variety of emerging technologies (Hagedorn, Perrakis, & Maxwell, 2006; Kazis, 2006; Rosenbaum, Redline, & Stephan, 2007). Some institutions are virtual colleges, providing all services and courses online (Lee & English, 2009).

According to statistics for online education in the United States, approximately 80% of undergraduate students enrolled in online courses are older than the traditional college students (Allen & Seaman, 2008). In addition, a majority of adult students work and have family responsibilities; thus, the flexibility offered by online classes is the only opportunity some of the nontraditional college students have to pursue a college education.

Community colleges offer a variety of certificate and degree programs designed to prepare students for immediate employment upon completion or prepare them for transfer to

a 4-year institution. At the community college level, academic programs are comprised of general core education courses and prerequisite courses for the degree programs offered. Traditionally, these courses have been taught on a college campus in a face-to-face classroom setting. Changes in technology and an increasingly mobilized society have led to expanded methods of course delivery beyond the traditional classroom. In addition to taking classes on campus, students have the opportunity to take classes online from a remote location using a personal computer. Students are able to access an online class module through a college's web site. Within the class site they can view class material, post assignments, engage in online class discussion boards, and take exams. Students are also able to remotely access the college's library and other areas of student support.

The growth in demand for online courses has raised the expectation for colleges offering classes through different delivery formats to maintain the integrity of the courses so the students will receive the same quality of instruction and learning opportunities whether in the classroom or online. There are accountability issues in providing online courses as part of a degree or certificate program. Institutional accreditation standards are established by regional accreditation associations such as the Southern Association of Colleges and Schools Commission on Colleges (SACS-COC) and by national program accrediting agencies such as the National League for Nursing Accrediting Commission, Inc. (NLNAC). All courses regardless of delivery method must meet the guidelines required of the degree or certificate programs by the appropriate accrediting agencies. These accountability standards are also mirrored in state college systems that require performance-based reporting on a set of common benchmarks.

Background

Community colleges provide undergraduate educational opportunities for many students seeking a degree. According to the American Association of Community Colleges (AACC, 2011) during fall 2008 community colleges in the United States served approximately 12.4 million total students, with 7.4 million being credit students. Demographically, more than half of the community college students were female, approximately two thirds attended part-time, the average student age was 28, approximately 60% were age 22 and older, and 42% were the first generation in their family to attend college. In addition to a majority of community college students being characterized as female and older (i.e. nontraditional), they also were more likely to be diverse in race and ethnicity with low-income status (Horn & Nevill, 2006).

Community colleges have responded to the changes in technology and demands of students by offering web-based courses for students who prefer this delivery method in order to better accommodate their daily schedules or who need access but do not live within a convenient driving distance to an on-campus course (Buckley, 2003; Thirunarayanan & Perez-Prado, 2002). Adult students (included in the nontraditional student definition) who work and/or have family responsibilities are among the growing number of people who prefer distance education courses (O'Lawrence, 2006; Palloff & Pratt, 2007). There is also a growing trend for students living on a college campus taking traditional courses to supplement their schedules by taking an online course for various reasons, whether it is to avoid rising early for an 8:00 a.m. class or as a means for taking a needed class to complete a schedule or program. As student enrollment in distance education increases, so does the

importance of ensuring that the same quality exists for both online courses and traditionally delivered courses.

Regional accrediting bodies such as the SACS-COC prescribe quality and equality of courses regardless of delivery mode. Methods of measuring student success include embedded assessment through learning outcomes within the course and through grades associated with assignments, quizzes, and exams. Maintaining compliance with SACS-COC standards is critical to the lifeline of a college in all aspects including funding; enrollment; effectiveness; and quality of faculty, staff, students, and programs.

Some colleges are part of a state college system such as the Tennessee Board of Regents (TBR) System in Tennessee, which is governed by the Tennessee Higher Education Commission (THEC). THEC provides an opportunity for additional funding to be earned by the TBR colleges through its Performance Funding program containing measurements that allot points for meeting and or exceeding expected outcomes. Colleges must provide evidence and justification for the points earned, which in turn can mean as much as $1 million in additional funding. Student learning and course-level data are included in the outcomes that must be measured, achieved, and documented by community colleges as part of the funding process. The same student learning and course outcomes are also included in the measures that are part of the college system's strategic planning process as a means of monitoring institutional effectiveness and ensuring continuous improvement. With the standards and expected outcomes placed on a college by external stake-holders, assessing academic effectiveness is an important measurement tool for providing evidence of compliance.

Statement of the Problem

The problem to be investigated in this study is to determine if there are significant differences in student success in face-to-face and online biology courses by analyzing student variables for lecture grades, lab grades, final course grades, gender, major, and age.

Research Questions

This study analyzed background and academic data on students enrolled in face-to-face sections and online sections of biology courses offered by a community college in East Tennessee during a 3-year period. The study was focused on the following research questions:

1. Is there a significant difference in student success in a biology course offered in the face to-face format and the online format as measured by average lecture grade, average lab grade, or final course grade?
2. Is there a significant difference in student success as measured by final course grade in a biology course offered in the face-to-face format and the online format as categorized by gender or major?
3. Is there a significant difference in student attrition in a biology course offered in the face-to-face format and the online format as categorized by students who withdrew?
4. Is there a significant difference in student success in a biology course offered in the face-to-face format and the online format as categorized by age group?

Significance of the Study

Community colleges in the Tennessee Higher Education System continue to be faced with providing evidence of institutional effectiveness for accreditation and performance funding and being held accountable for documenting student learning, retention, and graduation. Colleges also have the responsibility of providing programs and services to help prepare students for gainful employment in area communities. Jobs in the healthcare field have led to an increased demand for nursing and other health-related degrees and certificate programs. Accordingly, higher education institutions have increased the number of course sections offered in areas such as natural science through traditional delivery and online formats, as these courses are included in the general education curricula and are prerequisites for programs such as nursing, physical therapist assistant, and emergency medical technician. The courses with corresponding lab requirements are more challenging to convert to an electronic delivery system; however, labs are components of the science lecture courses and must be adapted for online access. Students taking these courses as prerequisites are required to earn a final course grade of "C" or better to be considered for their intended program. A concern for colleges offering these core courses in different delivery formats is ensuring equality and rigor in instruction and learning opportunities whether in the classroom or online. Assessment measures of course quality including student success, student retention, and course outcomes are evaluated to ascertain the quality of student learning.

In focusing on statistical evidence of whether differences exist in student success in face-to-face and online biology courses by examining select variables, this study will add to the body of literature in the field. The research will be useful to others interested in

comparing delivery formats within traditional and distance education and within the natural science discipline.

Definition of Terms

Higher education has its own vernacular that has encompassed technological terms associated with distance education. While many of the traditional descriptors used in discussing postsecondary education are commonly understood, some terms are used in a more narrowly defined glossary. The following terms are defined for the purposes of clarity and understanding in reading this study:

Asynchronous – online courses in which the information is accessible any time, any day by students through the internet (Oram, 2006)

Attrition – the decrease in the number of students attending a course, a program, or an institution (Boyles, 2000)

Course completion – refers to when a student completes all of the requirements of a given course and receives a final grade (Bangurah, 2004)

Course completion rate – the number of students in a given course who receive a final grade at the end of a semester, divided by the total number of students who enrolled in the course (Bangurah, 2004)

Core indicator – Measures of specific conditions or results that are central to carrying out a college's mission; examples include retention and degree or certificate completion (Alfred, Shults, & Seybert, 2007)

Correspondence courses – assignments are sent to students and returned to instructors by mail or e-mail; students work on an individualized basis (Oram, 2006)

Face-to-face delivery – Also referred to as traditional, in-class delivery, this format involves regular class meetings between an instructor and students according to a fixed schedule and physical location (Oram, 2006).

Hybrid (blended) learning – A combination of online components and face-to-face instruction within a given course (Means, Toyama, Murphy, Bakia, & Jones, 2010)

Indicators – Measures of effectiveness in all operational aspects of a college that are widely used in strategic planning and reporting; examples include quality of education programs, student satisfaction of programs and services, economic impact in the community, and use of college facilities (Alfred et al., 2007)

Learning outcomes – results that are generated by a college's identified indicators; examples include exam grades, quiz grades, course (final) grades, dropout rate, degree or award attainment; transfers to 4-year institution, general education competencies, employer satisfaction with graduates, (Alfred et al., 2007; Zhao, Lei, Yan, Lai, & Tan, 2005)

Online delivery – also referenced as web-based delivery in which digital information is provided for access by students via the internet at a time and location of their choosing (asynchronous) (Means et al., 2010)

Persistence – the continued attendance (by a stated standard, such class to class or term to term) of a student toward completion of an educational goal, program, or degree (Baldrige Performance Excellence Program, 2011)

Retention – the continued enrollment of a common group of students at an institution, typically tracked and measured from fall-to-fall (Boyles, 2000)

Successful completion – a grade of a "C" or better for a course, exam, or assignment (Walters State Community College, 2010)

Synchronous learning – A schedule of class meetings and/or assignments in which the students and the instructor participate as a group (Oram, 2006).

Traditional-age and nontraditional-age students – Ages 18-24 are classified as traditional-age students; ages 25 and over are classified as nontraditional-age students (Center for Community College Student Engagement, 2009b).

Delimitations and Limitations

The delimitations and limitations listed below establish the boundaries for the study in describing the population chosen for the study and the limits on generalizing to a larger population.

1. This study involved courses developed and taught by faculty at a specific community college and may not be generalized to other institutions.
2. The study is limited to students who took biology courses and may not be generalized to other types of courses.
3. Due to a majority of the summer-term students at the college being transient (enrolling for summer to take courses that will transfer to their home institution), summer terms were excluded from the study.
4. Student outcomes may have been impacted by other factors that were not involved in this study.
5. The grouping of the "major" variable in the study is health program majors and nonhealth program majors, which is limited to this study and the health program majors that require successful completion of the biology courses.
6. Demographic data were limited for the online students included in the study.

CHAPTER 2

REVIEW OF LITERATURE

This chapter includes the relevant literature supporting and establishing the context of this study. The literature addresses the history of distance education, traditional course delivery, online instruction, community colleges and distance education, distance education delivery and college-level science courses, accreditation and regulatory standards for distance education, measures of effectiveness in community colleges, and measuring the effectiveness of online vs. face-to-face formats.

History of Distance Education

Distance education in its most simplistic meaning is when teaching and learning take place without the face-to-face meeting of teacher and student (Holmberg, 2005). This definition is published by SACS-COC: "distance education is a formal educational process in which the majority of the instruction (interaction between students and instructors and among students) in a course occurs when students and instructors are not in the same place (SACS-COC, 2010, p. 1). The United States Distance Learning Association (2007) included a reference to the use of technology in its definition of distance education.

Formerly called correspondence education, the distinction of distance education came in 1982 with the renaming of the International Council for Distance Education (Holmberg, 2005). The Council became known as the International Council for Open and Distance Education in 1992 to reflect the open universities of Europe and to further move away from the unpopular image of independent, correspondence education (Daniel, 2005).

Correspondence colleges were in existence in the United States as early as the mid-1800s when Sir Issac Pitman's shorthand courses by mail gained in popularity (Bower & Hardy, 2004; Maeroff, 2003). Another distance education pioneer in the United States was Anna Ticknor, with her study programs of lessons and exams designed for women of elite status to enable them to add studying into their daily routine of their household responsibilities (Nasseh, 1997).

William Rainey Harper, credited with the distinction of the first 2 years of college as being a junior college (Brint & Karabel, 1989; Ratcliff, 1994), also had a hand in the beginning of correspondence courses in a higher education institution in the 1880s. Harper first offered correspondence courses at Chautauqua College (Maeroff, 2003). Then, as founding president of the University of Chicago, Harper established correspondence opportunities for degree-seeking students at the university (Larreamendy-Joerns & Leinhardt, 2006; Maeroff, 2003). Harper's accomplishments in developing correspondence courses in higher education, most notably at the junior college level, distinguished community colleges as pioneers in the distance education movement (Bower & Hardy, 2004).

Distance education has in part been defined by the method in which the information has been transferred to students (Peters, 2004), which has evolved through the years and has mirrored the technological changes in society through print, telephone, television, and audio-visual capabilities. Printed lessons and papers mailed between instructor and student was the early basis for independent study through correspondence education (Holmberg, 2005). SACS-COC still recognizes correspondence education as a means of delivery but has included electronic delivery of course material in its definition (SACS-COC, 2010). Radio and television were used as mediums to reach outside the boundaries of a school beginning in

the 1920s and 1950s, respectively (Gunawardena & McIsaac, 2004). The emphasis on distance education in higher education grew significantly in a short period of time, from the involvement of only a handful of states in 1987 to almost every state having some type of available distance education in 1989 (Gunawardena & McIsaac, 2004). Telecommunications technology allowed the colleges to reach rural student populations and collaborate with groups of people in public schools or other community settings (Office of Technology Assessment, 1989). Cable and satellite broadcasts increased the ability to reach larger audiences.

Gunawardena and McIssac (2004) identified aspects important in adopting technology for use in distance education. Key to selecting a delivery mode are considering where, how, and when students may have access; determining the need for one-way or two-way communication; considering the amount of social presence that is possible within the context of the medium and instructor; the amount of social interaction that would be possible through the delivery mode; and the degree of competency the students would need to use the technology.

Distance education was once a generic term for correspondence courses or independent study (Berg, 2005; Keegan, 1980; Pittman, 2003); however, through the years, its descriptors have included various technological delivery modes such as cable, DVDs, CDs, one-way and two-way transmission, satellite, and audio conferencing. In the last decade distance education became synonymous with online, internet-based technology (Hickman, 2003; Natriello, 2005) and continues to grow on an annual basis (Gallagher, 2002). Typically, the percentage of a course's format delivery determines whether a course is considered online, hybrid, web/computer facilitated, or face-to-face. An online course

requires no face-to-face meetings; a hybrid (or blended) course has roughly 30% to 79% of the content delivered online; web/computer facilitated requires some type of computer usage, about 1% to 29%, in the classroom or to access some instructional material or lessons through a course-management system in order to supplement the face-to-face instruction; and a traditional course relies on face-to-face instruction and interaction between students and faculty (Allen & Seaman, 2010).

Traditional Course Delivery

Historically, students attending a 4-year university left home, moved into campus-based housing, and attended classes in classrooms located on campus in statuesque buildings that had served generations of students. This type of setting allowed face-to-face interaction between instructor and student, with the instructor being the leader of a lecture-based class format (Coleman, 2005; MacBrayne, 1995). Community colleges traditionally used the face-to-face course-delivery format as well. While the nature of the traditional classroom encouraged and offered a setting for interaction between instructor and student (Seale & Cann, 2000), the interaction was dependent upon the effort put forth by the instructor and students. It is not unusual for a university to have held general education courses such as accounting or economics in large auditoriums seating 200 or more students, while the instructor taught from the stage, sometimes with the assistance of a presentation screen. There was very little interaction between the teacher and students in this scenario. There have also been courses offered in smaller classrooms where the students sat in close proximity to the instructor and the interaction was on a more personal level. This contrast in the level of interaction found in face-to-face, traditional classroom settings of varying sizes illustrates the

differences that the effort of the instructor and the students plays in creating or hindering an interactive face-to-face experience in the classroom (Hagedorn et al., 2006). The amount of interaction between students and instructor and within the class environment as a learning community has been attributed as being a key indicator of student success (Picciano, 2002).

