Comparing Biology Grades Based on Instructional Delivery and Instructor at a Community College: Face-to-Face Course Versus Online Course.

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Comparing Biology Grades Based on Instructional Delivery and Instructor at a Community College: Face-to-Face Course Versus Online Course.

A Dissertation

Submitted to the Graduate Faculty of the University of New Orleans in partial fulfillment of the requirements for the degree of

Doctor of Philosophy in Curriculum and Instruction

by

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Abstract

Through distance learning, the community college system has been able to serve more students by providing educational opportunities to students who would otherwise be unable to attend college. The community college of focus in the study increased its online enrollments and online course offerings due to the growth of overall enrollment. The need and purpose of the study is to address if there is a difference in students’ grades between face-to-face and online biology related courses and if there are differences in grades between face-to-face and online biology courses taught by different instructors and the same instructor. The study also addresses if online course delivery is a viable method to educate students in biology-related fields.

The study spanned 14 semesters between spring 2006 and summer 2011. Data were collected for 6,619 students. For each student, demographic information, cumulative grade point average, ACT, and data on course performance were gathered. Student data were gathered from General Biology I, Microbiology of Human Pathogens, Human Anatomy and Physiology I, and Human Anatomy and Physiology II courses.

Univariate analysis of variance, linear regression, and descriptive analysis were used to analyze the data and determine which variables significantly impacted grade achievement for face-to-face and online students in biology classes. The findings from the study showed that course type, face-to-face or online, was significant for Microbiology of Human Pathogens and Human Anatomy and Physiology I, both upper level courses. Teachers were significant for General Biology I, a lower level course, Human Anatomy and Physiology I, and Human Anatomy and Physiology II. However, in every class, there were teachers who had significant differences within their courses between their face-to-face and online courses.
This study will allow information to be concluded about the relationship between the students’ final grades and class type, face-to-face or online, and instructor. Administrators, faculty and students can use this information to understand what needs to be done to successfully teach and enroll in biology courses, face-to-face or online.
Chapter 1:

Introduction

With the proliferation of web technologies, as well as information and communication technologies, online teaching is becoming more prevalent in educational institutions. Online learning is a synchronous and asynchronous facilitation of Internet learning, thus allowing students to access information anywhere and anytime, thereby promoting active and independent learning (Cole, 2000; Poe & Stassen, n.d.). Online teaching is accessible, flexible and convenient for most of the learning population (Jursi & Lim, 2003; Lundberg, Castillo-Merino, & Dahmani, 2008). Online teaching increases learning experiences to individuals who cannot or choose not to attend face-to-face classes; it can potentially be more cost efficient and, in some instances, can allow instructors to handle larger class sizes (Means, Toyama, Murohy, Bakia, & Jones, 2009). In Fall 2008, more than 4.6 million students were enrolled in at least one online class; that is one out of every four students (Allen, & Seaman, 2010). This was a 17% increase in online course enrollment compared to the 1.2% increase in the overall higher education student population (Sloan Consortium, 2007). In Fall 2010, over 6.1 million students were taking at least one online course (31% of all higher education students). This is an increase of 560,000 students from the previous year. This was a 10% growth rate from Fall 2009. Yet, it was the second lowest since 2002 (Allen & Seaman, 2011). Even though the growth rate of online education has mired, it far exceeds the less than 1% growth rate in overall higher education (Allen & Seaman, 2011).

Unfortunately, much of the existing research does not provide a great understanding of the relationship between the unique characteristics of community college students compared to
traditional university students, and their ability to succeed in the online course environment (Adams & Corbett, 2010; Muse, 2003). A study performed by Adams & Corbett (2010) concluded that non-traditional and traditional students preferred face-to-face learning, and no non-traditional students reported wanting a solely online-based class. Therefore, this study will examine if there are differences in biology grades between courses taught face-to-face and online, and whether there are differences in grades between course types among different instructors and within the same instructor at a community college.

Online learning is a subset of distance education. Distance education has been present for 150 years. In earlier times, distance education was accomplished by individuals mailing letters back and forth with teachers (Watkins, 1991). However, in the last four decades, a rapid development of technology has allowed distance education to grow. Mass media, television and radio, video and audio conferencing, and the emergence of database learning known as Web 2.0 has allowed each generation to have access to materials more quickly (Anderson, 2008). Online courses are the most popular method for delivering information in postsecondary education due to the accessibility of information (Allen & Seaman, 2008; Instructional Technology Council, 2009).

Community colleges in the United States grew rapidly in the 1960s (Zeidenberg & Bailey, 2010). Today, about 1,000 community colleges exist throughout the United States. The mission of the community college system is to serve all segments of society through a flexible and open admissions policy (Vaughn, 1999). The community colleges are designed to provide education to students who do not take the traditional route from high school to four-year institutions or to students that lack the typical solid educational background. Community colleges have an open access admission policy and low tuition costs, which results in their
attracting a higher amount of low-income and minority students than four-year institutions.
Community colleges can meet three main goals: (a) to teach vocational skills, (b) to provide the first two years of a four-year bachelor’s degree program, and (c) to provide continuing education and enhancement for community residents (California Council on Science and Technology [CCST], 2007; Zeidenberg & Bailey, 2010).

Since community college students come from a variety of backgrounds and may have personal issues that can impede their ability to attain a traditional college education, the structure of the online environment provides non-traditional students with an opportunity to access higher education through a flexible format at practically any time or place (Allen & Seaman, 2008; George Mason University, 2001); this allows the students an opportunity to focus on issues such as career and family. The popularity of online education among these students has created a rapidly changing mission for community colleges.

In 2001, 90% of community colleges offered online courses (Waits & Lewis, 2003), and in 2008 that number rose to 92%, with 41% offering degree programs entirely online (American Association of Community Colleges [AACC], 2008). According to Allen and Seaman (2008), more than half of the enrollments in online courses are through community colleges. Cox (2006) reviewed online instructional approaches at community colleges and interviewed staff from 15 community colleges, who were selected to be representative of the U.S. population. Most staff members felt they must expand to online teaching to compete with larger online corporations such as Capella and University of Phoenix (Cox, 2006).

Faculty concerns need to be addressed. Many faculty members have concerns with increased work load, and they do not necessarily have the technological knowledge or the skills to use the programs (Mills, Yanes, & Casebeer, 2009). Allen and Seaman (2011) report that less
more than one-third of academic officers believe their faculty accept and value online education. The perceived acceptance rate varies extensively between institutions with and without online course and program offerings. Faculty perception of acceptance and value is higher at institutions with online offerings (21%-44% compared to 13%, respectively), but that could reflect hiring teachers specifically for online instruction (Allen & Seaman, 2011). Cox (2006) reported that the rapid growth of online instruction at community colleges might negate the community colleges mission of offering education to all, regardless of socio-economic and demographic status because courses are aimed for students that are more computer literate.

The biggest concern is the quality of student performance and learning in online courses compared to face-to-face classes (Parsons-Pollard, Diehl Lacks, & Grant, 2008). Online learning should provide the same level of educational effectiveness as face-to-face classroom learning (Rovai & Baker, 2005). Despite concerns, online programs within community colleges are continuing to flourish. Many classes considered face-to-face now have online components such as email, viewing web pages, and online homework.

Quality of discussion and teacher-student immediacy are similar when specific content-related questions are posed to students (O’Neal, 2009). Criticism of face-to-face classrooms has been common because teaching styles encourage passive learning, ignore individual needs of learners, and do not develop critical and analytical thinking skills (Banathy, 1994; Black, 2005; Choy & Cheah, 2009; Hannum & Briggs, 1982; O’Neal, 2009). Due to the rapid development of technology, online instruction also has issues; many students have an unstable online learning environment and a lack of commitment and understanding from both student and teacher of how much is needed to successfully participate in online classrooms, which poses problems for success in the online environment (Johnson, Aragon, Shaik, & Palma-Rivas, 2000). Clark’s
(1983) meta-analysis study on media research showed that students gain significant learning benefits from audiovisual or computer media, as opposed to conventional instruction. However, the same study also suggested that the reason for those benefits is not the medium of instruction, but the instructional strategies built into the learning materials. Similarly, other studies have suggested that learning is influenced more by the content and instructional strategy in the learning materials than by the type of technology used to deliver instruction (Bernard, Abrami, Lou, Borokhovski, Wade, Tamin, Surkes, & Bethel, 2009; Kozma, 2001; Means et al., 2009). It is not the computer that makes students learn, but rather the design of the activities provided by the teacher, as well as the interactions between the students, the material and the teacher (Bernard et al., 2009; Kozma, 2001; Means et al., 2009).

The computer is merely the vehicle that provides the processing capability and delivers the instruction to learners (Clark, 2001). Much of the success of the instruction is accomplished through the presentation from the teachers (Bernard et al., 2009; Means et al., 2009). Aragon, Johnson, and Shaik (2002) stated that students’ success in either type of class is comparable as long as the course is developed around concrete learning objectives. Learners can develop a liking for concrete experiences when learning or a preference for engaging in abstract or conceptual analyses when acquiring knowledge. However, it is most often assumed that online students will be more independent than face-to-face students (Lundberg, Castillo-Merino, & Dahmani, 2008), therefore will perform as well as their face-to-face counterparts.

Although a study in 2010 (Sussman & Dutter) also concluded that there was no significant difference in the performance of students in the same online and face-to-face course, the U.S. Department of Education’s recent meta-analysis concluded that students favor online conditions with an average effect size of +.24 when comparing learning outcomes for students in
online environments compared to students in face-to-face instruction (Means et al., 2009, p. xiv). Freeman and Capper (1999) found no differences in learning outcomes between business students participating in role simulations in face-to-face courses or asynchronously in online courses. Similarly, Arbaugh (2000) compared the course grades of face-to-face courses and Internet-based MBA students and found no significant differences between them. In a study of community health nursing students, Blackley and Curran-Smith (1998) not only found that online students met their course objectives as well as face-to-face students, but that the distant students performed equivalently in the field.

Students who attend face-to-face courses have a large amount of synchronous interaction between peers and the instructor, but may struggle with the time commitment required to attend meetings multiple times a week. Students who enroll in online courses usually do so because of their time constraints and occupations, but they may not be able to enjoy the synchronous interaction desired for the most effective learning environment (Allen & Seaman, 2008; George Mason University, 2001; O’Neal, 2009). Fully online courses are often deemed to be missing that immediacy between teacher and student, and student-to-student interaction (O’Neal, 2009).

If delivery methods, face-to-face or online, have an effect on successfully completing the course, then instructors teaching the course and the student’s grades can also be used as an indicator of success. Since community college online students are usually removed in time and distance from the instructor and they usually have competing roles and responsibilities, grades can be used to evaluate the delivery method. Wu and Hiltz (2004) reported that the number of online courses taken by students does not show a relationship with performance; the instructor is the biggest influence on learning and performance in an online course. Student success will change with the instructors’ influence. They also reported that integrating technology in face-to-
face classes and hybrid, partially face-to-face and online, classes can remove the physical classroom barriers, therefore giving students access to interactive curriculum anywhere, at anytime. These lifelong learning skills are developed and managed by the instructor, ultimately enhancing student success. Other factors that cannot be controlled, but can be measured, are the differences between delivery methods, gender, grade point average (GPA), ethnicity, and age.