Online Instruction

Online (web-based) learning grew rapidly in the 1990s (Holder, 2007) and proved to be a viable educational tool rather than just a passing fad (McMurray, 2007). Enrollment in distance education courses has increased at a higher rate than enrollment in face-to-face courses (Oblinger & Hawkins, 2006) in the 2000s as more opportunities have become available through institutions. There has also been a large growth in hybrid (or blended) courses, where the students and instructor meet on average 50% in the classroom, with the other assignments being handled via internet through the online module for the class. Other web instruction is used by instructors of face-to-face courses as a supplemental tool for assignments and reading material. Regardless of delivery mode, researchers have indicated that students have greater success when they have the opportunity to interact with an instructor (Zhao et al., 2005). With advances in technology, interaction is possible in various ways when face-to-face meetings are not possible. The hybrid model of course delivery that combines face-to-face instruction with online instruction, is widely used in higher education.

Even though a large portion of students taking online courses find this delivery mode fits their schedule due to work and family commitments, there are traditional full-time college students living on a college campus who enroll in online courses for a variety of reasons including scheduling around a part-time job or scheduling conflicts with face-to-face

classes (Oram, 2006). A recent estimate was given that a little more than 50% of the University of Central Florida's 56,000 students would take an online or hybrid course in addition to their on-campus classes during the 2010-2011 academic year (Parry, 2010).

Demographics for the online format compared to face-to-face vary according to sample participants, source, and year. One profile of online students showed the online students tend to be older with higher overall grades and more college credit than traditional students (Diaz, 2002). The later statistic is similar to earlier findings (Anderson, 2001; Roach, 2003) indicating that distance students included both the adult population and almost an equal number of traditional, on-campus students ages 18 to 25 (Instructional Technology Council, 2010) largely due to the flexibility and convenience that distance education offers (Parrott, 2001).

Community Colleges and Distance Education

Enrollment in online courses in 2-year and 4-year colleges has continued to grow at a faster rate than in traditionally delivered courses especially at the community college level (Center for Community College Student Engagement, 2009a; Oblinger & Hawkins, 2006). In fall 2008, the total higher education enrollment in the United States was just over 18 million students, with about a quarter of those students (4.6 million) taking at least one online course (Allen & Seaman, 2008). This represented a 43% increase over online enrollment just 5 years earlier in fall 2003.

The mission of community colleges has traditionally included having an open enrollment without a required grade point average or ACT/SAT score and serving all students with nondiscriminatory admissions policies, often referred to as an open-door

policy. Community colleges have served a large number of students who represent populations such as low-income, minority, adult, part-time, first-generation, developmental, remedial, underprepared, and underserved (Bower & Hardy, 2004; Hughes, 2008; National Center for Education Statistics, 2008). The community college students enroll in certificate or degree programs that are designed to prepare them for entry into the local job market or transfer to a 4-year institution (Karp & Hughes, 2008).

Where community colleges have been credited with offering access and the opportunity of obtaining a degree to residents in local communities, the internet has been credited to afford the same benefits to people who have previously not had availability to higher education (Bower & Hardy, 2004; Irizarry, 2002; Maeroff, 2003). The typical community college mission of providing education to the residents in their geographic service area has continued with a majority of online students coming from the service-area population (Carr, 2000).

Historical data have traced the phenomenon of community college enrollment increasing during periods of economic downturn. Community colleges are largely nonresidential, commuter colleges, with students in rural areas sometimes commuting several miles each way to attend classes. In the last few years the poor economy and rising fuel costs have put hardships on students; however, the increase of online course offerings has helped offset the increased fuel costs (Allen & Seaman, 2008) and allowed easier access to outlying students (Hughes, 2008; Peat & Taylor, 2005). By offering online courses, colleges have empowered students with greater flexibility in arranging their class schedules in order to overcome barriers dealing with location, family, and work (Hughes, 2008; NCES, 2008; Riffell & Merrill, 2005). These barriers have led to students taking classes on campus to drop

out due to the inability to manage their responsibilities (Kluckhohn Jones, 2010). For some students distance education has been their only option for taking classes (Bocchi, Eastman, & Swift, 2004) due to the round-the-clock access to course materials (Natriello, 2005).

In 2009 the ITC conducted a survey of its member community colleges and members of the American Association of Community Colleges with approximately 226 out of 1,200 community colleges responding. Among the findings, respondents reported a 22% increase in enrollment for distance education; 91% indicated their online courses to be just as rigorous as their face-to-face equivalent; and respondents reported a 72% retention or completion rate for online courses versus a 76% rate for face-to-face courses.

In a nationwide survey of community colleges characteristics of enrolled students indicated that 60% were considered part-time. Of the 54% who worked 20 or more hours per week, 21% worked more than 30 hours per week, 29% took evening classes, and 28% had taken online classes (Center for Community College Student Engagement, 2009a). In a 2008-2009 survey with 226 2-year colleges reporting demographics of students in online courses indicated 52% were between 18 and 25 years-of-age, 47% were age 26 and older, 63% were women, and 36% were men (ITC, 2010).

With distance education building momentum in community colleges, there remains an issue of access for students who live in rural areas with limited or no internet capability or for those who are part of the underserved, low-income population who cannot afford the technology needed for distance education courses. In either case considering the students' ability to access the online courses needs to be addressed in the distance education delivery decision-making process.

Distance Education Delivery and College-Level Science Courses

In a report of survey findings from the ITC (2010) higher education institutions identified classes that were the most difficult to offer in an online format including science labs, math, nursing, arts, languages, and technology. Part of the difficulty lies in components of these courses that deal with hands-on labs or learning modules. Science courses such as biology have a lab counterpart included in the course curriculum. Some studies have either focused on the course material or on the labs in evaluating learning outcomes and delivery modes (Riffell & Merrill, 2005), and others have included labs as a variable within the study of the course as a whole.

Traditional lab classes are comprised of active, hands-on learning activities that have not been as easy to replicate through distance education. Arle (2010) reported that interaction between students and teacher is crucial to students' success in blending technology with science and incorporated interactive, virtual labs and discussions into his online courses. Using an online virtual human dissection that is interactive, Arle has been able to provide a more realistic activity than having to use a different species in the classroom setting. His online students earned a higher average test score than the national, traditional classroom students' average for the same standardized test.

The hybrid class platform has been used for science courses by posting the lecture components online and requiring in-class meetings for the lab component (Riffell & Merrill, 2005). There has been some indication of higher outcomes of student performance on exams and higher student attendance rates in hybrid courses compared to both face-to-face and online courses (Riffell & Sibley, 2004). Yet, in other studies such as by Riffell and Sibley (2005) there have been findings of no significant difference in laboratory outcomes between

face-to-face and hybrid formats. Interestingly, researchers have also noted that minority students performed better than Caucasian students in hybrid lab formats (Hughes, 2008; Riffell & Sibley, 2005).

Sancho, Corral, Rivas, Gonzalez, Chordi, and Tejedor (2006) conducted a study to compare learning environments in three microbiology lab settings: in classroom lab, tutored virtual lab, and self-directed virtual lab. The findings indicated that the intended skills were learned by students and assessed appropriately in the virtual lab setting without the need for the classroom lab. The researchers found high student satisfaction levels for the virtual labs, and combined with outcomes of assessment measures, summarized that the blended learning method allowed for a variety of learning resources not otherwise available to students in the classroom setting (Sancho et al., 2006). Virtual labs have also been studied in terms of incorporating virtual dissections rather than actual specimens. Data from 400 first-year biology students who were exposed to a variety of learning resources indicated that the students perceived usefulness of the activity was dependent on the learning style used (Franklin, Peat, & Lewis, 2001). Students completing a virtual dissection activity perceived a high level of usefulness in developing individual learning, while students who participated in a live dissertation activity perceived a high level of cooperative learning skills' development.

A similar finding by Stuckey-Mickell and Stuckey-Danner (2007) suggested that online labs would benefit students when there was a combination of collaborative assignments and discussion that would encourage student engagement. Their study explored student perceptions of virtual labs in online biology courses in an effort to evaluate the effectiveness of virtual labs. The study included students enrolled in two online biology courses, with half of their labs meeting face-to-face and the other half of their labs being CD-

based virtual labs. Student perceptions were found to be more positive for the face-to-face labs, and attributed them more strongly to their overall learning experience. The researchers noted that the virtual labs were additional activities that were not incorporated into the course material, whereas the face-to-face labs were drawn from and supplemented by the course material and created by the course faculty. A future implication for designing virtual labs to accompany online courses would be to align the labs with the course material and link the lab exercises to course learning outcomes.

In a study evaluating the effectiveness of an online biology class compared to a face-to-face biology class as determined by test grades and survey questionnaires, researchers found no significant difference in performance and satisfaction between the two delivery modes (King & Hildreth, 2001). Grant and Thornton (2007) reported opposite findings with regard to satisfaction level in a comparison study of biology students enrolled in online versus face-to-face courses. The face-to-face students rated their experience higher than the online students. A more positive experience by students has been shown to be related to the amount of interaction and collaboration within a course regardless of the format. The efforts of the students and instructors play a large part in building community within a class. Students have also reported a feeling of greater connection to their instructor, a higher level of comfort in communicating with their instructor via e-mail, and an appreciation for the flexibility allowed within the course (Yokaichiya, Galembeck, & Torres, 2004). Engaging students through learning activities and feedback from the instructor and peers is an effective way to enhance the feeling of connectedness and community (Krawiec, Salter, & Kay, 2005).

A comparison of performance outcomes for students enrolled in online, correspondence, and face-to-face sections of a biology course (Collins, 2000) resulted in a

finding of no significant difference in student achievement between the distance and face-to-face formats. However, in comparing the mean final grades of the students, those who completed the correspondence and face-to-face sections scored higher than students who completed the online section, with the larger difference in means being between the correspondence and online final grades.

Johnson (2002), who also compared performance outcomes of online and face-to-face biology students, noted no significant difference between the two groups. Her findings added to the research that online students were just as likely as face-to-face students to effectively learn and have similar outcomes within the course (Allen & Seaman, 2010; Hughes, 2008).

In assessing learning outcomes in an online and face-to-face biology course each having discussions, labs, and review sessions according to the course delivery mode, researchers suggested that higher posttest scores of the online students was likely due to the differences between the students who enrolled in the online versus the face-to-face classes rather than a result of learning due to the delivery mode (Schoenfeld-Tacher, McConnell, & Graham, 2001). This finding echoes indications reported by Collins and Pascarella (2003) in their study of distance education in that students who self-selected the distance education course possessed a higher level of professional and personal motivation, along with precourse knowledge and previous experience in taking college courses. In selecting online courses students who choose this format may have a higher level of self-discipline and technological skills necessary for mastery of the course material.

Varying results have been documented by other researchers. Some have indicated that online students have achieved higher learning outcomes on embedded assessment in course modules compared to face-to-face students (Bird, 2010). Others have reported that students

have had higher average final grades in face-to-face classes as compared to online for those students who successfully completed the courses (Hughes, 2008). For a microbiology educator time management and an overwhelming amount of online material coupled with a higher percentage of nontraditional age men, led to mixed findings in comparing the performance of face-to-face and online classes (Kluckhohn Jones, 2010).

Lents and Cifuentes (2009) conducted a study at a university with an all-commuter campus using two sections of a required biology course for criminal justice majors. One section was held in the traditional, classroom lecture mode and the other was listed as distance education and used voice-over-video lecture presentations via the intranet. Both sections were taught by Lents, and exams for both groups were held in a classroom on campus. The researchers compared the exam scores and outcomes on specific test questions for each group. Following exam 1 the researchers noted the video lecture group did not perform as well even though the differences were statistically insignificant. However, following a class discussion where students shared pointers on how to improve their study habits of the video material, the video lecture group performed just as well as the traditional, in-class group on exam 2. The differences in outcomes of the groups were statistically insignificant and did not point to a clear advantage of one delivery mode over the other. Echoing earlier findings of Franklin et al. (2001) with regard to learning styles, the researchers concluded that allowing for differences in student learning and helping students understand how to study the video material increased the exam scores for the distance education students (Lents & Cifuentes, 2009).

Hoping to improve attendance and performance of students in introductory, nonmajor biology classes, the general science department at Michigan State University developed a

hybrid course in order to compare its effectiveness to the traditionally delivered course (Riffell & Sibley, 2004). The hybrid course consisted of classroom lectures and online assignments. The researchers concluded that the hybrid format provided more active learning opportunities. Online assignments were shown to be as effective as the classroom lectures, and classroom activities were more effective when combined with online assignments.

Recommended practices for distance education reported in a meta-analysis of online learning studies sponsored by the U.S. Department of Education included ensuring that online courses that are replacements for face-to-face courses share the same student learning outcomes (Means et al., 2010). Online courses were shown to be a beneficial, cost-effective delivery mode for students who were not able to attend on-campus classes as long as student achievement was not compromised. The USDOE's meta-analysis indicated that there was a significant difference ($p<.05$) between the subsets of (a) blended learning (combination of online and face-to-face instruction) and face-to-face classes and (b) online only and face-to-face classes, with the stronger learning outcomes being significant for blended learning classes (Means et al., 2010).

While the USDOE study did report a significant difference for blended instruction over face-to-face instruction, a review of the literature on distance learning indicated that while differences were noted in student perception and learning outcomes in studies comparing online versus traditionally delivered courses, a majority of the researchers reported no significant difference in the effect on student learning in comparisons of distance education and traditional classroom delivery modes. Like many researchers, Somenarain, Akkaraju, and Gharbaran (2010) also reported no significant difference in student perception and learning outcomes in their evaluation of online and blended sections of a biology course.

They concluded their study provided further evidence that distance education is a viable method of providing quality education to students. In essence finding no significant difference is in itself a significant finding. As more colleges offer online course delivery, the emphasis turned to the goal of no significant difference for students enrolled in an online course versus the same course offered on campus.

Accreditation and Regulatory Standards for Distance Education

Online, e-learning, was officially recognized as a viable delivery mode in the 1996 amendments to the Higher Education Act (HEA) of 1965 (Maeroff, 2003). The Higher Education Opportunity Act (HEOA) approved in 2008 added new provisions to the HEA that went into effect in July 2010. Included in the additions were new definitions for distance education and correspondence education as separate course delivery modes and regulations and compliance guidelines for institutions and accrediting agencies regarding distance and correspondence education (HEOA, 2008).

There are eight major regional accrediting groups encompassing higher educational institutions across the United States (Maeroff, 2003). One of these preeminent eight is SACS-COC. As with the accrediting agencies, SACS-COC bases its policies and guidelines for institutional administrative and academic processes on the provisions of the HEA and HEOA. To maintain accreditation, which is important for many reasons including eligibility for federal financial aid programs, institutions sanctioned by SACS-COC must demonstrate their compliance with a required set of standards, principles, and policies covering prescribed aspects of a college's operation. Policies are updated to accommodate emerging trends in higher education. As more institutions began developing web-based courses, an element of

increasing importance has been assessing the quality and success of their academic courses to ensure the same sense of an academic community typically found on the traditional campuses (Adams & Freeman, 2000).

The SACS-COC (2010) Policy on Distance and Correspondence Education defines the approved methods of distance education course delivery and enforces the same rigor for distance education as traditionally delivered courses. In June 2010 SACS-COC published an updated policy statement on distance and correspondence education. The policy attached the same rigors to ensure quality and coherency within an institution's degree and certificate programs regardless of delivery method, as measured "by the evaluation of educational effectiveness, including assessments of student learning outcomes, student retention, and student satisfaction" (p. 3). Students taking online classes at SACS-COC accredited colleges must have access to all of the typical on-ground services including counseling, tutoring, library, bookstore, and faculty advising. Having policies in place and monitoring their effectiveness strengthens the educational experience for students and reinforces the credibility of the institution.