As long as instructors use specific techniques that encourage students to engage in social interactions, the method of instruction is more important than the delivery platform (Dell, Low, & Wilker, 2010); both modes of teaching have their own sets of strengths and limitations. Consequently, there might be a difference in grade disbursement among the class type and instructor in the amount of technology used in face-to-face courses.

**Need for the Study**

Of students enrolled in all postsecondary educational institutions, 53% were 24 years of age or older (Provasnik & Planty, 2008), but based on a study commissioned by University of Phoenix (2011), the number was 44% for ages 25 or older. The second number could be smaller due to the year difference in the age grouping between the two studies. Outside responsibilities often hinder enrollment in face-to-face courses, so many adults choose the flexibility of the online environment, regardless of their preparedness. Waits and Lewis (2003) reported that nearly two-thirds of community college students attend college part time, 50% work full time, many have the responsibility of caring for others, and more than one-half are the first in their family to attend college. These barriers can impact a community college student’s ability to complete course requirements. Because community college students come from a variety of educational backgrounds, they possess a wide range of skill levels (Allen & Seaman, 2005). Lack of experience with technology can have an impact on their success in the online
environment (Phillippe & Valiga, 2000). Phillippe and Valiga (2000) found that community college students often lack the resources (computers and Internet access) to acquire the appropriate technology to be successful. Lack of access and experience can prevent them from being successful in the online environment (Muse, 2003). Because of the obstacles that many of the community college students face, it is important to research whether online courses are beneficial to the students’ success. However, it is also important to evaluate if the instructor’s influence in the course and his or her ability to deliver the material is affecting the success of students. Instructors’ presence and their ability to present the material are important to the success or the perceived success of the student (Garrison, Anderson, & Archer, 2001; Picciana, 2002; Rovai, 2002; Swan, 2002). Instructor training in online teaching is important. Allen & Seaman (2011) detail that only 6% of institutions (down from 19% in 2009) do not offer any training; while 72% of institutions offer internally run training courses. Informal mentoring and formal mentoring programs are the other most common training approaches. Training of faculty is necessary for them to understand, value, and accept the learning outcomes and goals of the institution’s online course offerings.

The view that online education is as good as face-to-face education is not universally held (Allen & Seaman, 2008, 2011). Allen and Seaman (2011) report that since 2002 there has been a 57% increase in academic leaders that rate online education as good as or superior to face-to-face education. The institution in the current study can use the results to determine if changes are necessary to online course delivery or in faculty and student preparation for this growing form of instruction.

In the sciences, community colleges award associate’s degrees in fields where a bachelor’s, master’s, or doctorate degrees are becoming a requirement for employment. This
makes the transferring of courses to degree programs and four-year institutions an essential goal for administrators. Because many students begin science careers at the community-college level, it seems important to develop, implement, and understand the effectiveness of science education, specifically the delivery of instruction, in order to better equip students to transfer and succeed at other institutions and programs (Lloyd & Eckhardt, 2010).

Significance of the Study

Some research has suggested that there is no significant difference in the success of students in online classes as opposed to those in seated classes (Russell, 2001). There are numerous studies focusing on face-to-face versus online learning in different disciplines such as business (Arbaugh, 2001; Wojciechowski & Bierlein-Palmer, 2005), economics (Coates et al., 2004), engineering (Ellis, Goodyear, Calvo, & Prosser, 2008), project management (Johnson, 2010) and wellness (Lim, Kim, Chen, & Ryder, 2008) to name a few. The health sciences are the fastest growing online enrollment of all disciplines. This entire field is the only area which is showing a greater proportion of programs with enrollment growth and a decrease in the proportion with an enrollment decline (Allen & Seaman, 2011). But, there is a lack of studies addressing the success of students in face-to-face courses versus online courses in biology. Because 30% of the students at the college of the study are enrolled in biology courses, it would benefit educators and administrators to assess if course delivery affects student success. This study addresses the existing gap in current research on student performance and teacher influence by specifically targeting biology classes in a community college.

This study will provide valuable information to community college faculty as they teach and consult students. Faculty can use the results of this study to identify what tools may help increase their students’ success in their courses.
Community college administrators may benefit from this study by being informed as to whether online courses really meet the mission of the college. Financial losses from dropouts and low student success rate have a negative impact on an institution. Accreditation can be placed in jeopardy when retention and success rates are low. Institutional leaders may use this information to assist them in establishing criteria for student entry into online courses or to modify course delivery and content to enhance the online course experience. The study may help academic leaders to revisit the provisions provided to faculty in training to teach online.

Students may benefit from this study by identifying characteristics of teachers that may be important to their success in the online environment. They may also become more aware of the qualities that make them, the students, ready for, and successful in an online course. Qualities that successful online students possess are: self-motivation, self-discipline, ability to commit time, the ability to think critically, decision-making skills, and access to a reliable computer and Internet connection (Johnson-Curiskis, 2007).

The online environment presents additional challenges to most community college students, and many teachers are not properly trained in online teaching and presentation, yet the convenience and flexibility of online delivery are very appealing to both student and teacher. It is essential that community colleges make the effort to help teachers become properly trained and to help students attain academic success, including tools to help them deal with the challenges.

**Theoretical Framework**

To frame this study in a grounded body of research, numerous models can help provide the theoretical basis, such as Dewey’s (1916, 1938) progressivism, Bandura’s (1989) social
cognitive model, Moore’s (1973) Transactional Distance theory and Mehrabian’s (1971) communication immediacy.

In progressivism, Dewey (1916) recognized the importance of active learning and emphasized the learner experience, the collaboration with others and the environment. Dewey (1938) described education as collaborative building of experiences. The distance education context for this study is not independent learning but rather a framework of collaborative, constructivist learning within a community of learners. For Dewey (1916), interaction is the most important component of education. The students transform information passed to them and construct their knowledge with personal application. Even though Dewey’s work was focused on primary and secondary students, Malcolm Knowles (1980) extended his work to adults through the concept of andragogy. Other theorists like Bruner (1966), Vygotsky (1978) and Piaget (1967) embraced the idea that learning does not occur in an isolated environment but through interactions.

Progressivism depends on the learner’s experiences, desires, and needs. Like online learning, it is flexible because it can be adjusted based on previous knowledge and/or experiences. Enlightenment of one’s mind can occur in or out of a classroom. The Internet is a place where students can share their thoughts through papers, wikis, and blogs, as well as receive comments and corrections. These tools make it possible for students to construct new knowledge together. Given Dewey’s (1916) emphasis upon the shared nature of knowledge and the impact on the social constructivist theory, an addition to progressivism, the Internet has broadened the meaning of community in ways that would have been unimaginable during the time of Dewey.
Bandura (1989) found that children learned by observing others and may learn by other’s experiences, not just their own. Bandura’s social cognitive model (1989) defines three constructs—environment, self, and behaviors—that will be symbiotic and will influence and affect each other. Personal factors will influence both behavior and environment, and all elements can affect the other elements positively or negatively. Environment, such as faculty immediacy and course type, is considered one of the most important factors because it can enhance or discourage student engagement (Zimmerman, 1989).

Moore’s transactional distance theory (Moore, 1973; Moore & Kearsley, 1996) provides an explanation for why the use of electronic communication tools may encourage interactions among learners and the instructor in an online environment. The theory states that the quality of teaching and interactions among students and the instructor relates less to geographical separation and more to the structure of a course and the interactions that take place within it (Lenmark, Shin, Reed, & Montgomery, 2005; Moore & Kearsley, 1996). Distance education can be viewed as a series of transactions between instructor and student, so Moore (1973) emphasized that the geographical separation in distance education leads to a psychological gap of possible misunderstandings between the instructor and the student. According to the theory, more interaction between the instructor and student results in less transactional distance. Advances in communications technology have made synchronous and asynchronous interaction more available, thus improving and increasing communication and decreasing transactional distance. Transactional distance theory is important conceptually because it provides an explanation for why the use of electronic communication tools may bridge the distance between learners and the instructor in an online environment. The electronic communication tools found in most course management systems (discussion, e-mail, messaging) increase the level of
interaction, thus allowing learners and instructors to reduce the psychological and physical
distance between them and to achieve levels of social interaction similar to those in face-to-face
classrooms (Lenmark et al., 2005). Of course, some instructors will cultivate interactions better
than others.

The foundation of transactional distance theory was Mehabrian’s (1971) communication
immediacy, which refers to communication behaviors that will reduce the psychological and
physical distance between individuals. Nonverbal communication behaviors include physical
behaviors (leaning forward, touching another, looking at someone’s eyes), whereas verbal
behaviors are nonphysical (giving praise, using humor). Verbal immediacy behaviors are easily
applicable for online instruction because they are easily controlled and do not have physical
barriers. Much of the immediacy research in online classes has centered on instructor
immediacy.

Research Questions

The difference in delivery method to students can be researched by comparing different
aspects of the delivery methods, such as grades and instructor. The null hypothesis is students
participating in face-to-face courses should achieve the same grades as students enrolled in the
same online courses. The alternative hypothesis is that students participating in face-to-face
courses will have higher grades than those in the same online courses. The purpose of this study
is to compare online students’ performance in four different biology courses to the face-to-face
equivalents at a large, metropolitan, southern community college. These courses range from a
major biology course to health-related prerequisite courses. A p value of .05 will be used to
determine significant differences. This study was undertaken to address four questions:
1. Is there a difference in grades between face-to-face and online biology related courses?

2. Is there a difference in grades between courses taught face-to-face or online among biology instructors?

3. Is there a difference in grades between courses taught face-to-face and online by the same instructor?

4. Is cumulative grade point average (CGPA) a good predictor of a student’s grade in biology courses?

**Definition of Terms**

*Distance education* as defined for the purpose of accreditation review, by the Southern Association of Colleges and Schools (SACS; 2000), is a formal educational process in which most of the instruction occurs when student and instructor are not in the same place. Synchronous or asynchronous instruction may occur through correspondence study, audio, video, and/or computer technologies.

*Online learning* is a vague term that encompasses vastly different methods supported by educational institutions. The current study defines online learning as Internet use to access materials that allow interaction with the content, instructor and other learners; this also allows them to gain knowledge, develop personal meaning and obtain support throughout the learning process (El-Hussein & Cronje, 2010).

*Online courses* refer to courses that are completely online, except for testing, and are given by a degree-granting, regionally accredited institution. The institution uses the Internet through their course management system to provide educational credits through tuition and fee mechanisms. The courses may use asynchronous (email, threaded discussions, wikis) or synchronous
technologies (webcasts, chat rooms and/or audio/video technology). Online courses are those in which at least 80% of the course content is delivered online (Allen & Seaman, 2008, 2011).

**Asynchronous learning** is learning that does not occur at the same time (referring to teacher-student interaction or student-student interaction) such as homework, discussion board, and web based activities (Nellen, 2003).

**Synchronous learning** is typically defined as being in the same physical location at the same time but it can be extended to live stream broadcasting through technology (Nellen, 2003).