Community colleges cannot be complacent in just meeting the needs of students by offering courses via distance education. What was a future trend forecast in the year 2000 (Howell, Williams, & Lindsay, 2003) has become a reality as accreditation groups have turned the focus to educational outcomes and accountability in higher education. The emphasis has moved from enrollment to retention and completion and evidence of successful learning outcomes.

In his book *A Classroom of One* Maeroff (2003) offered this summation,

> The best policy will be to let this experiment go forward, to see what it can contribute to learning. All the while, state regulators, accrediting organizations, Congress, education associations, and consumer groups should remain vigilant. They should judge e-learning by the outcomes, seeing whether the courses deliver what they promise—not condemning the courses because they are designed and taught in ways that challenge the status quo. (p. 267)

Measures of Effectiveness in Community Colleges

External stakeholders such as regional and national accrediting agencies are concerned with seeing evidence that a community college is doing what it is supposed to do according to its mission and the expectations of the particular stakeholders (Alfred et al., 2007). A college must be able to provide evidence it is producing the expected outcomes it has identified as being indicators of effectiveness.

The Tennessee Higher Education Commission (THEC) and Tennessee Board of Regents (TBR) are external stakeholders for colleges in the TBR system. In Tennessee THEC instituted a performance funding program as a means of allocating extra funds through a point system. The funding criteria for community colleges were based on certain outcomes identified by THEC as indicators of effectiveness such as Alumni Survey results, Employer Follow-up Survey results, MAPP scores, graduation rates, retention rates, licensure pass rates, and the number of transfers to 4-year institutions.

Internal stakeholders such as students, faculty, and staff have expectations of certain services, benefits, equipment, and educational programs. Satisfaction surveys and course evaluations assist college administrators in measuring the college's effectiveness in meeting the needs of the internal stakeholders.

Figure 1 illustrates a comprehensive model of core indicators applicable to community colleges as measures of outcomes of interest to internal and external stakeholders. Tracking outcomes such as student persistence, retention, completion, and transfers has become a key emphasis for community college administrators as the focus of accountability measures has moved away from enrollment in responding to state policies (Jenkins, 2006).

General education competencies have increased the focus on embedded assessment and tracking student learning outcomes in classes. Course completion rates and attrition rates have been reported as key measures of student performance in community colleges and in distance learning programs (Picciano, 2002). Motivational factors on the part of the instructor and the students' self-motivation have contributed to student retention rates in higher education (Irizarry, 2002). Key performance indicators are defined differently based on the policies, mission, and goals that are used in establishing institutional effectiveness measures. Common areas of effectiveness and related core indicators are for community colleges include participation measured by enrollment rate and student success measured by persistence, retention, and graduation rates and learning outcomes (Alfred et al., 2007).

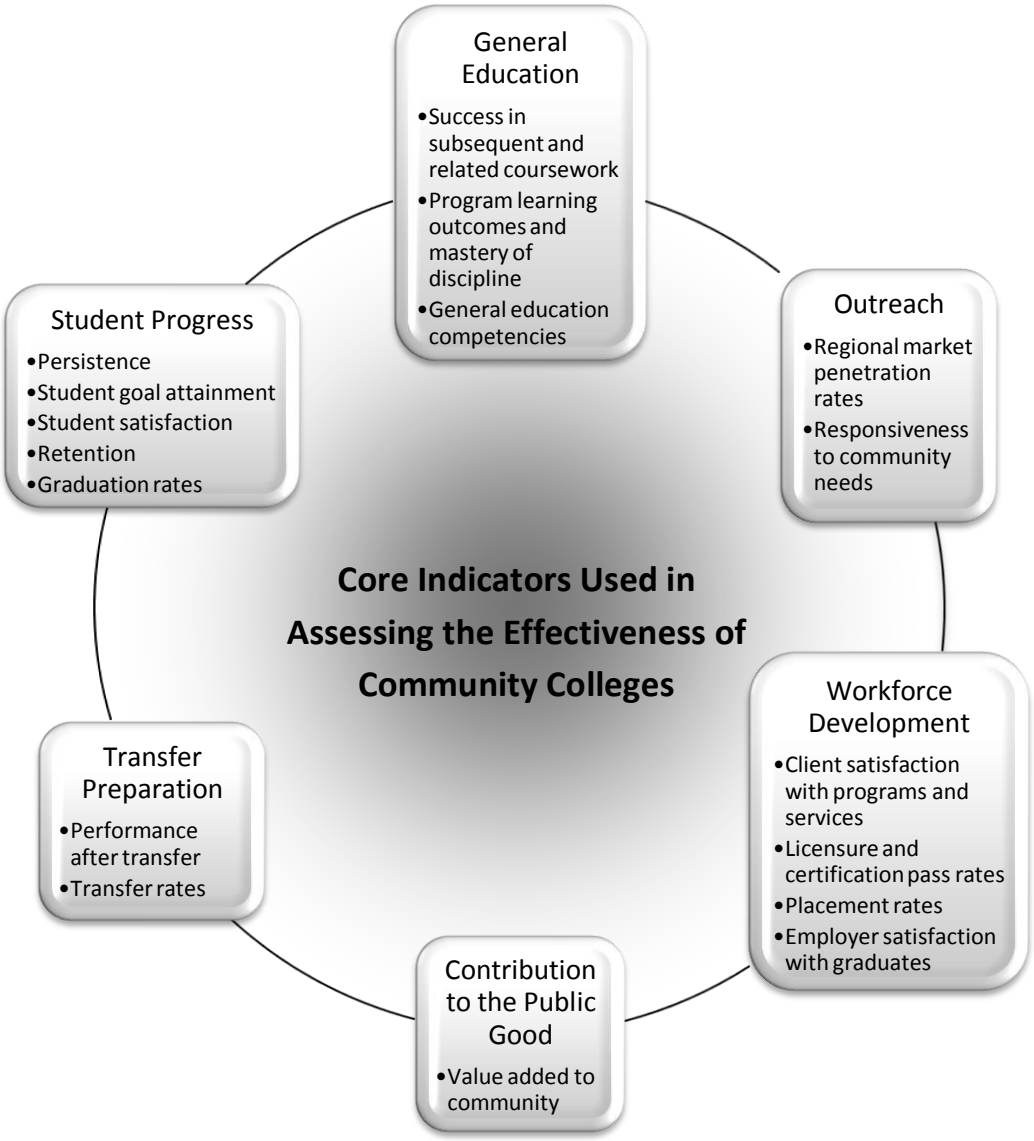

Figure 1. Model for Assessing the Effectiveness of Community Colleges. Adapted from Alfred et al., 2007.

Researchers have provided theoretical models to substantiate the importance of assessing student outcomes. Astin's (1991, 1993) model of student outcomes incorporated input, environment, and output (IEO). Astin purported that factors involving students personal and academic background, effort, and learning were key in determining their

academic success. Variables for this model included student characteristics, GPA, retention, and completion.

Another researcher (Zhao, 1999) built on Astin's IEO model in a study of underprepared undergraduates. Using a logistic regression model incorporating 31 variables associated with students' academic success levels, Zhao identified GPA, race and ethnicity among the variables to consider as predictors of academic progress. Similarly, Ronco (1996) determined that college GPA was the best indicator of whether a student was likely to drop out or continue; and college major, GPA, full-time status, and gender, were associated with successful completion of graduation or transfer requirements.

Ewell and Wellman (2007) acknowledge that student success has become a generic term with as many ways to measure it as there are definitions. Student success can encompass enrollment, retention, completion of a degree, transfer, grades, engagement, satisfaction, course learning outcomes mastered, and skills gained.

Measuring the Effectiveness of Online vs. Face-to-Face Formats

U.S. Department of Education statistics comparing online and face-to-face instruction reported that, on average, performance was best by students taking hybrid courses that combined face-to-face instruction with web-based modules followed by those taking online courses (Center for Community College Student Engagement, 2009a). Hybrid courses were beneficial for students who previously had not taken asynchronous online courses and were not familiar with the independent nature of the online format. The design of many hybrid courses has allowed for the face-to-face reinforcement needed by some types of learners. In a survey of online technology in higher education, of the 226 institutions responding to a

survey of online technology, 82% of respondents indicated their online classes were equivalent to their face-to-face classes, and 9% rated their online course as being superior (ITC, 2010). Respondents also indicated their online course completion rates were 72%, compared to 76% for their face-to-face classes.

Weber and Lennon (2007) measured the effectiveness of online versus face-to-face course delivery by investigating learning outcomes and satisfaction level of students in the same course being offered in the two formats. Learning outcomes were measured by the final exam, course project, and final course grade. Overall satisfaction included two variables—with course and with instructor. The researchers found no difference in the achievement of course objectives or learning outcomes but a slightly lower satisfaction level with students in the online course which could be attributed to the lack of personal interaction noted by students.

Claiming equivalency or superiority of one type of course delivery can be subject to criticism if the factors of evaluation are not substantiated. Critics of online education have questioned the academic integrity and rigor of courses and the diminished role of the instructor (Maeroff, 2003), just as there are critics of any process that challenges tradition. Rather than focus on identifying one method as being better than the other, some researchers have focused on ensuring that the rigor and quality is the same for the student regardless of delivery mode (Turner & Crews, 2005), thereby putting emphasis student needs and meeting intended course learning outcomes (Carnevale, 2001).

The "no significant difference" phenomenon is attributed to the work of Russell's research of more than 355 studies that investigated instructional technologies in distance education spanning the years 1928 through 1998 (Meyer, 2002). With a majority of the

studies evaluating student achievement, Russell noted those studies revealed no significant difference between achievement in comparing traditional and distance education (Russell, 2001).

Comparison studies involving distance education and face-to-face instruction have paralleled the changes of delivery modes for defining distance education. Studies in the years prior to the web technology compared traditional face-to-face instruction format with distance education modes such as correspondence and video (Meyer, 2002). In the past decade there have been numerous studies using online instruction as the distance education comparison with face-to-face in an attempt to identify variables such as motivation, self-efficacy, self-motivation, self-control, and self-discipline that could predict online student success (Irizarry, 2002; Parker, 2003; Waschull, 2005; Williams, 2008). In other studies researchers have evaluated the status of students identified as traditional or nontraditional as a predictor of success level in comparisons of educational delivery modes (McGivney, 2004; Wojciechowski & Palmer, 2005).

Gaythwaite (2006) conducted a study examining whether self-regulation, self-efficacy, and critical thinking were predictors of success and retention among community college students enrolled in face-to-face and distance education sections of public speaking courses. The data analysis indicated that self-efficacy was a significant predictor of final course grade; however, none of the variables were found to have significance with respect to course delivery mode. Similarly, Parker (2003) found that students' locus of control had no significant impact on persistence in online versus face-to-face courses; however, there was a positive correlation between persistence and self-motivation in the online course.

Researchers have reported mixed results when analyzing factors attributed to student persistence in distance education courses. Many come to the conclusion that student persistence is a complex issue that involves a multitude of factors (Holder, 2007). Higher student attrition rates in distance education can stem from a variety of reasons such as a lack of skills in self-direction, self-discipline, technology, or time-management or from a realization that the coursework and time involved is more intense than expected once a course has begun (Terry, 2001; Turner & Crews, 2005). Hsu and Shiue (2005) evaluated students' educational background, success, and learning styles to determine the differences in the face-to-face versus the distance education students. They reported that students having the self-directed learning style were better suited for distance learning due to having more self-discipline and ability to set their own schedules. The researchers indicated that giving students the tools to discover their own learning styles and helping them adapt to learning through distance education would improve the success rate for students who are not strong self-directed learners.

In a comparison of traditional and virtual classrooms Leasure, Davis, and Thievon (2000) found that students who needed face-to-face interaction for feedback and accountability were better suited for traditional classes rather than online classes. However, students in the online courses were shown to have an increase in self-confidence due to the flexibility they had in communicating within the virtual classroom. Collaboration among students was a factor in a study involving the delivery of a computer programming course using three different formats: the traditional, face-to-face class; an online class with standard online discussion postings; and an online class with advanced tools for communicating among participants (Cavus & Ibrahim, 2007). The online class had advanced tools to

automatically share assignments with each other and with the instructor, and those students performed significantly better than the standard online and the face-to-face class. Similar findings supporting collaboration were reported in a 3-year study of 26 undergraduate courses delivered in online and traditional classroom formats. In this study researchers found that learning outcomes were as good or better in the online courses when students were actively involved in the learning experience (Hiltz & Benbunan-Fich, 2000). The effort of the students taking online courses is a factor to consider when comparing learning outcomes in different formats. The researchers noted higher outcomes for traditional classroom students when compared to online students who did not actively participate in the collaborative learning opportunities in their courses.

To evaluate differences in delivery modes Rivera and Rice (2002) compared three formats for an introductory management information systems course that consisted of a face-to-face class, an online class, and a hybrid class that combined face-to-face and online elements. There was no significant difference in student outcomes for the three class formats; however, the results of the study indicated a lower satisfaction level for the online students, which was possibly due to the students unknowingly enrolling in a web-based class. Similar results were found in a comparison study of an online section and a classroom section of a marketing class. Weber and Lennon (2007) found no significant difference in learning outcomes measured by final grades and GPAs. They also noted a slightly higher drop rate for the younger, less experienced online students.

Researchers noted mixed results when evaluating learning outcomes for online and face-to-face English classes at Florida International University (Thirunarayanan & Perez-Prado, 2002). The online students scored lower in pretest scores when compared to the face-

to-face students. No significant difference was found in the posttest scores of both groups; yet, in looking at the differences between the pretest and posttest scores, the online class performed better than the students in the lecture-based format. Maki and Maki (2002) also reported a higher performance level in their online comparison group in a study of psychology students; however, they also found the online students had a lower satisfaction level than students in the classroom lecture group. In evaluating differences in online versus classroom settings for a given course variables other than the delivery mode itself can affect satisfaction level. For instance the amount of material and instructor-student interaction could be greater in a classroom lecture setting or the online course could allow for greater access to additional review material not available in a classroom meeting (Means et al., 2010).

In a study of nursing students taking traditional courses and web-based courses researchers found no significant difference in exam grades or final course grades between the two groups (Leasure et al., 2000). Researchers of other studies evaluating comparisons among performance levels in face-to-face, blended, and online formats have reported no significant differences in the groups (Beile & Boote, 2002; Caldwell, 2006; Gaddis, Napierkowski, Guzman, & Muth, 2000; Scoville & Buskirk, 2007). A different conclusion have been found in studies comparing online class formats and traditional face-to-face class (that may have had online discussion supplements), whereby the online students earned higher grades (Campbell, Gibson, Hall, Richards, & Callery, 2008; Christopher, Thomas, & Tallent-Runnels, 2004; Kearns, Shoaf, & Summey, 2004; Poirier & Feldman, 2004).

Similar findings were noted by Bata-Jones and Avery (2004) with regard to performance in a study comparing learning outcomes and satisfaction of students enrolled in face-to-face and online courses in a nursing program. They found no difference in learning

outcomes between the two formats and concluded that online students were more satisfied with their course than those in the face-to-face course. Cooper (2001) also found a higher level of student satisfaction in an online computer application course when compared to a face-to-face section yet no difference in performance between students in the two formats.

Buckley (2003) reported that maintaining consistency in course content was the primary factor, rather than course delivery mode, in finding no difference in student learning outcomes of online and face-to-face nursing classes.

Summary

The roots of distance education in the United States date to the correspondence courses in the 1800s. Through the years the methods used in distance education have evolved as technology has evolved in society. While correspondence courses, one- and two-way transmission, video, and other forms are still used, distance education has become synonymous with online courses (Hickman, 2003; Natriello, 2005). Higher education has embraced online education and has increased the number of courses available through this delivery system. In fall 2008 approximately one fourth (4.6 million) of the more than 18 million higher education students in the United States took at least one online course (Allen & Seaman, 2008). Demographics of the online students vary by college, but, on average a large portion are older and a majority of them are women (ITC, 2010). Students taking distance education courses also find the flexibility of the delivery method fits into their lives as many of them are also working, have family responsibilities, or do not live within a commuting distance to campus. The subject areas of courses offered through distance

education are not limited; however, some courses such as science labs, math, nursing, and languages are among the more challenging to design in an online format (ITC, 2010).

Researchers have evaluated comparison data between face-to-face and distance education courses for as long as there have been alternative delivery formats to traditionally delivered courses. Results have been mixed as to the findings reporting a significant difference or no significant difference. Some have indicated significant findings dependent on student learning styles (Franklin et al., 2001). Some researchers have noted greater satisfaction levels for online students but no difference in grades (Bata-Jones & Avery, 2004; Cooper, 2001); while others have reported just the opposite (Maki & Maki, 2002; Weber & Lennon, 2007).

For community colleges regional accreditation agencies such as SACS-COC (2010) have called for increased assessment of course effectiveness regardless of delivery method and have turned their focus toward increased accountability for students' educational outcomes. In meeting the demands of external stakeholders such as accreditation groups and state higher education systems and regents' boards, colleges have incorporated indicators of educational outcomes into their models for assessing their effectiveness. For example, a core indicator of student progress can include measures such as persistence rates, goal attainment, retention, graduation, satisfaction, and successful course completion (Alfred et al., 2007). Regardless of the indicators used, colleges have been given the directive to assess course effectiveness and ensure the same rigor exists in their distance education courses as in their traditional, face-to-face courses.

CHAPTER 3

RESEARCH METHOD

This chapter introduces the methodology providing the quantitative research framework for the study that includes the research questions and null hypotheses, instrumentation, population, data collection, and data analysis. The design of the study was a nonexperimental design involving secondary data analysis that allows for describing what has occurred and explore comparisons among groups and examine trends within the data (McMillan & Schumacher, 2006).

Research Questions and Null Hypotheses

This study analyzed data from students enrolled in face-to-face sections and online sections of biology courses offered by a community college in East Tennessee. The focus of the study was on the following research questions and associated hypotheses.

1. Is there a significant difference in student success in a biology course offered in the face to-face format and the online format as measured by average lecture grade, average lab grade, or final course grade?

   H_o1_1: There is no significant difference in student success in a biology course offered in the face-to-face format and the online format as measured by average lecture grade.

   H_o1_2: There is no significant difference in student success in a biology course offered in the face-to-face format and the online format as measured by average lab grade.

H_o1_3: There is no significant difference in student success in a biology course offered in the face-to-face format and the online format as measured by final course grade.

2. Is there a significant difference in student success as measured by final course grade in a biology course offered in the face-to-face format and the online format as categorized by gender or major?

H_o2_1: There is no significant difference in student success as measured by final course grade in a biology course offered in the face-to-face format and the online format for females.

H_o2_2: There is no significant difference in student success as measured by final course grade in a biology course offered in the face-to-face format and the online format for males.

H_o2_3: There is no significant difference in student success as measured by final course grade in a biology course offered in the face-to-face format and the online format for health program majors.

H_o2_4: There is no significant difference in student success as measured by final course grade in a biology course offered in the face-to-face format and the online format for nonhealth program majors.

3. Is there a significant difference in student attrition in a biology course offered in the face-to-face format and the online format as categorized by students who withdrew?

H_o3: There is no significant difference in student attrition as categorized by students' withdrawal from a biology course offered in the face-to-face format and the online format.

4. Is there a significant difference in student success in a biology course offered in the face-to-face format and the online format as categorized by age group?

H_o4_1: There is no significant difference in student success in a biology course offered in the face-to-face format and the online format as categorized by the traditional age group.

H_o4_2: There is no significant difference in student success in a biology course offered in the face-to-face format and the online format as categorized by the nontraditional age group.

Instrumentation

The data used in this study were secondary data that were collected through the college's student and course database systems. Information from students' applications to the college was entered into the student database system. The academic division deans and instructors have different levels of access to student records for students who have taken courses within a given division or major. Reports were created using the student data to gather information including demographics, enrollment, and grades. The academic division deans were given access to the course database for their division's student course-level data. The office of Planning, Research, and Assessment was given access to enrollment reports that were available through the student database and used for required external reporting purposes as well as course-level reports available from the division deans.

Population

Walters State Community College (WSCC) is a public 2-year higher education institution located in Morristown, Tennessee. It is governed by the Tennessee Board of Regents and is part of the state's university and community college system. The college provides affordable, quality higher education, continuing education, and workforce development opportunities to residents in its area of responsibility in northeast Tennessee. WSCC's average credit-student unduplicated headcount for fall and spring semesters including fall 2008 through spring 2011 was 6,279 (WSCC, 2011).

The biology courses at WSCC have experienced a growth in demand due to the growth in students taking the required core courses in the health-related academic programs. The dean and a faculty member of the natural science division at the college were instrumental in developing the online modules for select biology courses offered through the division. These modules were based on the traditional, face-to-face counterparts and designed to offer the same course material in digital format. The online courses were also incorporated into a Tennessee Board of Regents' online program (RODP) and have been accessible by students from other colleges.

The population for this study included students who were enrolled in the face-to-face sections of a biology lab and lecture course offered through the community college. Data were collected for 6,582 students (duplicated headcount) enrolled in the courses during the fall and spring semesters from fall 2008 through spring 2011.

The online sections were offered through the Regent's Online Degree Program (RODP) via the Tennessee Board of Regents (TBR) collaborative website, Regents Online Campus Collaborative (ROCC). Students from any college in the TBR system were able to

enroll in an RODP course and designated a specific college as their home institution. WSCC was the developing institution for the RODP biology course modules and materials and also provided the instructors for the online sections. As the developing institution for the RODP biology courses, WSCC retained the right to collect and analyze student data for all students enrolling in the courses. Students in the study designated as online students represented a combination of TBR schools including Walters State. The face-to-face course students were Walters State's students. For the purpose of the study, the students were collectively grouped as online and face-to-face.

Data Collection

This quantitative study analyzed secondary data collected through the college's student database system, Banner Student, as well as course-level data collected by the college's natural science division and enrollment reports accessed through the office of Planning, Research, and Assessment. Permission was obtained from the college president and the natural science dean to use the data for this study. The natural science dean removed all names and social security numbers from the students' records prior to releasing the data. He saved the data on a flash drive and delivered it to the office of Planning, Research, and Assessment. The flash drive was kept in a locked desk drawer to maintain the security of the information and was not removed from the researcher's office. The enrollment reports were accessed through official login to the college's Banner system and were saved onto the researcher's computer. The enrollment reports were run in a manner that did not pull the students' names or social security numbers but did include a student number that was used to match the data received from the natural science dean. The data files were combined to create

a student data record used for the analyses. The college's official confidentiality policy was observed during the data analysis process, and the researcher was the sole person with access to the computer that was used in the process. Additionally, the researcher was required to complete annual training to maintain compliance with the Gramm-Leach-Bliley Act (1999) as part of the college's information security program.

Data Analysis

The data used in the study were analyzed using SPSS 19. The independent variable in the study was class format (face-to-face and online). The dependent variables were lecture grades, lab grades, final grades, gender, major (health programs and nonhealth programs), and age (traditional and nontraditional). The *t*-test for independent samples was used to analyze each of the hypotheses for research questions 1 and 2, and Chi-square tests were used to analyze the hypotheses for research questions 3 and 4. A .05 level of significance (alpha) was established for the data analysis. The statistical procedures and results for the data analysis are detailed in Chapter 4.

CHAPTER 4

ANALYSIS OF DATA

The purpose of this study was to determine if there were significant differences in student success in face-to-face and online sections of a biology course through statistical analysis of select variables: gender, major, age, lecture grades, lab grades, and final course grades. The population for the study was a student enrollment of 6,582 in the face-to-face sections of a biology lecture and lab course and the online sections of combined lecture and lab during the fall and spring semesters beginning fall 2008 through spring 2011.

Chapter 4 presents a demographic overview of the total population followed by statistical analyses of the research questions and associated hypotheses for population samples. An alpha level of .05 was used in the tests to determine the significance of the data. The major findings of the study are addressed in this chapter.

Demographics

The data analyzed were extracted from the community college's student and course database systems with reports accessed through the Office of Planning, Research, and Assessment. The student and course-level data were collected for students who were enrolled in online and face-to-face sections of a biology course during the fall and spring semesters from fall 2008 through spring 2011.

The demographic characteristics of the total student enrollment indicated the majority of the students were female (80.2%), were enrolled in face-to-face sections (66%), and majored in health-related programs (35.9%, nursing; 19.7%, allied health). The overall

attrition rate was 18%. Students' age when reported were categorized into traditional (<25) and nontraditional (≥25), with the percentages being 60 and 40, respectively. Table 1 shows the number of sections taught and total enrollment for online and face-to-face delivery modes during the 3-year period. Due to variations in the data elements and multiple grades from course repeats within the collected data, the number of usable records is based on the variables available for analysis.

Table 1

Sections and Enrollment for a Biology Course Offered During Fall 2008-Spring 2011

Delivery Format	Sections *N*	Enrollment *N*
Face-to-face	170	4,345
Online	127	2,237
Total	297	6,582

Analysis of Research Questions

Four research questions guided this study, and a total of 10 null hypotheses were tested. The questions and associated hypotheses are presented with analyses and accompanying tables.

Research Question #1

Is there a significant difference in student success in a biology course offered in the face to-face format and the online format as measured by average lecture grade, average lab grade, or final course grade?

$H_0 1_1$: There is no significant difference in student success in a biology course offered in the face-to-face format and the online format as measured by average lecture grade.

An independent samples *t* test was used to evaluate the difference in student success between the online and face-to-face formats of a biology course as measured by average lecture grade. The test variable was average lecture grade and the grouping variable was class format. The test was significant, $t(4214)=9.366$, $p<.001$. Therefore, the null hypothesis was rejected. The average lecture grade ($M = 66.34$, $SD = 21.46$) was significantly higher for students in the face-to-face sections than the average lecture grade for students in the online sections ($M = 59.74$, $SD = 24.32$). Therefore, the students in the face-to-face sections tended to have higher success levels than students in the online sections as measured by average lecture grade. The 95% confidence interval for the difference in means was -7.98 to -5.22. The η^2 index was .02, indicating a small effect size. The Levene's test, <.01, was significant at the .05 level, indicating that equal variances were not assumed. The results of the test are presented in Table 2. A graphic representation of the confidence intervals of the means for the online and face-to-face students is showing in Figure 2.

Table 2

A Comparison of the Average Biology Lecture Grade for Students Enrolled in Face-To-Face and Online Sections (Fall 2008 – Spring 2011)

Lecture Grade	*N*	*M*	*SD*	*t*	*df*	*p*
Online	2,279	59.74	24.32	9.366	4,214	<.001
Face-to-face	1,942	66.34	21.46			

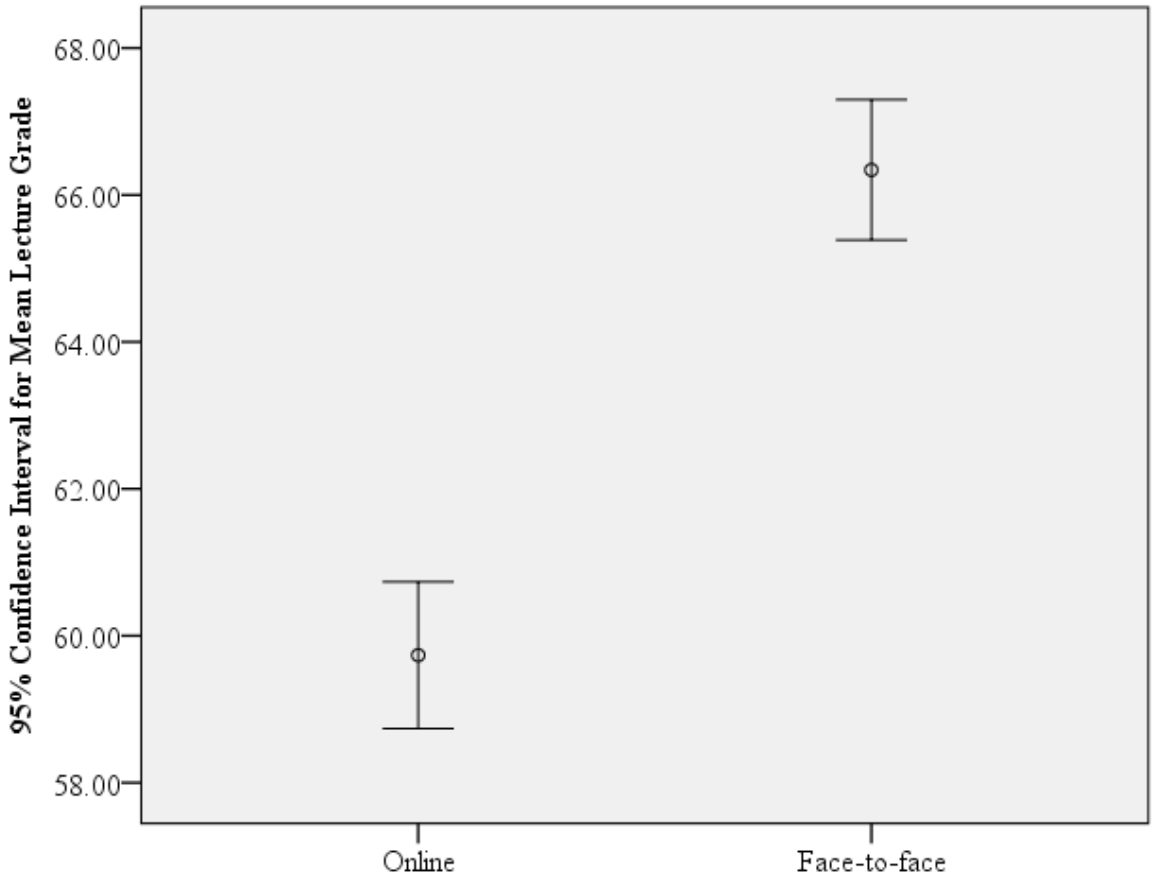

Figure 2: Error Bar of Lecture Grade Mean for Students in Online and Face-to-Face Sections of a Biology Course.

$H_0 1_2$: There is no significant difference in student success in a biology course offered in the face-to-face format and the online format as measured by average lab grade.

An independent samples *t* test was used to evaluate the difference in student success between the online and face-to-face formats of a biology course as measured by average lab grade. The test variable was average lab grade and the grouping variable was face-to-face or online format. The test was significant, $t(4085)=8.173$, $p<.001$. Therefore, the null

hypothesis was rejected. The average lab grade (M = 68.01, SD = 26.17) was significantly higher for students in the face-to-face sections than the average lab grade for students in the online sections (M = 61.24, SD = 26.44). Therefore, the students in the face-to-face sections tended to have higher success levels than students in the online sections as measured by average lab grade. The 95% confidence interval for the difference in means was -8.40 to -5.15. The η^2 index was .02, indicating a small effect size. The Levene's test, .140, was not significant at the .05 level, indicating that equal variances were assumed. The results of the test are presented in Table 3. A graphic representation of the confidence intervals of the means for the online and face-to-face students is showing in Figure 3.