**E-learning** is the technology used in online learning. This includes, but is not limited to, audio and video podcasts (YouTube), audio chat (Skype), wikis, blogs, and virtual worlds. Many of these are combined with social networking sites such as Facebook and MySpace (McGreal & Elliott, 2008).

**Face-to-face learning** in the current study is any course that meets for 150 minutes a week, either two days a week for 75 minutes each class meeting or three days a week for 50 minutes each class meeting. The courses may be considered web enhanced in which the teachers assign material and/or post supplemental material through the course management system or the Internet. According to Allen and Seaman (2011), face-to-face teaching includes courses in which 0%-29% of the material is delivered online.

**Cumulative grade point average** in this study is calculated by dividing the total amount of grade points earned by the total amount of credit hours attempted. The cumulative grade point average is calculated from college courses only.

**Hybrid course delivery format** is a combination of face-to-face and online instruction that can result in fewer face-to-face meetings with an increase in online activities (Garnham & Kaleta, 2002). Hybrid instruction has between 30%-80% of all content declined online (Allen &
Seaman, 2011). Hybrid courses at the institution in the current study meet one day a week for 75 minutes, and all testing is given during the designated class time.

**Overview of Methodology**

This study employs a quantitative research design to test the research questions. The study examines the relationship between student performances in biology face-to-face courses at a community college as compared to the same data derived from the online sections of the same biology courses. The variables are measured by data gathered from the college’s database.

The research design utilizes general linear model (GLM) ANOVA design, also known as a factorial ANOVA. Factorial ANOVA allows the research to learn more about the relationship between one dependent variable and more than one independent variable (Leech, Barrett & Morgan, 2005). Class type, face-to-face or online, and instructor are the independent variables, whereas the students’ final grade is the dependent variable. Linear regression is used to determine if there is a relationship between grade and cumulative grade point average. Descriptive statistics are used to review the variables basic features and summaries about the samples.

Participants of the current study were students enrolled in certain biology courses between spring 2006 and summer 2011 at a large community college in the south. Teachers included in the study taught at least two semesters of both online and face-to-face sections of the courses being included in the study. A survey was deployed to the teachers through the internet; the survey assessed the teachers’ use of Blackboard (BB), the school’s course management system, in their face-to-face classroom. Faculty participation was voluntary. Student data and teacher data were attained from the college’s database.
Limitations

With the growth of online courses in higher education, retention is an area of great concern. Online student retention has been suggested as one of the greatest weaknesses in online education (Carr, 2000). In the literature, there are not many studies addressing retention in online and distance learning. However, there is a large body of knowledge from research on face-to-face retention, which may be transferable to online learning (Doyle, 2003). Studies show that the attrition rate for online college and university undergraduates ranges from 20% to 50% and that course administrators believe the attrition rate for online courses to be 10% to 20% higher than traditional classroom environments (Frankola, 2001). A very popular theory by Tinto (1975) states that students drop out due to a combination of interactions between the student and the institution. Tinto (1975) believed that immediacy affects retention rate. Data being used in this study are extant, so the students’ position of immediacy with their teachers was not available.

Measuring retention rate is another problematic issue to researchers since students drop out in different ways, and schools may determine retention rates differently (Simpson & Kogan, 2003). Approximately 13% of students withdraw before the course even begins. They are registered but they never participate. This may state a failure in the institution’s ability to make the students feel welcomed. After a class begins but before the first assignment is due, approximately 18% of students withdraw (Simpson & Kogan, 2003). Course assignments could be intimidating or overwhelming and may contribute to withdrawal rate. Similarly, students withdraw after the first assignment is due and after the first examination (Doyle, 2003). Questionnaires focusing on why they withdrew were distributed to students at a university in the United Kingdom, and 35% of students replied with varying reasons such as lack of time, did not
realize how hard the material would be online, work conflicts, overwhelmed by assignments or marital issues/personal issues (Doyle, 2003). These reasons are similar to ones stated in other studies (Gaskell, Gibbons, Simpson, 1990; Perry, Boman, Dean Care, Edwards, & Park, 2008; Simpson & Kogan, 2003). Lastly, an issue that is most difficult in attaining true retention numbers is when students stop participating but do not withdraw from the course (Simpson & Kogan, 2003).

Teachers also differ in teaching abilities for delivery type and effectiveness in courses. One hundred teachers who taught sections of the same course face-to-face and online believed they taught the online the same as, if not better than, their face-to-face equivalent (Ryan, 2001). However, Aragon et al. (2002) stated that students’ success in either type of class is comparable as long as the course is developed around adult learning theories, which were not defined in their paper. Quality of interaction is as important as quantity of interactions between instructor and student (Rovai, 2002). Timeliness of interactions and amount of interactions from instructors help nurture success and build a comfortable environment to succeed. Instructors must continuously guide, challenge, and help students reflect on concepts while instilling new knowledge (Stodal, Thompson, & MacDonald, 2006).

Research has suggested that the instructor’s age, gender, and personality, which the instructor cannot control, can affect students’ perceptions and the instructor’s effectiveness, but teaching style also influences student evaluations (Zhang, 2004). These factors lead one to conclude that students’ personal bias, rather than instructor performance, have the greatest impact on the instructor’s effectiveness, regardless of course type (Sprinkle, 2008).

The number of online courses given by colleges and universities has been increasing; many universities even give complete degree programs online for which instructions and lectures
are in the form of videos, audio, and file presentations (Smith, Ferguson & Caris, 2002). The lessons are available for students to watch 24 hours a day. There are specific techniques and strategies used in facilitating learning through discussion in both face-to-face and online classes. In face-to-face classes, class discussions promote reflection and further exploration of issues and topics (Neuhauser, 2002). Lecturers use specific questioning techniques that draw out students' opinions, prior knowledge, and experience upon which they construct new knowledge. Discussions have long been a valuable method of learning through interaction with other learners, and teachers should know how effective this shared learning is for the application of knowledge. The same approach applies in the online class. Learners are encouraged to participate in discussions as they share prior knowledge and experience and use that as a springboard in formulating new knowledge. The advantage of online discussions is that there is no immediate time constraint to reply, and students have many opportunities for reflection and exploration of issues before they are required to respond to a question or comment.

Other studies have been conducted that addressed students attendance in class and their performance. Romer (1993), Durden and Ellis (1995), Credé, Roch and Kieszczynka (2010), and Obeidat, Bashir and Jadayil (2012) found that attendance did contribute to higher grades. However, in a study by Patron and Lopez (2011) stated that students should learn that it is not the amount of time logged in to their online course that is important to earn high grades, but how frequent and stable the amount of minutes logged on. They suggested that counselors need to emphasize that total minutes online (attendance) is not as important as quality and consistency of studying (Patron & Lopez, 2011).

From an economic stance, institutions would like to use the Internet, but only if it is as an effective teaching tool compared to face-to-face courses. Online courses can be more cost-
effective because the school can teach more students using less of the same resources (Lundberg et al., 2008).

**Other limitations.**

1. The data were taken directly from the database at the college, and the accuracy of the data are dependent on the input by the college’s Information Technology Department and the extraction by the researcher.

2. Potential bias may exist as a result of the researcher’s employment at the college.

3. Student grades of D or F may not be representative of student performance. Grade may be reflective of other factors.

4. Course delivery methods differ between face-to-face and online science courses.

5. The textbook used for face-to-face and online sections will be the same in all courses, but other content may differ.

**Delimitations**

The researcher acknowledges the following delimitations of this study:

1. Data came from only one community college in the south.

2. The research only used sections of courses that had the same teachers for both face-to-face and online courses.

3. The data used for this study were limited to face-to-face and online biology courses for 14 semesters, namely spring 2006 through summer 2011.

4. The different platforms being used to present content (i.e., face-to-face, online and hybrid [blended] courses) are not all being reviewed in the study.

To include the advantages of both face-to-face and online courses, there are hybrid courses. The Sloan Consortium estimated that public undergraduate institutions have the
highest penetration rates of hybrid courses (79.4%), just slightly lower than online (87.2%) among institutions of higher education (Allen, Seaman, & Garrett, 2007). With formal education quickly moving from faculty-centered teaching to student-focused learner designs, the hybrid format can accommodate the ever-changing educational pedagogy of accommodating the student. Research (Schachar, 2008; Shachar & Neumann, 2003) has suggested that performance in all three types of teaching platforms is not significantly different. In all three types, students still have to accept responsibility for their assignments and pursuing their learning outcomes (Shachar & Neumann, 2003). Continued research in hybrid delivery is needed, but the current research supports that students and faculty do perceive that there is value to the teaching platform. Since hybrids are new at the college in this study and the consistency among the hybrid courses taught is varying, hybrids are not being included. But, their growing presence in the colleges makes it a mentionable topic.

Organization of the Study

This chapter introduced the issues relating to success in online and face-to-face courses and the need for additional studies relating to the unique characteristics of community college students. As the use of online courses increases in community colleges and the flexibility and convenience of this delivery mode are demanded by the students, administrators, faculty, and students need to have the information in order to make informed decisions on what can be done for the students and teachers to be more successful.

Chapter 2 examines the literature about the past and current strategies of success in face-to-face and online courses with a focus on community colleges, but with all levels of higher education reviewed. The literature relating to the independent variables, class type (face-to-face
or online), and instructor is examined and reviewed. Chapter 3 provides and explanation of the methodology used in the study. Chapter 4 will report the findings of the data analysis including descriptive statistics, and Chapter 5 will summarize the findings, conclusions, and recommendations for future studies.
Chapter 2:

Literature Review

This chapter provides an overview of existing research and examines factors that can affect student success in face-to-face and online courses. The study is directed by the growth of online courses being offered at community colleges and whether it is as successful of a mode to teach students in the field of biology. The student’s performance in course, by final grade, will be examined to determine whether course type (face-to-face or online) and instructor have an influence. CGPA will be used to see if it is a predictor of final course grade.

Community colleges are open-door institutions whose mission is to serve all segments of the population (Vaughn, 1999). Students attending community colleges have a variety of educational backgrounds and represent a range of ages and ethnicities (Allen & Seaman, 2005). Many students are the first to attend college and will have life and time conflicts that include jobs and family responsibilities (Horn & Nevill, 2006). The admissions policy of community colleges allows individuals a chance to access higher education. Research notes that community college students are more likely to be taking remedial courses than their 4-year counterparts (Horn & Nevill, 2006). In any case, the expansion of online education in community college settings raises issues of how to academically prepare and support students in this autonomous and rigorous learning environment.

The National Center for Education Statistics (NCES) reports that during 2000-2001, community colleges had the largest percentage of online learners than any other higher education institution with 1,472,000 out of 3,077,000 students (48%; Wirt, Choy, Rooney, Provasnik, Sen, & Tobin, 2004). During fall 2007, the reported percentage was 51% (Allen & Seaman, 2008),
and 92% of all community colleges offered online courses in 2007 (AACC, 2008). Online learners are 22% of the students in higher education (Allen & Seaman, 2008).