Table 3

A Comparison of the Average Biology Lab Grade for Students Enrolled in Face-To-Face and Online Sections (Fall 2008 – Spring 2011)

Lab Grade	*N*	*M*	*SD*	*t*	*df*	*p*
Online	2,279	61.24	26.44	8.173	4,085	<.001
Face-to-face	1,808	68.01	26.17			

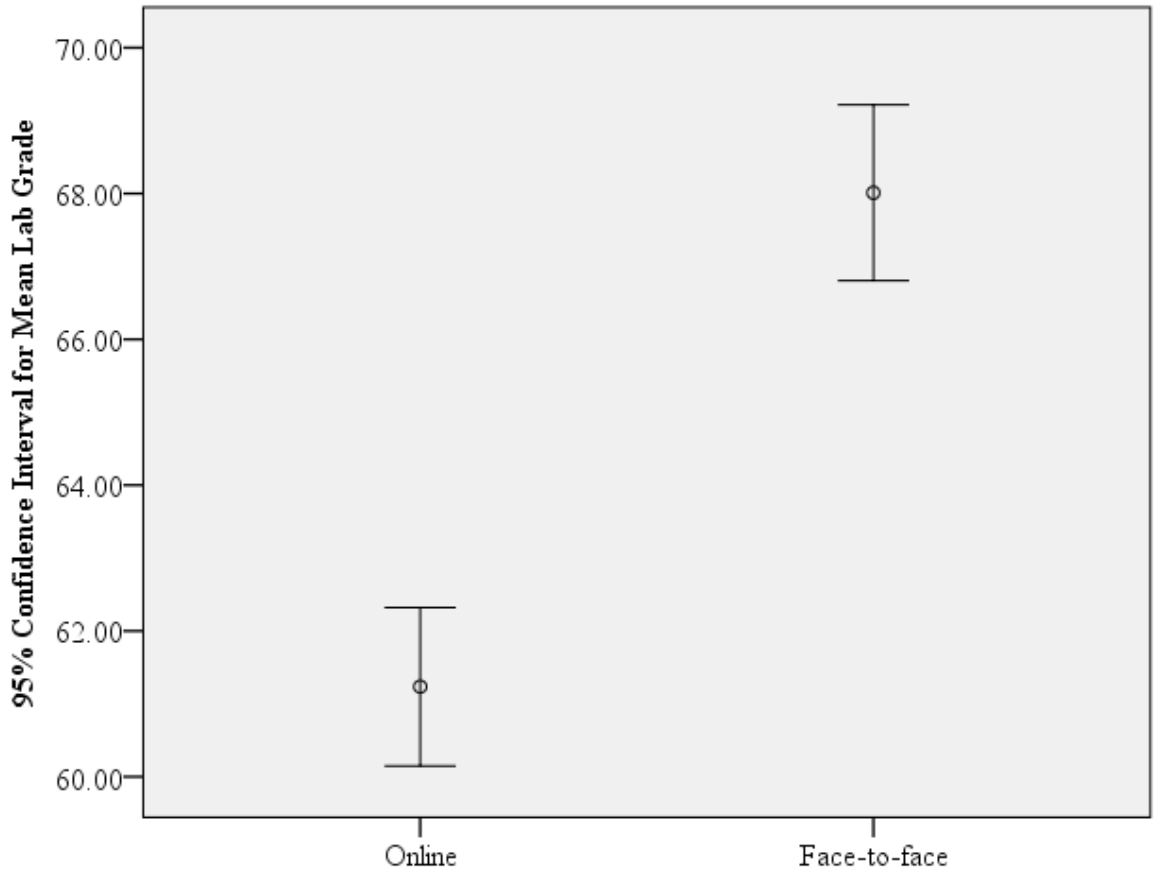

Figure 3: Error Bar of Lab Grade Mean for Students in Online and Face-to-Face Sections of a Biology Course.

$H_0 1_3$: There is no significant difference in student success in a biology course offered in the face-to-face format and the online format as measured by final course grade.

An independent samples *t* test was used to evaluate the difference in student success between the online and face-to-face formats of a biology course as measured by final course grade. The test variable was final course grade and the grouping variable was face-to-face or online format. The test was significant, $t(4085)=6.541$, $p<.001$. Therefore, the null

hypothesis was rejected. The final course grade (M = 69.02, SD = 26.25) was significantly higher for students in the face-to-face sections than the final course grade for students in the online sections (M = 63.72, SD = 25.30). Therefore, students in the face-to-face sections tended to have higher success levels than students in the online sections as measured by final course grade. The 95% confidence interval for the difference in means was -6.89 to -3.71. The η^2 index was <.01, indicating a small effect size. The Levene's test, .467, was not significant at the .05 level, indicating that equal variances were assumed. The results of the test are presented in Table 4. A graphic representation of the confidence intervals of the means for the online and face-to-face students is showing in Figure 4.

Table 4

A Comparison of the Average Biology Final Course Grade for Students Enrolled in Face-To-Face and Online Sections (Fall 2008 – Spring 2011)

Final Grade	*N*	*M*	*SD*	*t*	*df*	*p*
Online	2,279	63.72	25.30	6.541	4,085	<.001
Face-to-face	1,808	69.02	26.25			

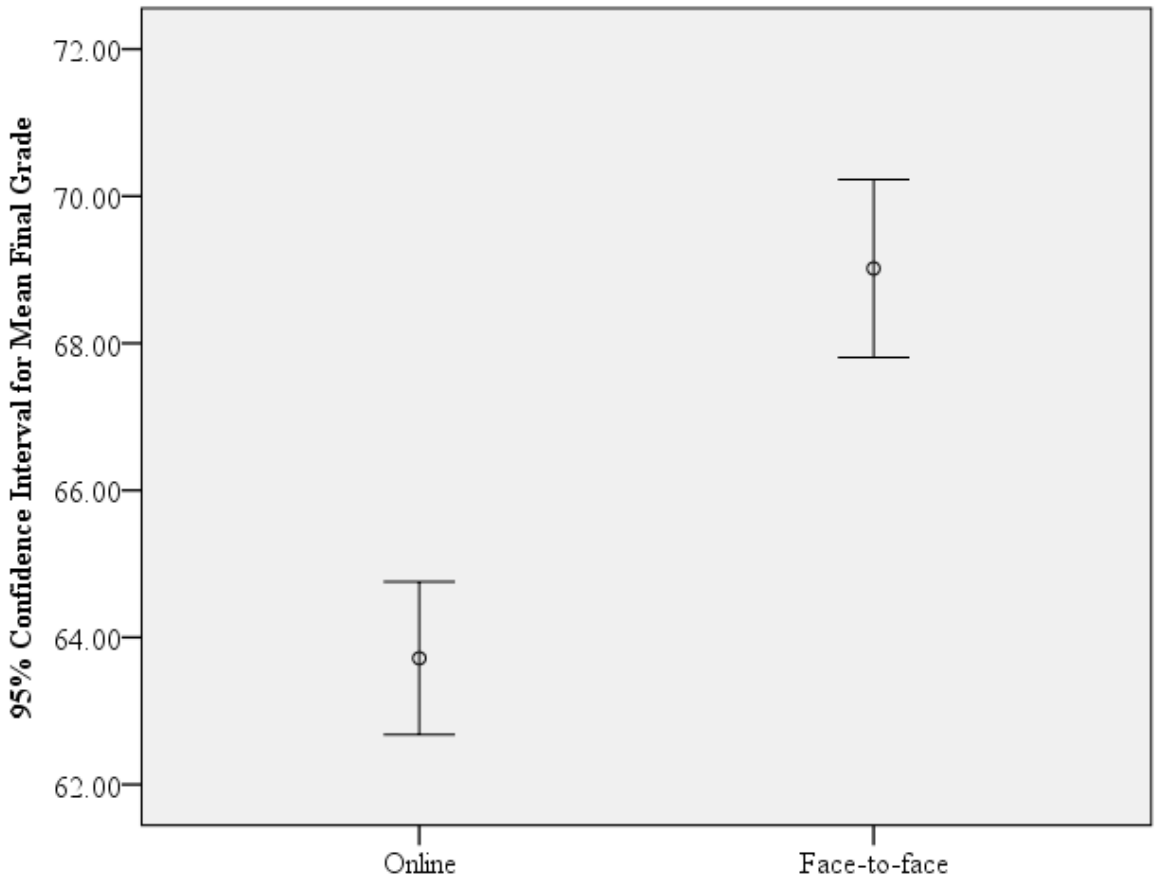

Figure 4: Error Bar of Final Grade Mean for Students in Online and Face-to-Face Sections of a Biology Course.

Research Question #2

Is there a significant difference in student success as measured by final course grade in biology course offered in the face-to-face format and the online format as categorized by gender or major?

H_o2_1: There is no significant difference in student success as measured by final grade in a biology course offered in the face-to-face format and the online format for females.

An independent samples *t* test was used to evaluate the difference in student success for females between the online and face-to-face formats of a biology course as measured by final course grade. The test variable was final course grade and the grouping variable was face-to-face or online format. The test was significant, $t(819)=9.016$, $p<.001$. Therefore, the null hypothesis was rejected. The females in the face-to-face sections tended to have significantly higher success levels than females in the online sections as measured by the final course grade. The final course grades ($M = 70.40$, $SD = 19.66$) were significantly higher for females in the face-to-face sections than final course grades for females in the online sections ($M = 58.99$, $SD = 25.52$). The 95% confidence interval for the difference in means was -13.90 to -8.93. The η^2 index was .05, which indicated a medium effect size. The Levene's test, <.01, was significant at the .05 level, indicating that equal variances were not assumed. The results of the test are presented in Table 5.

Table 5

A Comparison of Final Biology Course Grades for Females Enrolled in Face-To-Face and Online Sections (Fall 2008 – Spring 2011)

Final Course Grade	*N*	*M*	*SD*	*t*	*df*	*p*
Online	520	58.99	25.52	9.016	819	<.001
Face-to-face	1,107	70.40	19.66			

H_o2_2: There is no significant difference in student success as measured by final grade in a biology course offered in the face-to-face format and the online format for males.

An independent samples *t* test was used to evaluate the difference in student success for males between the online and face-to-face formats of a biology course as measured by final course grade. The test variable was final course grade and the grouping variable was face-to-face or online format. The test was significant, $t(171)=4.708$, $p<.001$. Therefore, the null hypothesis was rejected. The final course grades ($M = 71.04$, $SD = 19.18$) were significantly higher for males in the face-to-face sections than final course grades for males in the online sections ($M = 57.45$, $SD = 29.48$). The males in the face-to-face sections tended to have higher success levels than males in the online sections as measured by final course grades. The 95% confidence interval for the difference in means was -19.28 to -7.89. The η^2 index was .05, indicating a medium effect size. The Levene's test, <.01, was significant at the .05 level, indicating that equal variances were not assumed. The results of the test are presented in Table 6. A graphic representation of the confidence intervals of the means for the online and face-to-face students is showing in Figure 5.

Table 6

A Comparison of Final Biology Course Grades for Males Enrolled in Face-To-Face and Online Sections (Fall 2008 – Spring 2011)

Final Course Grade	*N*	*M*	*SD*	*t*	*df*	*p*
Online	124	57.45	29.48	4.708	171	<.001
Face-to-face	278	71.04	19.18			

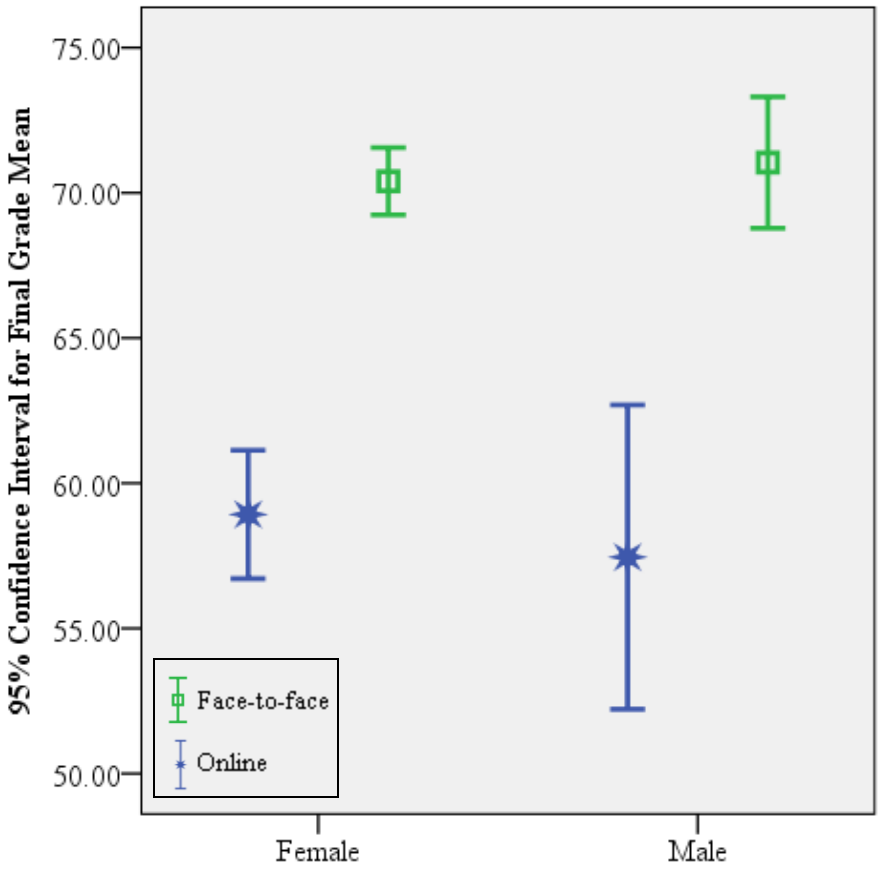

Figure 5: Error Bar of Final Grade Mean for Female and Male Students in Online and Face-to-Face Sections of a Biology Course.

Ho2$_3$: There is no significant difference in student success as measured by final grade in a biology course offered in the face-to-face format and the online format for health program majors.

An independent samples *t* test was used to evaluate the difference in student success for health program majors between the online and face-to-face formats of a biology course as measured by final course grade. The test variable was final course grade and the grouping variable was face-to-face or online format. The test was significant, $t(316)=8.325$, $p<.001$. Therefore, the null hypothesis was rejected. The final course grade ($M = 71.28$, $SD = 19.85$)

was significantly higher for health program majors in the face-to-face sections than the final course grade for health program majors in the online sections (M = 55.59, SD = 26.39). The health program majors in the face-to-face sections tended to have significantly higher success levels than the health program majors in the online sections as measured by final course grades. The 95% confidence interval for the difference in means was -19.40 to -11.98. The η^2 index was .07, indicating a large effect size. The Levene's test, <.01, was significant at the .05 level, indicating that equal variances were not assumed. The results of the test are presented in Table 7.

Table 7

A Comparison of Final Biology Course Grades for Health Program Majors Enrolled in Face-To-Face and Online Sections (Fall 2008 – Spring 2011)

Final Course Grade	*N*	*M*	*SD*	*t*	*df*	*p*
Online	231	55.59	26.39	8.325	316	<.001
Face-to-face	733	71.28	19.85			

H_o2_4: There is no significant difference in student success as measured by final grade in a biology course offered in the face-to-face format and the online format for nonhealth program majors.

An independent samples *t* test was used to evaluate the difference in student success for nonhealth program majors between the online and face-to-face formats of a biology

course as measured by final course grade. The test variable was final course grade and the grouping variable was face-to-face or online format. The test was significant, $t(691)=6.213$, $p<.001$. Therefore, the null hypothesis was rejected. The final course grades ($M = 69.69$, $SD = 19.21$) were significantly higher for nonhealth program majors in the face-to-face sections than final course grades for nonhealth program majors in the online sections ($M = 60.43$, $SD = 26.14$). Nonhealth program majors in the face-to-face sections tended to have higher success levels than nonhealth program majors in the online sections as measured by final course grades. The 95% confidence interval for the difference in means was -12.18 to -6.33. The η^2 index was .05, indicating a medium effect size. The Levene's test, <.01, was significant at the .05 level, indicating that equal variances were not assumed. The results of the test are presented in Table 8. A graphic representation of the confidence intervals of the means for the online and face-to-face students is showing in Figure 6.

Table 8

A Comparison of Final Biology Course Grades for Nonhealth Program Majors Enrolled in Face-To-Face and Online Sections (Fall 2008 – Spring 2011)

Final Course Grade	*N*	*M*	*SD*	*t*	*df*	*p*
Online	413	60.43	26.14	6.213	691	<.001
Face-to-face	652	69.69	19.21			

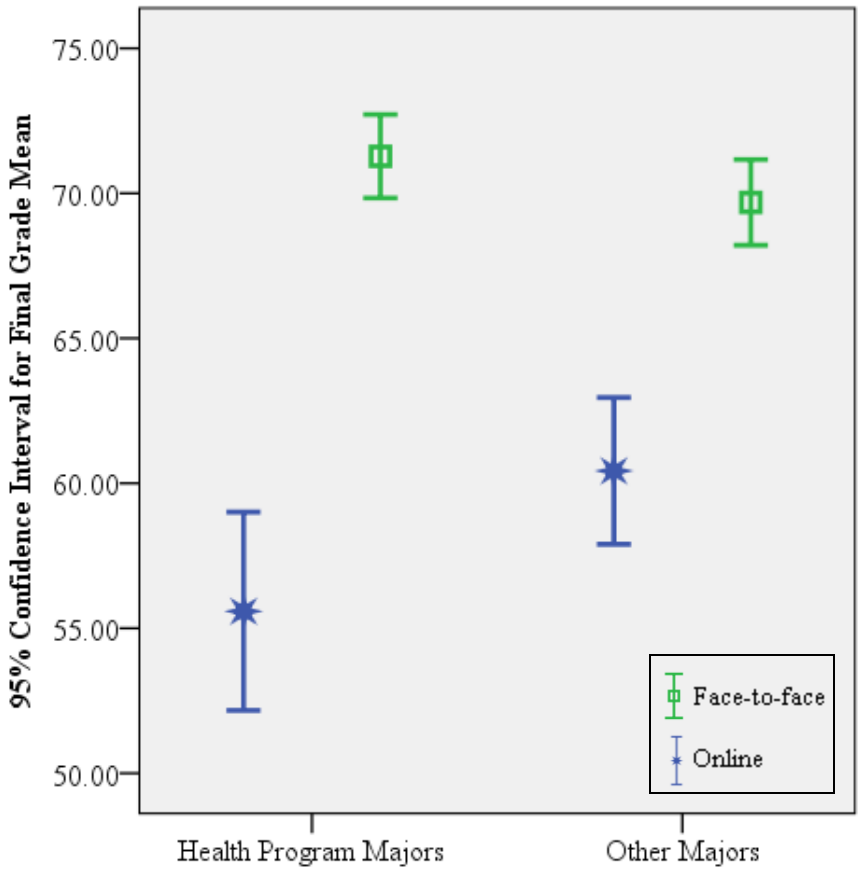

Figure 6: Error Bar of Final Grade Mean for Health Program Majors and Other Program Majors in Online and Face-to-Face Sections of a Biology Course.

Research Question #3

Is there a significant difference in student attrition in a biology course offered in the face-to-face format and the online format as categorized by students who withdrew?

H_o3: There is no significant difference in student attrition as categorized by students' withdrawal from a biology course offered in the face-to-face format and the online format.

A chi-square analysis was conducted to evaluate if there was a difference in student attrition in the face-to-face format and the online format of a biology course. The two

variables were status of the student with two levels, completed and withdrew, and the format of the class face-to-face and online. Status of the student and class format were found to be significantly related (Pearson χ^2 (1, N= 6852) = 34.50, p <.01, Cramer's V = .07). Therefore, the null hypothesis was rejected. The online sections tended to have significantly higher attrition rates than the face-to-face sections. As shown in Table 9, the percentage of students who withdrew from the online format was 22, compared to 16% of students who withdrew from the face-to-face format.

Table 9

Comparison of Student Status in the Face-To-Face and Online Formats of a Biology Course (Fall 2008 – Spring 2011)

	Online		*Face-to-face*	
Student Status	*N*	*%*	*N*	*%*
Completed	1,742	77.9	3,640	83.8
Withdrew	495	22.1	705	16.2
Total	2,237	100.0	4,345	100.0

Research Question #4

Is there a significant difference in student success in a biology course offered in the face-to-face format and the online format as categorized by age group?

$H_0 4_1$: There is no significant difference in student success in a biology course offered in the face-to-face format and the online format for the traditional (<25) age group.

A chi-square analysis was conducted to evaluate if there was a difference in student success in the face-to-face format and the online format of a biology course for the traditional (<25) age group. The variables were success of the student, successful (defined as passing with a grade of C or better) and unsuccessful, and the format of the class face-to-face and online. Student success among the traditional age group and class format were not significantly related (χ^2 (1, N= 2433) = .090, p = .764). Thus, the null hypothesis was retained. There was no significant difference in student success for traditional age (<25) students in the face-to-face and online formats. As shown in Table 10, the percentages of traditional-age students who were successful (58.9, online; 60.2, face-to-face) and unsuccessful (41.1, online; 39.8, face-to-face) showed little difference.

Table 10

A Comparison of Traditional Age Student Success in the Face-To-Face and Online Formats of a Biology Course (Fall 2008 – Spring 2011)

Traditional Age (<25)	*Online*		*Face-to-face*	
Student Success	*N*	*%*	*N*	*%*
Successful (≥ C)	76	58.9	1,388	60.2
Unsuccessful (≤ C)	53	41.1	916	39.8
Total	129	100.0	2,304	100.0

$H_0 4_2$: There is no significant difference in student success in a biology course offered in the face-to-face format and the online format as categorized by the nontraditional age group.

A chi-square analysis was conducted to evaluate if there was a difference in student success in the face-to-face format and the online format of a biology course for the nontraditional (≥25) age group. The variables were success of the student, successful (defined as passing with a grade of C or better) and unsuccessful, and the format of the class face-to-face and online. Student success among the nontraditional age group and class format were significantly related (χ^2 (1, N=1655) = 17.54, p<.001, Cramer's V<.001). Therefore, the null hypothesis was rejected. The nontraditional age (≥25) students in the face-to-face sections tended to have higher success levels than those in the online sections. As shown in Table 11, 66.9% of nontraditional age students were successful and 33.1% were unsuccessful in the online class format, compared to 80.8% success and 19.2% unsuccessful for nontraditional age students in the face-to-face format.

Table 11

Comparison of Nontraditional Age Student Success in the Face-To-Face and Online Formats of a Biology Course (Fall 2008 – Spring 2011)

Nontraditional Age (≥25)	*Online*		*Face-to-face*	
Student Success	*N*	*%*	*N*	*%*
Successful (≥ C)	109	66.9	1,206	80.8
Unsuccessful (≤ C)	54	33.1	286	19.2
Total	163	100.0	1,492	100.0

Summary

Chapter 4 presented the descriptive and comparative analyses for data collected from a community college's student and course databases for students who were enrolled in online and face-to-face sections of a biology course during the fall and spring semesters from fall 2008 through spring 2011. The data were analyzed using *t*-tests for independent samples and chi-square cross-tabulations. The summary, conclusions, implications for practice, and recommendations for further study based on the findings of the research data are presented in Chapter 5.

CHAPTER 5

SUMMARY, CONCLUSIONS, IMPLICATIONS FOR PRACTICE, AND RECOMMENDATIONS FOR FUTURE RESEARCH

Chapter 5 contains the findings, conclusions, implications for practice, and recommendations based on data gathered for the purpose of determining whether there were significant differences in student success in face-to-face and online sections of a biology course through statistical analysis of select variables: gender, major, age, lecture grades, lab grades, and final course grades. The total population was comprised of 4,345 students enrolled in the face-to-face sections and 2,237 students enrolled in the online sections of a biology course during the fall and spring semesters beginning fall 2008 through spring 2011, with demographics shown in Table 1 and completion represented in Table 9. The analyses for research question 1 included lecture grades, lab grades, and final course grades for records with available grades. Research question 2 included analyses on final grades for females, males, health program majors, and nonhealth program majors. Attrition rate was the focus in the analysis in research question 3. The analyses for research question 4 included success rates for traditional age (<25) and nontraditional age (≥25) students whose ages were available.

The number of community college courses being offered through distance education has continued to grow as a result of the rapid growth of the internet. Online courses are in demand by students who desire remote access to classes. As colleges have strived to meet the needs of these students, they have also faced increased accountability measures by governing and external accrediting bodies. A common goal of concern to all parties involved has been

to maintain excellence in student learning opportunities regardless of the mode of delivery. Measuring student learning outcomes through grades associated with courses is one way to access academic effectiveness and provide evidence of educational quality.

The data analyzed in the study presented a demographic characterization of a majority of the students being female (80.2%), enrolled in face-to-face sections (66%), health program majors (35.9%), and traditional in age, defined as younger than 25 (60%). Nationally, a majority of community college students have generally been female and older than age 22 (Horn & Nevill, 2006). Females continue to be the majority within health-related fields, and this study does not stray from that generality.

The statistical analyses for the research questions and associated hypotheses introduced in Chapter 1, discussed in Chapter 3, and analyzed in Chapter 4 are summarized in this chapter. A .05 level of significance was established for testing the research questions and hypotheses, using a Levene's test for equality of variances to determine whether to report a *t* value that assumed equal variances or a *t* value related to equal variances not assumed. Research questions 1 and 2 were analyzed using *t*-tests for independent samples; research questions 3 and 4 were analyzed using chi-square tests, with Cramer's V determining association strengths for significant chi-square tests.

Summary of Findings

The demographics for the student data analyzed varied in comparison to those identified in the literature as describing a majority of the community college students. While the majority of students in this study were female, which is in line with other studies (AACC,

2011; Horn & Nevill, 2006), the majority of students in this study were in the traditional age group (<25) rather than nontraditional age group (≥25).

There were statistically significant differences between lecture grades, lab grades, final grades, female success rates, male success rates, health program major success rates, and nontraditional age (≥25) success rate for students in the face-to-face course compared to the online students. There was no significant difference in the success rate for traditional age (<25) students in the face-to-face sections compared to those in the online sections. There was a statistically significant difference in the attrition rate between online and face-to-face sections.

Research Question #1

Is there a significant difference in student success in a biology course offered in the face to-face format and the online format as measured by average lecture grade, average lab grade, or final course grade?

Independent samples *t* tests were used to evaluate whether there were differences in average lecture, lab, and final grades between the face-to-face and online sections of a biology course. The results were that significant differences existed between grades and class format, with all three average grades being higher for students in the face-to-face sections than the online sections. The difference was stronger for the average lab grade and the average final grade of students in the face-to-face sections compared to the online sections due to nonsignificant Levene's tests which assumed equal variances. These findings are contradictory with the findings of some researchers (Collins, 2000; Johnson, 2002; King &

Hildreth, 2001), who reported no significant difference in performance for students in online and face-to-face formats of biology classes.

Research Question #2

Is there a significant difference in student success as measured by final course grade in a biology course offered in the face-to-face format and the online format as categorized by gender or major?

Independent samples *t* tests were used to evaluate differences in student success for females, males, health program majors, and nonhealth majors in face-to-face and online biology course formats. The results were that significant differences existed between females, males, and health program majors in face-to-face sections compared to those in online sections. With Levene's tests indicating equal variances were not assumed, student success was greater for females, males, and health program majors in face-to-face sections compared to their counterparts in online sections. In comparative studies, researchers have indicated that while gender and college major are factors used in measuring students' success (Ronco, 1996; Zhao, 1999), some have reported findings of no significant differences (Bata-Jones & Avery, 2004; Leasure et al., 2000).

Research Question #3

Is there a significant difference in student attrition in a biology course offered in the face-to-face format and the online format as categorized by students who withdrew?

A chi-square test analyzed whether there was a significant difference in student attrition between the face-to-face and online formats. There was a significant difference in

the attrition rate for students in the online sections compared to the attrition rate in face-to-face sections. While the Cramer's V test for the strength of relationship was small, suggesting little relationship between attrition rate and class format, the chi-square test indicated in a higher attrition rate for students in the online sections. Researchers in previous studies have attributed significant differences in persistence or the lack thereof (attrition) to self-motivation more than class format (Gaythwaite, 2006; Parker, 2003).

Research Question #4

Is there a significant difference in student success in a biology course offered in the face-to-face format and the distance education format as categorized by age group?

Chi-square tests were used to analyze whether there were significant differences in student success between the face-to-face and online formats for traditional age (<25) and nontraditional age (≥25) students. There was no significant difference in the success rate for traditional age (<25) students in the online sections compared to traditional age (<25) students in the face-to-face sections. There was a significant difference in the success rate for nontraditional age (≥25) students in the face-to-face sections compared to the online sections, with this age group having a higher success rate in the face-to-face format. While significant differences have been found in evaluating other variables in relation to face-to-face and online course formats, age, specifically the traditional-age (<25) group, is the only variable to have produced a nonsignificant finding based on a .05 level of significance.

Conclusions

Based on data analyses and findings of this study, the following conclusions may be drawn:

1. Students in face-to-face sections of the biology course studied tended to have higher average lecture, lab, and final course grades than students in the online sections. The means were surprisingly low by being in the "D" grade range, at 66.34 and 59.74 for lecture; 68.01 and 61.24 for lab; and 69.02 and 63.72 for final course grade. Overall, while students may have fared somewhat better in the face-to-face sections, the low mean grades may be a result of the difficulty of the course rather than delivery format. A report of survey findings by the ITC (2010) listed science classes with labs as being among the most difficult courses to deliver online.
2. Disaggregating the students by gender and major yielded results indicating female students in the face-to-face sections (M = 70.40) tended to have a higher success level than females in the online sections (M = 58.99), with the same significant finding for males (M = 71.04; M = 57.45). Students majoring in health related programs tended to have a higher success level than students in nonhealth related programs (M = 71.28; M = 55.59). Historically at the community college in the study females have comprised a majority of the health related majors, and biology is a core required course in which the final grade is used in the points' formula for entrance into the major program.
3. The attrition rate was derived from the percentage of students who withdrew from a course section compared to those who remained enrolled. The attrition rate was

significantly higher (22%) for the online sections than for the face-to-face sections (16%). This finding reinforced the notion that students may not be adequately prepared for the online course structure and withdraw after failing to pass the first and/or second exam (a time period that falls in the college's official withdrawal period.) Researchers Collins and Pascarella (2003) reported that the successful online students possessed a higher level of self-discipline and technological skills, which suggested they were prepared to handle the online format.