Educational literature is replete with studies comparing face-to-face (traditional, in-classroom) versus online (computer-based) classes. There have been meta-analyses that combine research over the years on the different instructional methods. To a large extent, prior research comparing face-to-face and online learning environments report no significant difference in learning outcomes (Clark, 1983; Coates et al., 2004; Jahmg, Krug, & Zhang, 2007; Zhao, Lei, Yan, Lai, & Tan, 2005). One comparative study found students have a slight preference for traditional education (Allen, Bourhis, Burrell, & Mabry, 2002). But, the study by the U.S Department of Education’s research showed students having a slight preference for online learning (Means et al., 2009). In Means et al.’s meta-analysis, the effect size was +.24, and according to Cohen (1992), effect sizes of .20 are “small” sizes and .50 are “medium” sizes (p. 100). Since this study reports a small effect size using Cohen’s definition, Means et al. (2009) reported that learning is significantly higher ($p < .001$). This particular meta-analysis reviewed online and face-to-face courses in elementary, secondary, undergraduate, and graduate settings but did not differentiate community colleges from other institutions of higher education. Allen and Seaman (2011) reported that student satisfaction can be used to rate quality of course. Allen and Seaman (2011) have been tracking reports on student satisfaction since 2004, and found that students were equally satisfied with online courses as the face-to-face counterparts. The most recent report (2011) by Allen and Seaman confirms this trend.

Allen et al. (2002) reported that as more supplemental learning tools are added to online courses, such as audio and video tools, there is no difference in achievement levels. Recent large-scale studies, however, have begun to identify significant differences associated with
different approaches and factors. In a meta-analysis of studies published between 1996 through July 2008, it was found that overall, students in online learning conditions or classes that were partially online (hybrid) performed better than those receiving face-to-face instruction (Means et al., 2009). This is supported by an earlier study by Clark (1983) and a study by Liao (1998), which found that media influence had a positive effect on students’ achievement over face-to-face courses.

There are many studies that focus on factors that relate to student success in college courses, whether they are online or face-to-face (Arbaugh, 2000; Egan and Akdere 2004; Halsne & Gatta, 2002; Hannay & Newvine, 2006; Horn & Nevill, 2006; Keegan, 1996; Means et al., 2009; Menager-Beeley, 2001; Muse, 2003; Phillipe & Valiga, 2000; Rooks, 2012; Rovai & Baker, 2005; Tucker, 2002; Urtel, 2008; Wojciechowski & Bierlein-Palmer, 2005). The factors are motivation, age, gender, technology, and teacher immediacy.

**Community College Students**

**Demographics.**

There are numerous studies that address age, gender, family responsibilities, and employment as effects on students’ success in college (Arbaugh, 2000; Egan and Akdere 2004; Halsne & Gatta, 2002; Hannay & Newvine, 2006; Horn & Nevill, 2006; Keegan, 1996; Means et al., 2009; Menager-Beeley, 2001; Muse, 2003; Phillipe & Valiga, 2000; Rooks, 2012; Rovai & Baker, 2005; Tucker, 2002; Urtel, 2008; Wojciechowski & Bierlein-Palmer, 2005).

Community colleges serve students who are older and usually working. Phillipe and Valiga (2000) reported that 65% are first-generation college students, 7% are single parents of which 51% make below $20,000. In 2003-2004, NCES reported that 18% of community college
students were 25-29 years old and 40% were under the age of 24. Most students (66.6%) attend part-time, and 80% work part or full time (Horn & Nevill, 2006).

Because of the convenience, online courses at community colleges provide students who would normally be unable to enroll in college a chance to pursue a higher education. Many colleges take advantage of this and have increased their online offerings (Allen & Seaman, 2005). NCES reported that 69% of community colleges are using online education to increase student access and to grow their enrollment (Wirt et al, 2004), and 92% of community colleges offer online courses (AACC, 2008). The community college in the current study reported an increase of 50.5% in students taking at least one online course between the years 2006-2010. The challenges that community college students often face, make online courses’ flexibility appealing (Muse, 2003). In 2007, community colleges experienced an increase in online enrollment at 51% compared to 1.6% growth overall (Allen & Seaman, 2005).

Numerous studies have been conducted to learn why students choose online courses. The most common answer was convenience and flexibility (Halsne & Gatta, 2002; Hannay & Newvine, 2006; Rovai & Baker, 2005; Tucker, 2002). In these same studies, the students were usually older and female. Tucker (2002) also reported that there were no significant differences in grades between online and face-to-face sections but the average on the final exam was 85.92 compared to 78.26, respectively.

Much of the literature that discusses the effects of online and hybrid teaching versus face-to-face teaching is closely linked to the literature on general determinants of student success. Understanding the reasons students succeed may help determine the benefits of different classroom delivery type. Other factors may likely affect a student’s success in a course regardless if the student attends the course online or face-to-face.
Motivation and pre-knowledge.

Motivation is considered one of the most important factors contributing to student success, but it is also one of the most difficult to measure due to subjectivity. Allen and Seaman (2005) had an overwhelming response (80%) to a survey question that stated that students need more discipline to succeed in an online course compared to a face-to-face course. In online courses, students must be independent, want to learn, and have the ability to set goals and follow through. Students with little motivation and self-discipline will struggle more so in online courses (Pillay, Irving, & McCrindle, 2006).

Student approach-avoidance behaviors can occur when both fear and hope are associated with the same act (Velez & Cano, 2008). This can take the form of being active in a course and building autonomy or it can be seen when students stop participating. Often the fear of the unknown causes students to avoid feelings of discomfort (Velez & Cano, 2008).

Pre-knowledge may also affect student’s ability to pass exams. Pre-knowledge is often measured by previous high school grades, previous college grades, or standardized tests (Lundberg et al., 2008). Durden and Ellis (1995) and Coates et al. (2004) found that high pre-grades have a positive effect on performance in classes.

Motivation and pre-knowledge can be used to determine success in college. According to Wade and Walker (1994), GPA, class rank, ACT scores, as well as participation in certain classes were standards by which admissions officers predicted future college success. However, honors students entering a southern university were tracked for two years, and their high school GPA was the best and most consistent predictor of success for these students.

The Standard Research Service of the ACT program (Dvorak, 1989) accessed the records of 10,758 college freshmen and reviewed ACT scores, high school GPA, and yearbook and
newspaper staff participation while in high school, to help determine college success. They used 
this information to predict the students’ success in college English classes. The ACT English 
score and high school GPA had the highest correlation with success in a college English course, 
unlike extracurricular activities, which were not shown to be a positive predictor. A study by 
Noble and Sawyer (2002), showed that ACT score can predict the likelihood of persistence to 
year two of college. The results were similar across ethnic and family incomes, and the 
composite ACT was a better predictor for enrollment of African Americans and low-income 
students.

Educators must be aware that students prefer certain methods of learning to others. 
Students’ learning preferences are often referred to as their learning styles (Arthurs, 2007). 
Learning has to do with making meaning (Clark & Rossiter, 2006). Online learning provides a 
distinctive opportunity for experiencing and learning different activities and tasks that may fit an 
individual learning style because students can take control of their own experience and become 
more self aware (Zacharis, 2010). However, the majority of students who take web classes do so 
not necessarily because the format suits their learning styles, but because they are attracted by 
the convenience, availability, and flexibility of scheduling the classes (Ryan, 2001). Therefore, 
the students may not develop appropriate strategies for self-learning and find online courses do 
not meet their needs. Miller, Rainer, and Corley (2003) noted that the more negative aspects of 
web-based instruction include procrastination, poor attendance, and a sense of isolation. This 
may lead to a higher attrition rate than traditional face-to-face courses (Summers, Waigandt, & 
Whittaker, 2005).

Since the students’ learning styles are often unknown to themselves and the instructor, it 
is difficult to design effective instruction. Therefore, to make the most of the students' learning
experiences, instructors need to be aware of diverse learning styles and understand the online learning environment. A learning style inventory often used in online course research is the Kolb Learning Style Inventory (LSI; Kolb, 1986). Kolb's LSI measures student learning style preference in two scopes. Learners can develop a liking for concrete experiences when learning or a preference for engaging in abstract or conceptual analyses when acquiring knowledge. However, it is most often assumed that online students will be more independent than face-to-face students (Lundberg et al., 2008). Terrell and Dringus (2000) and Lippert, Radhakrishnam, Plank, and Mitchell (2001) measured learning styles of online students based on the Kolbs's LSI. Both studies showed that learning style had no effect on success in online learning, but that it determines preference for this delivery format.

Because of the characteristics, motivation, and learning style that usually make an online student successful, community colleges must be willing to provide students with adequate preparation, course placement (face-to-face or online), and have an online orientation (Pillay, et al., 2006).

**Age and gender.**

Two other variables frequently used to measure success rates in classes are age and gender. It has been argued that age reveals maturity and hence should have a positive effect on performance, but it is also sensible to deduce that the capability to learn new things, such as technology and content, diminish with age (Coates et al., 2004). Previous research has produced mixed results between age and performance. Gender is harder to assess since one cannot say men are more or less intelligent than women.

Anderson, Benjamin, and Fuss (1994) found that students performed lower with age, but Coates et al. (2004) and McEvoy (1989) did not find any difference in grades with age. One
researcher found a moderate positive relationship between age and performance (Waldman, 1986). In 1990, one of the first studies focused on age and distance education was performed (Ross & Powell). The findings have been supported by the recent studies that found that online learners are predominantly women; Ross and Powell’s (1990) study results showed females scoring up to 20 percentage points higher on assessments in humanities, sciences and social sciences. Halsne and Gatta (2002) reported that of 1,642 community college students in online and face-to-face courses, most were women with children, and they were 26-55 years old with full-time jobs. Distance education is marketed to older women not only because of the convenience, but because women use virtual messaging systems more than men, so they tend to thrive in an asynchronous environment (Rovai & Baker, 2005). Arbauch (2000) reported that females are more likely to participate in online discussions, and a study in Michigan reported that there was a significant correlation of .36 between older students and the final grade (Wojciechowski & Bierlein-Palmer, 2005).

Muse (2003) conducted a study at a community college in Maryland in 2002. The average age of the 276 respondents was 30 years, with a range of 16 to 72 years. The results indicated that older students, who have more life experience, are more likely to successfully complete an online course. They maintained an average 3.4 GPA as opposed to their younger, more inexperienced counterparts, who maintained an average GPA of 2.75. The study focused on factors that led to the success and risk of community college students in online classes. Muse identified three areas of concern: (a) a lack of current information about why students succeed or fail in community college online courses; (b) a lack of pre-assessment measures in place to help these students determine if online learning is suitable for them; and (c) the need for institutions to
reduce the attrition rate to deal with the financial losses of having large numbers of students not complete the course.

In opposition to Muse’s study, Menager-Beeley (2001) surveyed 59 students in two online classes in a California community college and found that older students in the range of 28-50 years of age are more likely to drop an online class. The students claimed that work and family responsibilities competed with their available online time.

A study by Urtel (2008) reviewed 269 online and 116 traditional university students and found that older students do not do better than younger students in the online environment. The online students’ average age was 27 years, and the face-to-face student’s average age was 24 years. Both groups had the same academic success, but the female students in the traditional class significantly outperformed females in the online class. Male students fared as well in both environments.