4. The analysis of student success in face-to-face and online formats provided a nonsignificant finding in this study: the percentages of traditional age (<25) students who were successful were almost equal in both delivery formats (60.2% face-to-face; 58.9% online). Conversely, a second finding was significant in that nontraditional age students (≥25) tended to be more successful in the face-to-face sections (80.8%) than in the online sections (66.9%). The traditional-age students have grown up immersed in technology and may be less apprehensive than older students in adapting to online course delivery. Traditional-age students also tend to be less involved in other responsibilities like working and supporting a family and may be more disciplined in devoting the time required for coursework, regardless of course delivery format.

Implications for Practice

The researcher of this study investigated whether there were significant differences in face-to-face and online delivery formats for a biology course as measured by average lecture

grade, average lab grade, or final course grade, and as categorized by gender or major. The following recommendations are based on the findings of this study.

1. Even though students in the face-to-face sections had higher average grades than the online students, averages for both groups were low. Incorporating such strategies as study materials and more interaction between students and instructors could be advantageous to students in the more difficult core courses regardless of delivery format.
2. Overall, females in the study performed at a higher average grade level than males, with the average success level for males being below passing. Strategies for providing additional advising and academic support may encourage higher success levels for males in core courses such as biology.
3. On online orientation could be developed and instituted as a requirement for all students prior to enrollment in online courses. This would introduce students to the format and would help them understand the self-direction and time management skills necessary for success.
4. Addressing the higher attrition rate for online courses could include the incorporation of proficiency requirements that must be met before students are cleared for registration for first-time online courses.
5. Instructors should consider providing intervention strategies immediately following the first exam for those students who do not pass in an effort to help and encourage them.
6. Students should be encouraged to understand their personal learning style and be equipped with strategies for adapting their style to the format of online courses.

7. Faculty in all divisions should share successful intervention strategies for helping students succeed.
8. The college could benefit from imploring a focus group of former biology students representing online and face-to-face students who have completed, withdrawn, passed, and failed, to gather information that may help future students successfully complete biology and other science-based courses.

Recommendations for Further Research

It is hoped that the findings of this study would provide research-based information that could be useful in the planning and assessment of courses delivered in online and face-to-face formats at the community college level.

1. A qualitative study of similar students could explore factors related to various success levels and attrition rates for science courses in the face-to-face and online formats.
2. A study at the community college level investigating courses in other academic disciplines that are offered in the face-to-face and online formats would be useful in determining whether courses in other disciplines are better suited for the online format.
3. Research has provided insight into greater student success in a hybrid class platform that includes an online lecture component and a face-to-face lab component (Riffell & Merrill, 2005). Further research comparing student outcomes in hybrid courses and online courses would be beneficial in determining which format is most effective for science courses.

4. Similar studies should be performed on other community colleges offering the face-to-face and online formats of science courses.

REFERENCES

Adams, E. C., & Freeman, C. (2000). Commuting the "distance" of distance learning: The Pepperdine story. In L. Lau (Ed.), *Distance learning technologies: Issues, trends, and opportunities,* 157-165. Hershey, PA: Idea Group.

Alfred, R., Shults, C., & Seybert, J. (2007). *Core indicators of effectiveness for community colleges*. Washington, DC: Community College Press.

Allen, I. E., & Seaman, J. (2008). Staying the course: Online education in the United States, 2008. Sloan Consortium (Sloan-C). Retrieved June 1, 2011, from http://sloanconsortium.org/sites/default/files/staying_the_course-2.pdf

Allen, I. E., & Seaman, J. (2010). Class differences: Online education in the United States, 2010. Sloan Consortium (Sloan-C). Retrieved June 1, 2011, from http://sloanconsortium.org/sites/default/files/class_differences.pdf

American Association of Community Colleges. (2011). Community college fast facts. Retrieved June 1, 2011, from www.aacc.nche.edu/AboutCC/Documents/FactSheet2011.pdf

Anderson, T. (2001). The hidden curriculum in distance education: An updated view. *Change, 33(6),* 28-35.

Arle, J. (2010). Rio Salado College: A systems approach to online learning. In C. Twigg (Ed.), *NCAT monograph case studies. Innovations in online learning: Moving beyond no significant difference*. Retrieved June 1, 2011, from http://www.thencat.org/Monographs/InnovCaseSt.htm#Rio

Astin, A. W. (1991*). Assessment for excellence: The philosophy and practice of assessment and evaluation in higher education*. New York: Macmillan.

Astin, A. W. (1993*). What matters in college? Four critical years revisited*. San Francisco: Jossey-Bass.

Baldrige Performance Excellence Program. (2011). *2011-2012 Education criteria for performance excellence*. Gaithersburg, MD: National Institute of Standards and Technology.

Bangurah, F. M. (2004). *A study of completion and passing rates between traditional and web-based instruction at a two-year public community college in northeast Tennessee*. (Doctoral dissertation). Johnson City, TN: East Tennessee State University.

Bata-Jones, B., & Avery, M. D. (2004). Teaching pharmacology to graduate nursing students: Evaluation and comparison of web-based and face-to-face methods. *Journal of Nursing Education, 43*, 185-189.

Beile, P. M., & Boote, D. N. (2002). Library instruction and graduate professional development: Exploring the effect of learning environments on self-efficacy and learning outcomes. *Alberta Journal of Educational Research, 48*, 364-367.

Berg, G. A. (2005). History of correspondence instruction. In C. Howard, J. V. Boettcher, L. Justice, K. D. Schenk, P. L. Rogers, & G. A. Berg (Eds.), *Encyclopedia of distance learning*, 1006-1011. doi:10.4018/978-1-59140-555-9.

Bird, F. (2010). A comparison of the effectiveness of an interactive, online module versus a laboratory-based exercise which introduces microscopy to first-year biology students. Proceedings of the 16th UniServe Science Annual Conference, University of Sydney, Sept. to Oct 1, 2010, 13-17. Retrieved June 1, 2011, from http://escholarship.usyd.edu.au/journals/index.php/IISME/article/viewFile/4684/5458

Bocchi, J., Eastman, J. K., & Swift, C. O. (2004). Retaining the online learner: Profile of students in an online MBA program and implications for teaching them. *Journal of Education for Business, 79*, 245-253.

Bower, B. L., & Hardy, K. P. (2004). From correspondence to cyberspace: Changes and challenges in distance education. In B. L. Bower & K. P. Hardy (Eds.), *From distance education to e-learning: Lessons along the way*, 5-12. San Francisco: Jossey-Bass.

Boyles, L. W. (2000). *Exploration of a retention model for community college students*. (Doctoral dissertation). Greensboro, NC: The University of North Carolina. UMI No. 9972048.

Brint, S., & Karabel, J. (1989). *The diverted dream: Community colleges and the promise of educational opportunity in America 1900-1985*. New York: Oxford University Press.

Buckley, K. M. (2003). Evaluation of class-room based, web-enhanced, and web-based distance learning nutrition courses for undergraduate nursing. *Journal of Nursing Education, 42*, 367.

Caldwell, E. R. (2006). *A comparative study of three instructional modalities in a computer programming course: Traditional instruction, web-based instruction, and online instruction*. (Doctoral dissertation). Greensboro, NC: The University of North Carolina.

Campbell, M., Gibson, W., Hall, A., Richards, D., & Callery, P. (2008). Online vs. face-to-face discussion in a web-based research methods course for postgraduate nursing students: A quasi-experimental study. *International Journal of Nursing Studies, 45,* 750-759.

Carnevale, D. (2001). Union offers standards for distance education. *The Chronicle of Higher Education,* A23.

Carr, S. (2000). As distance education comes of age, the challenge is keeping the students. *Chronicle of Higher Education, 46(23),* A39.

Cavus, N., & Ibrahim, D. (2007). Assessing the success rate of students using a learning management system together with a collaborative tool in web-based teaching of programming languages. *Journal of Educational Computing Research, 36,* 301-321.

Center for Community College Student Engagement. (2009a). Making connections: Dimensions of student engagement – 2009 CCSSE findings. Austin, TX: University of Texas at Austin, Community College Leadership Program.

Center for Community College Student Engagement. (2009b). Most and least engaged students – 2009 CCSSE cohort data. Austin, TX: The University of Texas at Austin, Community College Leadership Program.

Christopher, M., Thomas, J., & Tallent-Runnels, M. (2004). Raising the bar: Encouraging high level thinking in online discussion forums. *Roeper Review, 26,* 166-171. Retrieved June 1, 2011, from http://www.umsl.edu/technology/frc/pdfs/encourage_high_level_thinking_online_DB.pdf

Coleman, S. (2005). Why do students like on-line learning? *World Wide Learn*. Retrieved June 1, 2011, from http://www.worldwidelearn.com/education-articles/benefits-of-online-learning.htm

Collins, J., & Pascarella, E. T. (2003). Learning on campus and learning at a distance: A randomized instructional experiment. *Research in Higher Education, 44,* 315-326.

Collins, M. (2000). Comparing web, correspondence and lecture versions of a second-year non-major biology course. *British Journal of Educational Technology, 31(1),* 21-27.

Cooper, L. W. (2001). Online and traditional computer application classes. *T.H.E. Journal, 28(9),* 52-58.

Daniel, J. D. (2005). Open and distance learning: What's in a name? Speech presented at the 11th Cambridge Conference in Cambridge, United Kingdom. Retrieved June 1, 2011, from http://www.col.org/resources/speeches/2005presentations/Pages/2005-09-20.aspx

Diaz, D. P. (2002). Online drop rates revisited. *The Technology Source. May/June.* Retrieved June 1, 2011, http://technologysource.org/article/online_drop_rates_revisited/

Ewell, P., & Wellman, J. (2007). Enhancing student success in education: Summary report of the NPEC initiative and national symposium on postsecondary student success. National Postsecondary Education Cooperative: Washington, DC. Retrieved June 1, 2011, from http://www.cpec.ca.gov/CompleteReports/ExternalDocuments/NPEC_Ewell_Report.pdf

Franklin, S., Peat, M., & Lewis, A. (2001). Virtual versus traditional dissections in enhancing learning: A student perspective. *Journal of Biological Education, 36,* 124-129.

Gaddis, B. H., Napierkowski, H., Guzman, N., & Muth, R. (2000). A comparison of collaborative learning and audience awareness in two computer-mediated writing environments. ERIC Document Reproduction Service ED455771.

Gallagher, S. (2002). *Distance learning at the tipping point: Critical success factors to growing fully online distance learning programs*. Boston, MA: Eduventures.

Gaythwaite, E. S. (2006). *Metacognitive self-regulation, self-efficacy for learning and performance, and critical thinking as predictors of academic success and course retention among community college students enrolled in online, telecourse, and traditional public speaking courses*. (Doctoral dissertation). Orlando: University of Central Florida.

Gramm-Leach-Bliley Act of 1999, Pub. L. No. 106-102, 12 U.S.C. § 1811, 113 Stat. 1338 (1999).

Grant, M. R., & Thornton, H. R. (2007). Longitudinal comparison between online and face-to-face courses in an adult continuing education program. Retrieved June 1, 2011, from http://www.itdl.org/Journal/Dec_07/article01.htm

Gunawardena, C. N., & McIssac, M. S. (2004). Distance education. In D. H. Jonassen (Ed.), *The handbook of research in educational communications and technology* (2nd ed.). Mahwah, NJ: Lawrence Erlbaum.

Hagedorn, L. S., Perrakis, A. I., & Maxwell, W. (2006). The positive commandments: 10 ways community colleges help students succeed. *Community College Journal, April/May,* 58-61.

Hickman, C. J. (2003). Results of survey regarding distance education offerings. University Continuing Education Association (UCEA) Distance Learning Community of Practice, Research committee report.

Higher Education Opportunity Act. (2008). Public Law 110-315. Retrieved June 1, 2011, from http://www.aessuccess.org/higher_ed/pdf/common_manual/HEOA.pdf

Hiltz, S. R., & Benbunan-Fich, R. (2000). Measuring the importance of collaborative learning for effectiveness of ALN: A multi-measure, multi-method approach. *Journal of Asynchronous Learning Networks, 4*, 103-126.

Holder, B. (2007). An investigation of hope, academics, environment, and motivation as predictors of persistence in higher education online programs. *Internet and Higher Education, 10*, 245–260.

Holmberg, B. (2005). *The evolution, principles, and practices of distance education, 11,* 1-174. Retrieved June 1, 2011, from http://www.mde.uni-oldenburg.de/download/asfvolume11_eBook.pdf

Horn, L., & Nevill, S. (2006). *Profiles of undergraduates in U.S. postsecondary education institutions: 2003-04. With a special analysis of community college students* (NCES 2006-184). U.S. Department of Education. Washington, DC: National Center for Education Statistics.

Howell, S. L., Williams, P. B., & Lindsay, N. K. (2003). Thirty-two trends affecting distance education: An informed foundation for strategic planning. *Online Journal of Distance Learning Administration, 7(3)*. Retrieved June 1, 2011, from http://www.westga.edu/~distance/ojdla/fall63/howell63.html

Hsu, Y. C., & Shiue, Y. M. (2005). The effect of self-directed learning readiness on achievement comparing face-to-face and two-way distance learning instruction. *International Journal of Instructional Media, 32,* 143-156.

Hughes, L. (2008). Construction and evaluation of an online microbiology course for non-science majors. *Journal of Microbiology & Biology Education, 9*. Retrieved June 1, 2011, from http://jmbe.asm.org/index.php/jmbe/article/viewArticle/92/html_11

Instructional Technology Council. (2010). *Distance education survey results. Trends in elearning: Tracking the impact of elearning at community colleges*. Washington, DC: ITC.

Internet World Stats. (2010). *Internet usage statistics, the internet big picture*. Retrieved June 1, 2011, from http://www.internetworldstats.com/stats.htm

Irizarry, R. (2002). Self-efficacy and motivation effects on online psychology student retention. *United States Distance Learning Administration (USDLA) Journal, 16(12)*, 55-64.

Jenkins, D. (2006). What community college management practices are effective in promoting student success? A study of high- and low-impact institutions. New York: Columbia University, Teachers College, Community College Research Center.

Johnson, M. (2002). Introductory biology online: Assessing outcomes of two student populations. *Journal of College Science Teaching, 5*, 312-317.

Karp, M. M., & Hughes, K. L. (2008). Information networks and integration: Institutional influences on experiences and persistence of beginning students. *New Directions for Community Colleges, 144*, 73-82.

Kazis, R. (2006). State policy and advocacy for student success. *Community College Journal, April/May*, 48-53.

Kearns, L. E., Shoaf, J. R., & Summey, M. B. (2004). Performance and satisfaction of second degree BSN students in web-based and traditional course delivery environments. *Journal of Nursing Education, 43*, 280-282.

Keegan, D. J. (1980). *ZIFF papiere 33: On the nature of distance education*. Hagen: Zentrales Institut fur Fernstudienforschung. 1-47. Retrieved June 1, 2011, from www.mde.uni-oldenburg.de/download/asfvolume11_eBook.pdf

King, P., & Hildreth, D. (2001). A side-by-side comparison of traditional and web-based courses. *Journal of College Science Teaching, 31*, 112-115.

Kluckholn Jones, L. W. (2010). Experiences vary in learning microbiology online. *Microbe. 5(12)*. Retrieved June 1, 2011, http://www.microbemagazine.org/images/stories/images/dec2010/znw01210000520.pdf

Krawiec, S., Salter, D., & Kay, E. (2005). A "hybrid" bacteriology course: The professor's design and expectations; the students' performance and assessment. *Journal of Microbiology & Biology Education, 6*, 8-13. Retrieved February 15, 2011, from http://jmbe.asm.org/index.php/jmbe/article/viewArticle/78/html_20

Larreamendy-Joerns, J., & Leinhardt, G. (2006). Going the distance with online education. *Review of Educational Research, 76*, p. 567-605.

Leasure, A. R., Davis, L., & Thievon, S. L. (2000). Comparison of student outcomes and preferences in traditional vs. world wide web-based baccalaureate nursing research course. *Journal of Nursing Education, 39*, 149-154.

Lee, M., & English, M. (2009). Online degree programs: An overview. *Points of View: Online Degree Programs*. Points of View Reference Center database. Retrieved June 1, 2011, from EBSCOhost.

Lents, N. H., & Cifuentes, O. E. (2009). Web-based learning enhancements: Video lectures through voice-over PowerPoint in a majors-level biology course. *Journal of College Science Teaching, 39(2),* 38-46.

MacBrayne, P. S. (1995). Distance education: The way of the future for rural community colleges. *New Directions for Community Colleges, 90,* 55-63.

Maeroff, G. (2003). *A classroom of one*. New York: McMillan.

Maki, W. S., & Maki, R. H. (2002). Multimedia comprehension skill predicts differential outcomes of web-based and lecture courses. *Journal of Experimental Psychology: Applied, 8(2),* 85-98.

McGivney, V. (2004). Understanding persistence in adult learning. *Open Learning, 19(1),* 33-46.

McMillan, J. H. & Schumacher, S. (2006). *Research in education, evidence-based inquiry* (6th ed). Boston: Pearson Education.

McMurray, A. J. (2007). College students, the GI bill, and the proliferation of online learning: A history of learning and contemporary challenges. *Internet and Higher Education, 10*, 143–150.

Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2010). *Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies*. U.S. Department of Education. Retrieved June 1, 2011, from http://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf

Meyer, K. A. (2002). *Quality in distance education*. (Report No. EDO-HE-20002-09) Washington, DC: United States Department of Education.

Nasseh, B. (1997). A brief history of distance education. *SeniorNet*. Retrieved June 1, 2011, from http://www.seniornet.org/edu/art/history.html

National Center for Education Statistics. (2008). *The condition of education: 2008* (NCES 2008-031). Washington, DC: U.S. Department of Education.

Natriello, G. (2005). Modest changes, revolutionary possibilities: Distance learning and the future of education. *Teachers College Record, 107,* 1885-1904.

O'Lawrence, H. (2006). The influences of distance learning on adult learners. *Techniques: Connecting Education and Careers, 81(5),* 47-49.

Oblinger, D. G., & Hawkins, B. L. (2006). The myth about online course development - A faculty member can individually develop and deliver an effective online course. *EDUCAUSE Review, 41(1),* 14-15.

Office of Technology Assessment. (1989). *Linking for learning: A new course for education*. Congress of the United States. NTIS PB90-156969.

Oram, F. A. (2006). *Peterson's guide to online learning*. Lawrenceville, NJ: Thomson Peterson's.

Palloff, R., & Pratt, K. (2007). *Building online learning communities.* (2nd ed.). San Francisco: Jossey-Bass.

Parker, A. (2003). Identifying predictors of academic persistence in distance education. *Online Journal of the United States Distance Learning Association, 17(1).* Retrieved September 15, 2009, from http://www.usdla.org.html/journal/JAN03_Issue/article06.html

Parrott, S. (2001). Future learning: Distance education in the community college. ERIC Document Reproduction Service ED385311.

Parry, M. (2010) Tomorrow's college. The classroom of the future features face-to-face, online, and hybrid learning. And the future is here. *The Chronicle of Higher Education, Online Learning Special Edition,* Nov. 23, 2010.

Peat, M. & Taylor, C. (2005) Virtual biology: How well can it replace authentic activities? *Synergy, 20,* 25-27. Retrieved June 1, 2011, from http://sydney.edu.au/science/uniserve_science/pubs/callab/Vol13/05.web.pdf

Peters, O. (2004). *Distance education in transition. New trends and challenges*. Oldenburg: Bibliotheks- und Informationssystem der Universität Oldenburg.

Picciano, A. G. (2002). Beyond student perceptions: Issues of interaction, presence, and performance in an online course. *Journal of Asynchronous Learning Networks, JALN, 6(1),* 21-40.

Pittman, V. V. (2003). Correspondence study in the American university: A second historiographic study. In M. Moore (Ed.), *Handbook of distance education,* 21-35. Mahwah, NJ: Erlbaum.

Poirier, C. R., & Feldman, R. S. (2004). Teaching in cyberspace: Online versus traditional instruction using a waiting-list experimental design. *Teaching of Psychology, 31(1),* 59-62.

Riffell, S., & Sibley, D. (2004). Using web-based instruction to improve large undergraduate biology courses: An evaluation of a hybrid course format. *Computers & Education, 44*, 271-235.

Riffell, S., & Merrill, J. (2005) Do hybrid lecture formats influence laboratory performance in large, pre-professional biology courses? *Journal of Natural Resources and Life Sciences Education, 34*, 96-100. Retrieved June 1, 2011, from http://www.lon-capa.org/papers/Riffell_Merrill_JNRLSE.pdf

Ratcliff, J. L. (1994). Seven streams in the historical development of the modern American community college. In G. A. Baker, J. Dudziak, and P. Tyler (Eds.), *A handbook on the community college in America: Its history, mission and management*, 3-16. West Port, CT.: Greenwood Press.

Rivera, J. C., & Rice, M. L. (2002). A comparison of student outcomes and satisfaction between traditional and web-based course offerings. *Online Journal of Distance Learning Administration, 5(3)*, Retrieved June 1, 2011, from http://www.westga.edu/~distance/ojdla/fall53/rivera53.html

Roach, R. (2003). Survey says online learning equal to classroom instruction. *Black Issues in Higher Education*. Retrieved June 1, 2011, from http://findarticles.com/p/articles/mi_m0DXK/is_16_20/ai_108967479/?tag=content;col1

Ronco, S. R. (1996). How enrollment ends: Analyzing the correlates of student graduation, transfer, and dropout with a competing risks model. *The Association for Institutional Research, Policy Analysis, and Planning Professional File, 61*, 1-12.

Rosenbaum, J. E., Redline, J., & Stephan, J. L. (2007). Community college: The unfinished revolution. *Issues in Science and Technology*. Retrieved June 1, 2011, from http://www.issues.org/23.4/rosenbaum.html

Russell, T. L. (2001). *The no significant difference phenomenon: A comparative Research annotated bibliography on technology for distance education*. Montgomery, AL: International Distance Education Certificate Center.

Sancho, P., Corral, R., Rivas, T., Gonzalez, M., Chordi, A., & Tejedor, C. (2006). Instructional design and assessment: A blended learning experience for teaching microbiology. *American Journal of Pharmaceutical Education, 70*, Article 120.

Schoenfeld-Tacher, R., McConnell, S., & Graham, M. (2001). Do no harm – A comparison of the effects of online vs. traditional delivery media on a science course. *Journal of Science Education and Technology, 10,* 257-265.

Scoville, S. A., & Buskirk, T. D. (2007). Traditional and microscopy compared experimentally in a classroom setting. *Clinical Anatomy, 20,* 565-570.

Seale, J. K., & Cann, A. J. (2000). Reflection on-line or off-line: The role of learning technologies in encouraging students to reflect. *Computers & Education, 34,* 309-320.

Somenarain, L., Akkaraju, S., & Gharbaran, R. (2010). Student perceptions and learning outcomes in asynchronous and synchronous online learning environments in a biology course. *MERLOT Journal of Online Learning and Teaching, 6,* 353-356.

Southern Association of Colleges and Schools Commission on Colleges, SACS-COC. (2010). *Distance and correspondence education – Policy statement*. Retrieved June 1, 2011, from http://www.sacscoc.org/pdf/Distance%20and%20correspondence%20policy%20final.pdf

Stuckey-Mickell, T. A., & Stuckey-Danner, B. D. (2007). Virtual labs in the online biology course: Student perceptions of effectiveness and usability. *MERLOT Journal of Online Learning and Teaching, 3(2)*. Retrieved June 1, 2011, from http://jolt.merlot.org/vol3no2/stuckey.htm

Terry, N. (2001). Assessing enrollment and attrition rates for the online MBA. *T.H.E. Journal, 28 (7),* 64-68.

Thirunarayanan, M. O., & Perez-Prado, A. (2002). Comparing web-based and classroom-based learning: A quantitative study. *Journal of Research on Technology in Education, 34*, 131-137.

Turner, F., & Crews, J. (2005). Bricks and clicks: A comparative analysis of online and traditional education setting. Retrieved June 1, 2011, from http://www.itdl.org/Journal/Apr_05/article01.htm

United States Distance Learning Association. (2007). *Distance learning glossary*. Retrieved June 1, 2011, from http://www.usdla.org/assets/pdf_files/Glossary_Distance.pdf

Walters State Community College (2010). *2010-2011 catalog/student handbook*. Retrieved June 1, 2011, from http://catalog.ws.edu/index.php?catoid=6

Walters State Community College (2011). *2011 factbook*. Office of Planning, Research, and Assessment.

Waschull, S. B. (2005). Predicting success in online psychology courses: Self-discipline and motivation. *Teaching of Psychology, 32(3),* 3.

Weber, J. M. & Lennon, R. (2007). Multi-course comparisons of traditional versus web-based course delivery systems. *The Journal of Educators Online, 4(2)*. Retrieved June 1, 2011, from www.thejeo.com/Archives/Volume4Number2/Weber%20Final.pdf

Williams, M. (2008). The relationship between selected predictor variables and successful completion of online courses. Lynchburg, VA: Liberty University. Retrieved June 1, 2011, from http://digitalcommons.liberty.edu/cgi/viewcontent.cgi?article=1084&context=doctoral&sei-redir=1#search=%22Williams%2C%20M.%20%282008%29.%20relationship%20between%20selected%20predictor%20variables%20successful%20completion%20online%20courses.%20Lynchburg%2C%20VA%3A%20Liberty%20University%22

Wojciechowski, A., & Palmer, L. (2005). Individual student characteristics: Can any be predictors of success in online classes? *Online Journal of Distance Learning Administration, 8(2)*. Retrieved June 1, 2011, from http://www.westga.edu/~distance/ojdla/summer82/wojciechowski82.htm

Yokaichiya, D. K., Galembeck, E., & Torres, B. B. (2004). Adapting a biochemistry course to distance education. *Biochemistry and Molecular Biology Education, 32(1)*, 27-29. Retrieved June 1, 2011, from http://onlinelibrary.wiley.com/doi/10.1002/bmb.2004.494032010307/full

Zhao, J. C. (1999). *Factors affecting the academic outcomes of underprepared community college students.* Paper presented at the 39th Annual Forum of the Association for Institutional Research, Seattle, WA. ERIC Document Reproduction Service ED433762.

Zhao, Y., Lei, J., Yan, B., Lai, C., & Tan, H. S. (2005). What makes a difference? A practical analysis of research on the effectiveness of distance education. *Teachers College Record, 107,* 1836-1884.

APPENDICES

APPENDIX A: WSCC IRB Form

Research Project Information Form
Walters State Community College
Institutional Review Board

Application Date: August 15, 2011

Project Title: Student Success in Face-to-Face and Online Sections of a Biology Course at a Community College in East Tennessee

Study Director

Name:	Deanna E. Garman
Division:	Office of Planning, Research, and Assessment
Program:	
Office Location:	CCEN 233
Phone Number:	423-585-6897
Email Address:	Deanna.garman@ws.edu

Funding Source

☐ Grant:
☐ Federal
☐ State
☐ Intramural
☐ Non-Profit
☒ None

☐ Corporate:

Company Name			
Contact Name		Title	
Address		Email	
City		Phone	
State ZIP			

Project Period
From: *08/15/11*
To: *12/15/11*

Other Participating Institutions/Organizations:

Institution	East Tennessee State University
Contact Name	Dr. Donald W. Good
Role on Project	Co-investigator/dissertation chair
Email	Gooddw@mail.etsu.edu
Phone	423-439-7621
Institution	
Contact Name	
Role on Project	
Email	
Phone	

Continued on Next Page

Signatures:

The principal academic review of the proposal is the responsibility of the office of Academic Affairs. Signatures certify that all information on this form is accurate. No project involving humans may be undertaken until a protocol has been approved by the Institutional Review Board. The office of Planning, Research, and Assessment (OPRA) is authorized to release the protocol and supporting information to cooperating institutions and/or sponsors listed in the application. All work will be performed in accordance with Tennessee Board of Regents and sponsor policies and follow commonly accepted scientific practices in conducting, recording, and interpreting research. Any changes in the status of conflict of interest (financial benefit) during the grant/contract (if applicable) period will be reported to the OIR.

Study Director:

Signature: Deana E. Garman Date: 8/15/11

Division Dean or Administrative Supervisor (if applicable)

Signature: Jeffrey T. Horton Date: 8/17/11

Vice President for Planning, Research and Assessment: Dr. Debra L. McCarter

Signature: Debra L. McCarter Date: 8/16/11

Vice President for Student Affairs: Dr. Foster Chason

Signature: Date: 8-16-11

Vice President for Academic Affairs: Dr. Lori Campbell

Signature: Lori Campbell Date: 8/17/11

President: Dr. Wade B. McCamey

Signature: Wade B. McCamey Date: 8-17-11

APPENDIX B: ETSU IRB Letter

East Tennessee State University
Office for the Protection of Human Research Subjects • Box 70565 • Johnson City, Tennessee 37614-1707
Phone: (423) 439-6053 Fax: (423) 439-6060

July 22, 2011

Deanna E. Garman
2227 Eagle Ridge Lane
Jefferson City, TN 37760

Dear Ms. Garman,

Thank you for recently submitting information regarding your proposed project "Student Success in Face-to-Face and Online Sections of a Biology Course at a Community College in East Tennessee".

I have reviewed the information, which includes a completed Form 129.

The determination is that this proposed activity as described meets neither the FDA nor the DHHS definition of research involving human subjects. Therefore, it does not fall under the purview of the ETSU IRB.

IRB review and approval by East Tennessee State University is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these activities are human subject research in which the organization is engaged, please submit a new request to the IRB for a determination.

Thank you for your commitment to excellence.

Sincerely,
Chris Ayres
Chair, ETSUIRB

Full AAHRPP Accreditation

Accredited Since December 2005

VITA

DEANNA ESSINGTON GARMAN

Education:

Ed. D. Educational Leadership, East Tennessee State University, Johnson City, Tennessee 2012

M.S. Agricultural Extension Education, The University of Tennessee, Knoxville, Tennessee 1995

B.S. Communications, The University of Tennessee, Knoxville, Tennessee 1985

Professional Experience:

Director of Planning, Research, and Assessment, Walters State Community College, Morristown, Tennessee, 2010 - current

Coordinator of Planning, Research, and Assessment, Walters State Community College, Morristown, Tennessee, 2005 – 2010

Communications Specialist, Cedar Springs Presbyterian Church, Knoxville, Tennessee, 1998 – 2005

Assistant Communications Specialist & Publications Coordinator, The University of Tennessee Agricultural Extension Service, Knoxville, Tennessee, 1986 – 1998