A three-year study of 179 online undergraduates in business classes compared student characteristics, such as age, gender, GPA, academic experience, with student success in the courses (Wojciechowski & Bierlein-Palmer, 2005). The students’ GPA had the highest correlation to the final grade, whereas participation in an optional orientation was the second highest. The student’s average age was 25, which suggests that distance education is well liked by younger students. This study found that older students typically make higher grades in online courses, finding a .36 correlation. Almost 70% of the students in the study were female, therefore supporting the idea that online courses attract more females; however, no significant relationship was found between gender and final grade. In Naderia, Abdullah, Hamid and Sharir’s (2008) study, undergraduate males and females between ages 18-27 from Malaysian universities did not differ significantly in academic performance. Technological functioning
level could also affect grades in online courses. Younger students have grown up in the technology age; therefore it should make them more comfortable with the hardware in online courses.

**Technology familiarity.**

Use of computers has increased as computers and Internet have become more accessible in the United States. The U.S. Census Bureau (2007) reported that 61.8% of American households owned a computer and 54.7% of households had Internet access during 2003. In 2007, internet access increased to 61.7%. In March 2009, 63% of American households were using high-speed Internet connections, up from 55% in March 2008, whereas dial-up connections were down from 10% to 7% (Horrigan, 2009). However, these numbers did not look at the demographic breakdowns. According to the 2010 Pew Report, 35% of households earning less than $25,000 have broadband Internet access, and less than half of black and Latino households have Internet access compared to almost 65% of white households (Rooks, 2012).

Phillippe and Valiga (2000) reported that 11% of community college students taking credit courses have never used the Internet. Of community college students between the ages of 40-59, 20% have no Internet experience at all. A level of confidence with technology is one of the primary factors affecting student achievement in an online class. Students must have access to technology and the ability to use the hardware and software required to meet online course learning objectives (Allen & Seaman, 2003; Allen & Seaman, 2011). Online students must have access to different technologies and must be able to adapt to ever-changing technology in order to achieve academic success. Although high-speed Internet access is becoming more readily available, many community college students may not have the financial resources to acquire the
appropriate computer and internet technology necessary for the online course environment (Phillippe & Valiga, 2000; Rooks, 2012).

Egan and Akdere (2004) conducted a study on graduate students that looked at 57 competencies for online success. The two most important were basic technology and technology access knowledge. Few community college students have the experience that graduate students have. Many are attending college for the first time, so this lack of experience with technology may have an even greater impact on their educational success (Phillippe & Valiga, 2000). Twenty percent of the students surveyed had learned to use a computer while attending a community college. Wojciechowski and Bierlein-Palmer (2005) found a .438 significance between the number of prior online courses taken and a student’s success in present and subsequent online courses, attributing that finding to increased independence and time management skills. A similar study by Menager-Beeley (2001) was conducted and reviewed 59 students in two online classes at a community college. They found that previous online course completions and prior course grades earned were not significant predictors of a student’s success. Harrel and Bowell (2011) postulate that basic computer skills are necessary to succeed in online courses but advanced computer skills can cause distractions and cause one to spend less time on their studies. They also suggested that individuals with a preference for auditory learning styles will become frustrated more easily due to online courses containing a large amount of written material. This could lead to a higher rate of attrition. A study by Knipe reported 10 critical factors that determine success in community college online programs. This study focused on one community college but did address risks and characteristics that are often discussed. The factors are time of registration, poor or nonexistent advising, age, student engagement in the material,
developmental needs, gender (males are at higher risk until they turn 25 years of age), first time distance learners, previous success with college work and learning style (2009).

Administration must address the lack of technology access and skills of students because the college needs to provide the appropriate access and support for the students to complete the online courses successfully. Community college students’ technology competences cannot be assumed (Muse, 2003).

**Instructor Immediacy**

Separation of teacher and student is a typical scenario seen in online courses at community colleges (Keegan, 1996). However, schools are using different technologies to implement online learning. Synchronous and asynchronous methods were used independently in the past, but more classroom settings have begun to use multiple forms of both types of communication together (Means et al., 2009). Advantages of synchronous and asynchronous learning have been reviewed (Bernard et al., 2004; Harlen & Doubler, 2004; Zhao et al., 2005). Asynchronous activities give students more time for self-reflection, so it is more conducive to deep learning (Harlen & Doubler, 2004). Yet, interaction is at the center of learning experiences and is cited as a defining characteristic of successful learning in both face-to-face and online learning environments (Picciano, 2002; Swan, 2002).

Picciano (2002) noted that an instructor needs to be seen to be considered present in online learning communities. In order to establish online presence, instructors can develop different types of interactions and patterns of interaction by providing consistent and substantive feedback, by moderating discussions efficiently, and by providing content expertise through discussion posts to restart stalled discussions (Arbaugh & Hwang, 2006). Swan (2002) called for extended research on
differences in the quality and quantity of instructor presence projected by online instructors and how such variations might relate to learning.

Instructor immediacy can be an important concept for delivery methods for online classrooms (Garrison, Anderson, & Archer, 2001; Swan, 2002). Garrison et al. (2001) projected that social presence in online communities is a central component to success. Interaction with the instructor is important in both face-to-face and online formats and student success is higher when instructors help guide discussion and provide structure for discussions (Dell et al., 2010). Verbal immediacy is associated with positive outcomes in online classrooms, at least by student perceptions. In three separate studies, students reported verbal immediacy as the reason they were satisfied with a course; however, they reported that it helped them in writing assignments but not with test scores (Arbaugh, 2001; Baker, 2004; Picciana, 2002). Picciana (2002) concluded that online interaction affects perceptions of learning, but perceptions are not corresponding to actual achievement.

Muse (2003) suggested that there needs to be more research to determine what might affect a student’s success in their online courses. Since many studies (Arbaugh, 2001; Baker, 2004; Coates et al., 2004; Garrison et al., 2001; Picciana, 2002) reported that the teacher has a large influence on success in the course, both face-to-face and online, this study will look at the difference in student success based on final grade as well as instructor influence. The high attrition rates for science, technology, engineering, and math (STEM) courses are associated with the intimidating factors of the course, the dull nature of the lecture, and inadequate faculty guidance (Vogt, 2008).

Technology has an impact on a student’s ability to persist and succeed in an online course, but does technology being used in a face-to-face classroom also affect a student’s
success? The less familiar students are with technology, the more likely they will experience negative issues in the online course environment.

**Instructor, Students, and Technology**

Language and psychological processes develop initially as social, interpersonal interactions among people (Vygotsky, 1978). Vygotsky (1978) described the zone of proximal development (ZPD) as the space between one’s developmental level based on his or her problem-solving abilities and the level of possible development when problem solving with adult guidance or with more capable peers (p. 86). Learning with and from others applies to all levels of learners and can be adaptable to the electronic/virtual environment. During the learning process, students need support, technologically and academically. Learners can only utilize the new tools in the ZPD if they have the ability to do so, and teachers cannot take advantage of the tools unless they also know how to use them. Technological adaptations help advance distant socialization and can be powerful means for learning. These include forums, threaded discussions, e-mail, instant messaging, chat, video, audio, learning communities, and case-based learning. Administrators and faculty need to continue to create innovations that will not only benefit distance education, but may enhance learning in the traditional classroom. Adult learners can recognize the ZPD for themselves through metacognitive processes.

Unlike Vygotsky, Piaget (1969) projected that development would occur when two peers collaborate in finding the information more than when an authority or a more knowledgeable peer participated in the assignment. Piaget believed that effective learning was possible when there was equal power between the participants. Peer discussion was more valuable than authoritative discussion because equals were more likely to find a resolution between the differences of each other’s views than were partners of unequal authority.
Regardless if the students learn more from ZPD or peer-to-peer interaction, they cannot be passive. They need to rely on the instructor and each other to help create and participate in activities that will promote learning experiences. The ability to use other individuals and tools to help one learn in an online environment helps suggest that distance education will provide the same learning opportunities as traditional education.

**Conclusion**

This study will examine if there are differences in biology grades between courses taught face-to-face and online. The study will assess if there are differences in grades between course types among different instructors as well as within the same instructor. The study will also determine if CGPA is a good predictor of success in courses. Last, the study will examine if there are differences in attrition rates between courses taught face-to-face and online.

Chapter 2 provided a review of literature pertaining to the independent variables. While many of the variables are important they are not being used since the data is extant and students’ opinions were not gathered during his or her time at the community college in the current study. Chapter 3 will provide an explanation of methods.
Chapter 3:

Methodology

The purpose of this study is to examine four different research questions.

1. Is there a difference in grades between face-to-face and online biology related courses?

2. Is there a difference in grades between courses taught face-to-face or online among biology instructors?

3. Is there a difference in grades between courses taught face-to-face and online by the same instructor?

4. Is cumulative grade point average (CGPA) a good predictor of a student’s grade in biology courses?

Several variables depicting students’ characteristics were considered and gathered, but only one will be used for the study based on an extensive review of the literature. The variable, CGPA, will help determine any relationship between grades in and success in biology a course. The CGPA is being used instead of the ACT score because not all students have taken the ACT, and some students are enrolling in the college many years after taking the ACT. Therefore, their ACT score may not be a good reflection of their current knowledge. In order to achieve the study’s goal of examining the relationship between grades and course type and instructors influence, selected statistical methods were applied. The research design used in the study was factorial analysis of variance to determine if the independent variables of class type, online or face-to-face, and instructor would predict or affect the dependent variable, student performance in the class. A simple linear regression was performed to determine if CGPA can be used as a predictor for grades in a biology course.
Experiments where the effects of more than one factor are considered together are factorial experiments. The academic achievement of a student may depend on class type as well as the teacher. In factorial ANOVAs, dependence or independence of the two factors, teacher and class type can be addressed. Factorial ANOVAs allow treatment variations to be examined and they are efficient. Instead of conducting independent studies, one can effectively combine all factors into one analysis. Factorial ANOVAs are the only effective way to examine interaction effects (Leech, Barrett & Morgan, 2005).

Information about the instructors’ use of BB used at the college in the study, in their face-to-face course was gathered using SurveyMonkey.com, an online survey application, which deployed a survey instrument that was developed by the researcher for the study. Information related to the courses of interest and the students’ grades was gathered through the database at the college. Permission was received from the Institutional Review Board (IRB).

The selected research setting was a large, metropolitan, southern community college (SCC). SCC is one of the largest, southern, community colleges, and it is a multi-campus institution, with the largest campus containing 59.8% of the student population. In September of 1921, the school opened as a vocational trade program for 1,300 boys and young men. After thriving in the 1920s, it had lack of funding during the Great Depression. During World War II it flourished again because of the demand for technically skilled workers in aircraft construction and maintenance, and the metal and woodworking trades; it once again had financial problems during the 1950s. In the mid-1950s, it revamped its mission under new leadership, and a well-known private university suggested that it expand into a technical institute at the junior-college level. In 1960, the first graduates of the institute received their college degrees. In 1966, the school was recognized and approved as a model multi-campus, comprehensive
community/junior college for its state. In 1971, Commission on Colleges of the Southern Association of Colleges and Schools accredited the school; the accreditation was reaffirmed in 1975, 1986, and 1996.

Today, it serves men and women of all ages who reflect the diversity of the metropolitan area. It is a comprehensive, multi-campus community college and a major institution of higher education in the state. Its seven locations form a center for professional and advanced technology career education, academic pre-baccalaureate education, and traditional occupational training. There are seven other campuses spread throughout the metropolitan area that SCC is established in. SCC has also joined forces with a state technical college, which has become SCC’s technical division; this has added four additional sites. Second to the flagship university in size, SCC is the largest institution in the state of Louisiana. Three of the main campuses use both face-to-face and online teaching formats but only information from the main campus is being used due to the large number of data that are available. Since Hurricane Katrina the number of students enrolling in online courses has grown from 3.8% to 30%. SCC offers more than 400 online courses; biology courses comprise about 8% of these.

To identify what may predict student success in different classroom formats, the relationship between the dependent variable, grade in completed course, and the selected independent variables, class type and instructor, was examined.

The purpose of this chapter is to describe the research design, the rationale for the methods employed, the population, the sample selection technique, instrumentation, data collection, data analysis and interpretation techniques, the study’s limitations and other issues that are relevant.
Pilot Study

The pilot study was conducted with only two instructors and the information gathered supported the literature. The study did not provide any evidence that a specific delivery method resulted in higher grades. However, grades did differ based on the instructor of the course. Face-to-face grades were higher for both instructors. A factorial ANOVA was conducted to evaluate the effects of instructor and delivery method on grades. The factorial ANOVA indicated no significant interaction between instructor and delivery method (p=.794). There was no significant difference in grades for the type of delivery method (p=.164), but there was a significant difference for instructor (p=.004).

Student’s grades did differ by instructor, but there was no difference within instructors. Instructor A’s online GPA was 1.19 whereas the face-to-face GPA was 1.45, and Instructor B’s was 1.69 and 1.87 respectively. Instructor A’s and Instructor B’s online courses were not significantly different from their face-to-face courses. Because of these findings, many other aspects could be looked at to determine the differences, such as use of technology within the face-to-face classroom and instructional method. Since Instructor A’s grades were higher than Instructor B’s grades, many variables were considered. The courses cover the same material but the instructors could emphasize different concepts, and the difficulty of the tests may differ. Both are long-term (i.e. eight or more years at the college) instructors at the college, which may have an effect on the students that take their classes. Also, the time spent in class on learning activities may differ between instructors. Even though there is no significant effect in delivery method, online course grades are lower. This pattern among the instructors was the same.

Since the effect of age on grades is a topic that has been debated, it was looked at in the pilot study. The students in this particular study performed better with age, which contradicts
both Anderson et al. (1994) and Coates et al. (2004). The youngest students, which were termed Group 0, had the lowest grades whereas the oldest students, Group 3, had the highest grades. Some of the differences could be attributed to sample size. Group 3 had 29 students while Group 0 had 142 students. A student who made a higher-grade within Group 3 contributed more to the mean GPA of the group, whereas a student with a high grade in Group 0 would not had as much impact on the mean GPA of the group (see Table 3.1 and Table 3.2). Due to the lack of support in the literature for age affecting grades (Anderson et al., 1994; Coates et al., 2004), age was not a variable considered in the full study.

Table 3.1
Summary of ANOVA for Ages Effect on GPA Average (4.0 scale) in Pilot Study

<table>
<thead>
<tr>
<th>Group Age*</th>
<th>Group Age*</th>
<th>Mean Difference</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>-0.1824</td>
<td>0.766</td>
</tr>
<tr>
<td>0</td>
<td>2</td>
<td>-0.7287</td>
<td>0.016</td>
</tr>
<tr>
<td>0</td>
<td>3</td>
<td>-0.8485</td>
<td>0.011</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0.1824</td>
<td>0.766</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>-0.5463</td>
<td>0.166</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>-0.6661</td>
<td>0.102</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0.7287</td>
<td>0.016</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>0.5463</td>
<td>0.166</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>-0.1198</td>
<td>0.984</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0.8485</td>
<td>0.011</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>0.6661</td>
<td>0.102</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>0.1198</td>
<td>0.984</td>
</tr>
</tbody>
</table>

*Note. 0 is Group 0 ages 18-22, 1 is Group 1 ages 23-29, 2 is Group 2 ages 30-34 and 3 is Group 3 ages 35+

**Note. p = .05
Table 3.2
*Tukey-HSD Analysis for Differences in Grades with Age in Pilot Study*

<table>
<thead>
<tr>
<th>Age</th>
<th>N</th>
<th>Subset 1</th>
<th>Subset 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>142</td>
<td>1.324</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>79</td>
<td>1.506</td>
<td>1.506</td>
</tr>
<tr>
<td>2</td>
<td>38</td>
<td></td>
<td>2.053</td>
</tr>
<tr>
<td>3</td>
<td>29</td>
<td></td>
<td>2.173</td>
</tr>
<tr>
<td>Sig.</td>
<td></td>
<td>0.905</td>
<td>0.065</td>
</tr>
</tbody>
</table>

*Note. 0 is Group 0 ages 18-22, 1 is Group 1 ages 23-29, 2 is Group 2 ages 30-34, and 3 is Group 3 ages 35+*

**Note. p = .05**

Research in student retention has been conducted for decades, but formerly dealt strictly with a traditional postsecondary setting, one in which students typically entered college immediately after high school and attended classes on campus (Bean, 2003). To appeal to a larger student base, institutions have utilized current online technologies to provide courses to those students who would not otherwise be served (Hebert, 2006). Online courses in the pilot study had a significantly higher drop rate than face-to-face courses. Likewise, instructors were significantly different. Instructor B had a higher drop rate in both face-to-face and online courses. Due to low sample sizes for this test, the information may not be generalizable to the population. Online student retention has been suggested as one of the greatest weaknesses in online education (Carr, 2000). Studies show that the failed retention rate for online college and university undergraduates range from 20% to 50% (Diaz, 2002; Frankola, 2001) and that online course administrators believe the failed retention rate for online courses to be 10% to 20% higher than traditional classroom environments (Carr, 2000). The higher drop rate in online courses could be attributed to feelings of disconnect with the instructor, time management problems or...
personal problems (Frankola, 2001). Measuring student perception on online courses can be used as one way to identify the variables that are most important to students. The study used pre-collected data and retention was not looked at since there is no way to successfully track why the students had withdrawn from the course. However, withdrawal rates were reviewed.

**Population and Sample**

The population for the study consisted of students enrolled at SCC between spring 2006 and summer 2011. In spring 2011, the population at SCC was 19,258, which was a 2.6% increase from the fall 2010 semester, and a 12.3% increase from the spring 2010 semester (SCC documents, 2011). The female to male percentages were 64.6% and 35.4%, respectively. The majority of the students are Black, non-Hispanic (42%), White, non-Hispanic (33%) and 11% of the students did not indicate ethnicity. The average age at the college is 27.8 years with 42% of the population between 22-29 years old (22-23 and 24-29 have 21% in each group). However, the age groups 18-19 and 20-21 were 20% of the population. Of the population in spring 2011, 4,462 students were enrolled in at least one online course, which comprised 23.2% of the entire student population. Within the entire population, 4,045 were enrolled in the science and math division. Biology consisted of 7.8% of the online courses offered. For similar information for the span of the study refer to Table 3.3.

At the campus where the study is being conducted, the population was 11,532 students, which was a 7.66% increase in enrollment from the previous spring. All information provided is from spring 2011 on the main campus. Females were 63.7% of the student population and males were 36.3% of the student population (SCC documents, 2011). The ethnicity at the main campus is comparable to the college-wide ethnicity percentages, with all groups within a 1% range. The enrollment based on age at the main campus was the same for age groups 20-21, 22-24, and 25-
Based on their admission status, continuing students made up 70% of the population and only 10% were first-time students. Enrollment status was approximately 46% full time and 54% part time. Students enrolled in an online course were 24.4%, whereas only 6% of the students took only online courses.

The participants in this study were students enrolled in a biology online or face-to-face course. The semesters were either 16 weeks (fall and spring) or 8 weeks (summer). Hybrid courses were not included due to the inconsistency of how the courses were taught and the small sample size since biology hybrids were not introduced at the college until fall 2009.

Students self selected to enroll themselves in the sections of their choice for the courses offered. The students’ selections into face-to-face or online sections are most likely due to time scheduling preferences to accommodate their family and work schedules.

In determining appropriate sample size N, the researcher based it on the amount of error willing to be tolerated (George & Mallery, 2006). If an error of 5% is acceptable, then \( N = \frac{1}{.05^2} = \frac{1}{.0025} = 400 \). A sample size of 400 would therefore be adequate for this study.

**Data Collection**

An online survey using the SurveyMonkey.com survey application and portal was employed to collect data from the faculty members involved with the face-to-face classes. The surveys were not anonymous so the data collected could be applied to the classes being taught by the instructor and information could be inferred when the results were gathered. The participation in the survey was voluntary and the instructor’s name was kept anonymous and the data confidential. The instructors were informed through a consent letter (APPENDIX A) that their participation was voluntary and they could discontinue or exit the survey at any time and their responses would not be reported if they aborted the survey process. The responses would
only be collected by the survey application if the instructors clicked the submit button at the end of the questionnaire.

Proper permission was obtained from the IRB at SCC as well as the department dean and department head for permissions to facilitate in conducting the online survey at the college.

The survey questionnaire titled “Use of Blackboard in your Face-to-Face Course” (UBBF2F) (APPENDIX B) was created by the researcher and was open for the entire month of November 2011.

Information pertaining to the students’ academic and demographic information was gathered from SCC’s institutional database. The course, course type, semester, year, teacher, student name, CGPA, ACT score, and final grade for the biology course of interest were collected. Once the data were collected, all students’ names were deleted from files.

Student’s pre-knowledge was determined by their CGPA. If CGPA was not available, the student was excluded from the study. The dependent variable, student performance in class, is an ordinal variable with seven possible levels, A, B, C, D, F, W and I. A grade is defined as outstanding when an A is awarded, above average when a B is awarded, and average when a C is awarded. These grades are considered passing for allied health, nursing or science majors; a D is below average, but passing, for non-science majors, but a student must earn a grade of C or better in order to advance to the next course in the sequence for allied health or science majors. An F is considered failing, and the student would have to repeat the course. A W is assigned to a student who has withdrawn from the course or the college or has been withdrawn from the course by the teacher. A grade of incomplete, I, indicates that satisfactory work has been done in a course, but the student has been prevented from completing the final examination or other concluding work because of some verifiable reason. Any student receiving an ‘I’ was not
included in the study since no conclusive grade could be calculated. SCC assesses student performance on a criterion reference score, so there are no different scores, minuses and pluses, for grades that are different but very close. The grades were coded 0, 1, 2, 3, 4 to replicate a standard grade point average seen at most colleges with F being assigned a 0 and A being assigned a 4. W’s were removed from this section of the data analysis and were used in different analyses for frequency comparisons.

**Course Descriptions**

There are four courses being reviewed in this study. These courses were chosen because they are required related courses to complete with a C or better in order to be accepted to an associate degree program or a certificate program such as clinical nursing courses, health information technology, occupational therapy assistant, physical therapy assistant, radiologic technology, and respiratory care technology. Some of the courses are required for science related fields such as diagnostic medical sonography, funeral service education, general science, radiation therapy, and veterinary technology.

All courses reviewed in the study are taught face-to-face and online. Only instructors who taught at least two sections of both face-to-face and online sections of the biology classes at SCCs main campus were used for the study. Each course reviewed, whether face-to-face and online, used the same syllabus, course chapters, course objectives, and textbook, which are determined by the department. The final test for each course must be 25% of the final course grade. Each teacher is responsible for creating their own tests based on material covered in lectures. Traditional paper and pencil tests are required in face-to-face and online courses.
General Biology I.

General Biology I is a one-semester course for general science and health science majors. The course covers biochemistry, cellular biology, cellular metabolism, genetics, molecular biology, evolution and tissue structure, as well as a General Biology I laboratory. These courses are prerequisites for the higher level biology courses. Any student can enroll in General Biology I as long as they are eligible for English composition I. General Biology I must be passed with a C or higher to move on to Microbiology of Human Pathogens, Human Anatomy and Physiology I and II.

Microbiology of Human Pathogens.

Microbiology of Human Pathogens covers signs, symptoms, diagnosis, treatment and prevention of infectious diseases caused by pathogenic bacteria, fungi, protozoans, and viruses in the human body.

Human Anatomy and Physiology I.

Human Anatomy and Physiology I is a systemic survey of the human body and focuses on structure, function and chemical mechanisms in the integumentary, skeletal, muscular, and nervous systems, as well as special senses.

Human Anatomy and Physiology II.

Human Anatomy and Physiology II is a continuation of Human Anatomy and Physiology I; it reviews the remaining systems in the body. Students must pass both Human Anatomy and Physiology I and the corresponding laboratory with a C or better in order to take Human Anatomy and Physiology II.
Variables

Different variables were reviewed to determine if there is a relationship between course type and success measured by grades. There was one dependent variable (course grade) and two independent variables, the instructional method (with two levels: online and face-to-face) and instructor. CGPA was also used in as a variable in one statistical analysis. In previous research, the student’s GPA was found to have the highest relationship to the final grade (Wojciechowski & Bierlein-Palmer, 2005).

Four different biology courses that were offered in both online and face-to-face formats were reviewed over a 5-year period. The courses were General Biology I, Microbiology of Human Pathogens, Human Anatomy and Physiology I, and Human Anatomy and Physiology II. For Microbiology of Human Pathogens, Human Anatomy and Physiology I, and Human Anatomy and Physiology II, students need a C or higher in both General Biology I and its corresponding lab or a composite ACT score of 22 or higher and a B in high school biology or passing score, 22, on the Biology Placement Exam.

Various student characteristics were considered when designing the study to determine if there was a relationship to student grades in online and face-to-face courses. These characteristics were gender, age, ethnicity, previous courses completed online at the institution, full-time or part-time status, semester format (16 week versus 8 weeks) and CGPA. Professor use of technology may also affect student’s grades in face-to-face courses, so a survey was administered to determine the use of technology in face-to-face courses being reviewed in this study.

To determine grade influences, characteristics such as learner’s demographics, age, gender, and the semester in which the course was taken were not used based on previous
literature showing inconclusive results in affecting course grade. ACT science scores or CGPA were used to determine pre-knowledge in other studies, but only CGPA was used because less than half of the population’s students have taken the ACT. In General Biology I, only 41% of population’s students had taken the ACT, with a mean score of 17.2; in Microbiology of Human Pathogens, 33% of the population took the ACT, with a mean score of 17.6. In Human Anatomy and Physiology I and II, 38.8% and 33% of the population took the ACT, with mean scores of 17.6 and 18, respectively.

Until the fall 2008 semester, online courses had an enrollment limit of 20 individuals per class as mandated by the Board of Regent’s for the college. Louisiana Community and Technical College System increased the enrollment to 30 per class. In contrast, the face-to-face lectures can accommodate from 20–40 students per class, depending on the room size.

Online students are encouraged to experience the online orientation session, which helps familiarize them with the requirements, such as software and hardware, email and the course management system, BB, login instructions, as well as general expectations of online courses. Once students log in to their BB site, they will have the online science course available with information including the syllabus, textbook, schedule, instructor information, course goals, and objectives. In contrast, face-to-face students are informed during their first class session of the requirements to succeed in the course.

Similarities between the face-to-face and online classes in the science department include testing. All testing must occur face-to-face on campus. Online students are offered dates for each test, from which they will come to take the test. Out of town students are allowed to obtain a proctor. The proctor must be a teacher, librarian, administrator from a community college, university, elementary/secondary school, test administrator or an Educational Services Officer
from the U.S. Military. The individual stated as the proctor cannot be a relative of the student, nor live at the same address as the student, as that would jeopardize or violate the academic honesty policy of SCC. A proctor may not be a current student with SCC or a relative of a current student. The student must provide the instructor with the proctor’s employer, work address, work phone, and work email. Cooper (1999) surveyed students in online classes about testing online and students preferred face-to-face testing. Some teachers offer an alternate test taking method through ProctorU. ProctorU is an online proctoring service that permits students to take their online test from their computer. ProctorU allows students to use almost any webcam to take an exam securely. The students will connect one-on-one with the proctor, follow their instructions, and take exams from the comfort of their own home. ProctorU does cost an additional $22.50 per test, and the cost is the student’s responsibility.

Participants

The population (N = 6,619) for this study is composed of freshman, sophomore, and upperclassmen, enrolled in a face-to-face or online General Biology I, Microbiology of Human Pathogens, Human Anatomy and Physiology I, or Human Anatomy and Physiology II lecture at the selected institute between spring 2006 and summer 2011. The student characteristics of the study population are similar to the main campus’s general population.

General Biology I.

The population studied was 1,437 total students enrolled in two teacher’s General Biology I face-to-face class and General Biology I online class. The students’ ages were from 17-59, with a mean age of 25. The demographic makeup of the General Biology I study population is presented in Table 3.4.
The sample included 233 (16.2%) males and 1,199 (83.4%) females. Of the 1,437 students, 1,118 were allied health or biology majors, with 606 (42.2%) being nursing majors (see Table 3.5). The large difference could be attributed to the fact that General Biology I is a prerequisite for nursing school, and a majority of nurses are females. In 2008, the U.S. Department of Health and Human Services reported that a little above 7% of the total registered nurse population is male.

**Microbiology of Human Pathogens.**

The population studied was 1,102 total students enrolled in two teachers’ Microbiology of Human Pathogens face-to-face class and Microbiology of Human Pathogens online class. The students’ ages were from 18-61, with a mean age of 26. The demographic makeup of the microbiology of human pathogens study population is presented in Table 3.4. The sample included 151 (13.7%) males and 951 (86.3%) females. As the courses become more specialized and focused for allied health students, a rise in allied health majors is shown in Table 3.5.

**Human Anatomy and Physiology I.**

The population studied was 2,236 total students enrolled in four teachers’ Human Anatomy and Physiology I face-to-face class and Human Anatomy and Physiology I online class. The students’ ages were from 18-62 with a mean age of 26.5. The demographic makeup of Human Anatomy and Physiology I study population is presented in Table 3.4. The sample included 383 (17.1%) males and 1,853 (82.9%) females. The student’s majors for Human Anatomy and Physiology I are presented in Table 3.5.

**Human Anatomy and Physiology II.**

The population studied was 1,844 total students enrolled in four teacher’s Human Anatomy and Physiology II face-to-face class and Human Anatomy and Physiology II online
class. The students’ ages were from 18-61 with a mean age of 27.2. The demographic makeup of Human Anatomy and Physiology II study population is presented in Table 3.4. The sample included 267 (11.9%) males and 1,577 (70.5%) females. The students’ majors for anatomy and physiology II are presented in Table 3.5.

**Statistical Design**

The analysis begins with descriptive statistics. Summary statistics such as means were computed, and histograms were generated for quantitative variables. Frequencies were tabulated, and bar graphs were generated for categorical variables.

The research design implemented for the study was factorial ANOVA. The factorial ANOVA procedure provides regression analysis and analysis of variance for one dependent variable that includes more than one independent variable and calculates main effects for each independent variable, and calculates interactive effects between the independent variables.

Differences in grades between a single instructor’s face-to-face and online courses grades may differ based on technology in the face-to-face classroom. A regression analysis was conducted using CGPA as a predictor of grades in selected biology courses. Last, attrition in class type by teacher was reviewed using factorial ANOVA.

In all courses, comparisons were made between courses with instructors that taught in both delivery formats, online and face-to-face. Only instructors who taught at least two sections of both face-to-face and online sections of the biology classes at SCCs main campus were used for the study. The instructors reviewed were chosen because they taught numerous sections of the face-to-face and the online biology classes being reviewed. Each instructor used the same content, similar activities, and similar assignments for the two different instructional method classes in all the courses. Course grades were used to measure instructional method success.
The survey UBBF2F will help understand instructors use of technology in their face-to-face courses and whether they think it may have an effect on student’s performance in the course. Based on use of technology in the classroom, grades of courses can be compared between instructors who use technology in their face-to-face courses and ones who do not.
Chapter 4:

Results

Purpose of the Study

This chapter briefly summarizes the purpose of the study and discusses the results of the analyses. This chapter also presents the descriptive statistics of the sample. Table 4.1 displays the descriptive statistics (number and percentage) of the students who passed, failed and withdrew from the selected biology courses in the study.

Table 4.1

<table>
<thead>
<tr>
<th></th>
<th>Gen Bio I</th>
<th>Microbiology</th>
<th>Human A &amp; P I</th>
<th>Human A &amp; P II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Pass (A, B, C)</td>
<td>533</td>
<td>37.1%</td>
<td>731</td>
<td>66.3%</td>
</tr>
<tr>
<td>Fail (D, F)</td>
<td>511</td>
<td>35.6%</td>
<td>174</td>
<td>15.8%</td>
</tr>
<tr>
<td>Withdrawal</td>
<td>393</td>
<td>27.3%</td>
<td>197</td>
<td>17.9%</td>
</tr>
<tr>
<td>Total</td>
<td>1437</td>
<td>100.0%</td>
<td>1102</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Note. Gen Bio I is General Biology I and A & P is Anatomy and Physiology.

In addition, histograms (figure 4.1 and 4.2) for the quantitative and categorical independent variables are included. A histogram can be used to show frequencies of a series of values when number of instances of a variable are too large to list them all (George & Mallery, 2006, p 84).
The research results are presented by course. The purpose of the study was:

1. To investigate if there was a difference in grades between face-to-face or online biology related courses.
2. To investigate if there was a difference in grades between courses taught face-to-face or online among biology instructors.

3. To investigate if there was a difference in grades between courses taught face-to-face and online by the same instructor.

4. Is cumulative grade point average (CGPA) a good predictor of a student’s grade in biology courses?

To accomplish this purpose, data were extracted from the SCC database. The Statistical Package for the Social Sciences (SPSS) Version 20 was used to conduct the statistical analyses.

**General Biology I**

A factorial ANOVA was conducted to evaluate the effects of class type, online versus face-to-face, and teacher influence on student grade, the dependent variable in General Biology I class. There were two teachers being reviewed in the study for General Biology I.

The results indicated a significant main effect on grade by teacher, $F(1, 1040) = 18.527, p < .000$. There was not a significant effect by class type, $F(1, 1040) = 2.110, p = .147$. Students in face-to-face classes, type 0, had a better overall GPA ($M = 1.57$) than those in an online class, type 1 ($M = 1.51$). When reviewing class type within teachers, teacher 1 had a significantly different mean GPA between online ($M = 1.52$) and face-to-face ($M = 1.26$), $F(1, 696) = 6.878, p < .009$, while teacher 2 did not, $F(1, 344) = .011, p = .916$. The two main effects, type and teacher, did not interact, $F(1, 1040) = 1.609, p = .205$ (See Table 4.2).
Table 4.2
Mean GPA Differences Between General Biology I Teachers for Face-to-Face and Online Courses

<table>
<thead>
<tr>
<th>Variable</th>
<th>MF2F</th>
<th>MOL</th>
<th>F(1, 696)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher 1</td>
<td>1.52</td>
<td>1.26</td>
<td>6.87</td>
<td>.009</td>
</tr>
<tr>
<td>Teacher 2</td>
<td>1.81</td>
<td>1.79</td>
<td>0.011</td>
<td>.916</td>
</tr>
</tbody>
</table>

Note. F2F is face-to-face and OL is online.

A regression analysis was conducted and the model revealed that CGPA accounts for 46% of the variance in grades in General Biology I course with a $R^2 = .46$, $F(1, 1042) = 886.250$, $p < .000$ (see Table 4.3).

Table 4.3
Cumulative Grade Point Average as a Predictor of Course Grade in a Biology Class

<table>
<thead>
<tr>
<th>Course</th>
<th>R²</th>
<th>F</th>
<th>p</th>
<th>B</th>
<th>95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Biology I</td>
<td>0.46</td>
<td>886.25</td>
<td>&lt;.000</td>
<td>0.47</td>
<td>0.44</td>
</tr>
<tr>
<td>Microbiology of Human Pathogens</td>
<td>0.51</td>
<td>941.021</td>
<td>&lt;.000</td>
<td>0.38</td>
<td>0.36</td>
</tr>
<tr>
<td>Human &amp; Anatomy Physiology I</td>
<td>0.41</td>
<td>1192.124</td>
<td>&lt;.000</td>
<td>0.33</td>
<td>0.31</td>
</tr>
<tr>
<td>Human &amp; Anatomy Physiology II</td>
<td>0.33</td>
<td>755.302</td>
<td>&lt;.000</td>
<td>0.3</td>
<td>0.28</td>
</tr>
</tbody>
</table>

A factorial ANOVA was conducted to determine mean percentage attrition in General Biology I classes. Both instructors, teacher 1 (M = 29.93) and teacher 2 (M = 18.17), $F(1,48) = 5.496$, $p = .023$, and class type, face-to-face, type 0 (M = 18.63), and online, type 1 (M = 29.47), $F(1,48) = 4.670$, $p = .036$, had significant effects. There is no interaction effect, $F(1,48) = .165$, $p = .686$ (see Table 4.4).
Table 4.4
Mean Percentage Differences in Drop Rates Between General Biology I Teachers and Course Type

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>F(1, 48)</th>
<th>p</th>
<th>LL</th>
<th>UL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher 1</td>
<td>29.93</td>
<td>5.496</td>
<td>.023</td>
<td>25.16</td>
<td>34.69</td>
</tr>
<tr>
<td>Teacher 2</td>
<td>18.17</td>
<td>5.496</td>
<td>.023</td>
<td>9.29</td>
<td>27.05</td>
</tr>
<tr>
<td>Face-to-face</td>
<td>18.63</td>
<td>4.67</td>
<td>.036</td>
<td>9.79</td>
<td>27.46</td>
</tr>
<tr>
<td>Online</td>
<td>29.47</td>
<td>4.67</td>
<td>.036</td>
<td>24.6</td>
<td>34.33</td>
</tr>
</tbody>
</table>

Microbiology of Human Pathogens

In Microbiology of Human Pathogens, two different teachers met the criteria for the inclusion in the study. The effects of teacher and type of class, face-to-face, type 1, and online, type 0, were tested through GLM univariate analysis of variance. Results indicated that teachers did not have a significant effect on grade, $F(1, 901) = 2.275, p = .132$, but class type did have a significant main effect on grade, $F(1, 901) = 23.944, p < .000$.

Although, each teacher did show significant differences in mean GPA between class types. Teacher 1 ($M = 2.61$) and teacher 3 ($M = 2.69$) face-to-face were significantly higher than their online ($M = 2.17, 2.34$) GPA, $F(1,431) = 13.882, p = .000, F(1,470) = 13.730, p < .002$. 

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respectively. The two main effects, type and teacher, were not qualified, $F(1, 901) = .201, p = .639$ (see Table 4.5).

| Table 4.5 |
| Mean GPA Differences Between Microbiology of Human Pathogen Teachers for Face-to-Face and Online Courses |

<table>
<thead>
<tr>
<th>Teacher</th>
<th>MF2F</th>
<th>MOL</th>
<th>$F(1, 431)$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher 1</td>
<td>2.61</td>
<td>2.17</td>
<td>13.882</td>
<td>&lt;.000</td>
</tr>
<tr>
<td>Teacher 3</td>
<td>2.69</td>
<td>2.34</td>
<td>10.117</td>
<td>.002</td>
</tr>
</tbody>
</table>

*Note. F2F is face-to-face and OL is online.*

A regression analysis was conducted and the model revealed that CGPA accounts for 51% of the variance in grades in Microbiology of Human Pathogens course with a $R^2 = .51, F(1, 903) = 667.419, p < .000$ (see Table 4.3).

A factorial ANOVA for mean percentage attrition was performed and for class type, face-to-face (M = 10.23) and online (M = 24.68), there is a reliable main effect, $F(1,41) = 15.92, p < .000$. There is no reliable main effect for instructor, $F(1,41) = 2.124, p = .153$. There is no interaction effect, $F(1,41) = .706, p = .406$ (see Table 4.6).

| Table 4.6 |
| Mean Percentage Differences in Drop Rates Between Microbiology of Human Pathogens Teachers and Course Type |

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>$F(1, 41)$</th>
<th>$p$</th>
<th>LL</th>
<th>UL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher 1</td>
<td>14.82</td>
<td>2.124</td>
<td>.153</td>
<td>9.36</td>
<td>20.27</td>
</tr>
</tbody>
</table>
Human Anatomy and Physiology I

In Human Anatomy and Physiology I, four different teachers met the criteria to be included in the study. The effects of teacher and type of class, face-to-face, type 1, and online, type 0, were tested through GLM univariate analysis of variance. Results indicated a significant main effect for the type of class, face-to-face or online, \( F(1, 1718) = 21.732, p = < .000 \). There was also a significant main effect for the teacher, teacher 2, teacher 5, teacher 6 or teacher 7, \( F(3, 1718) = 21.302, p = < .000 \). The two main effects, type and teacher, did not interact or demonstrate a statistical significance, \( F(1, 1718) = 1.399, p = .241 \) (see Table 4.7).

Table 4.7
Mean GPA Differences Between Human Anatomy & Physiology I Teachers for Face-to-Face and Online Courses

<table>
<thead>
<tr>
<th>Variable</th>
<th>MF2F</th>
<th>MOL</th>
<th>( F(3, 1718) )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher 2</td>
<td>2.44</td>
<td>1.81</td>
<td>41.819</td>
<td>&lt; .000</td>
</tr>
<tr>
<td>Teacher 5</td>
<td>2.83</td>
<td>2.43</td>
<td>3.862</td>
<td>.051</td>
</tr>
<tr>
<td>Teacher 6</td>
<td>1.80</td>
<td>1.57</td>
<td>1.231</td>
<td>.268</td>
</tr>
<tr>
<td>Teacher 7</td>
<td>1.93</td>
<td>1.56</td>
<td>3.859</td>
<td>.051</td>
</tr>
</tbody>
</table>

*Note. F2F is face-to-face and OL is online.*
Because the overall $F$ test was significant, Tukey and Scheffe’s follow up tests were conducted to evaluate pair wise differences among the means between teachers face-to-face and online GPAs. Tukey is preferred when pairwise comparisons are of interest and Scheffe is preferred when many contrasts are of interest and sample sizes are unequal. The output for both methods gave the same results so only Tukey results were reported. The post hoc comparison of the teachers indicate that teacher five ($M = 2.63$, 95% Cl [2.45, 2.82]) is significantly different from all the teachers and is in their own subset. Teacher 2 ($M = 2.12$, 95% Cl [2.02, 2.22]) is significantly different from teachers 6 ($M = 1.69$, 95% Cl [1.50, 1.88]) and teacher 7 ($M = 1.74$, 95% Cl [1.56, 1.93]) who are in a subset together (see Tables 4.8 and 4.9).

Table 4.8

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>$F$</th>
<th>$p$</th>
<th>LL</th>
<th>UL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher 2</td>
<td>2.16</td>
<td>21.302 (3, 1718)</td>
<td>&lt; .000</td>
<td>2.02</td>
<td>2.22</td>
</tr>
<tr>
<td>Teacher 5</td>
<td>2.63</td>
<td>21.302 (3, 1718)</td>
<td>&lt; .000</td>
<td>2.45</td>
<td>2.82</td>
</tr>
</tbody>
</table>
Teacher 6  1.78  21.302 (3, 1718)  < .000  1.50  1.88
Teacher 7  1.81  21.302 (3, 1718)  < .000  1.56  1.93
Face-to-face  2.25  21.732 (1, 1718)  < .000  2.16  2.34
Online  1.84  21.732 (1, 1718)  < .000  1.70  1.99

Table 4.9  
GPA Means for Groups in Homogeneous Subsets in Human Anatomy & Physiology I  
Based on Observed Means

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Subset</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1.78</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1.81</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tukey HSD</td>
<td>2</td>
<td>2.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>2.63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig.</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

Since teachers influenced student grades, a factorial ANOVA was performed on individual teachers to investigate if there were differences between their grades in their face-to-face and online Human Anatomy and Physiology I course. Teacher 2’s face-to-face (M = 2.43) was significantly higher than their online (M = 1.81), $F(1, 632) = 41.819, p = < .000$. Both teacher 5 and teacher 7 had a $p = .051$ which is so close to $p = .05$ that some researchers would still consider it to be statistically significant (Bruin, 2006). Teacher 6’s class grades across class type were not significantly different, $F(1, 690) = 1.231, p = .268$ (see Table 4.7).
A regression analysis was conducted and the model revealed that CGPA accounts for 41% of the variance in grades in Human Anatomy and Physiology I course with a $R^2 = .41$, $F(1, 1722) = 1192.677$, $p < .000$ (see Table 4.3).

A factorial ANOVA was performed to examine mean percentage drop rate for Human Anatomy and Physiology I. There is a reliable main effect across instructor, $F(3, 71) = 8.386$, $p < .000$. There is a significant main effect with class type, face-to-type ($M = 18.02$) and online ($M = 31.04$), $F(1,71) = 17.804$, $p < .000$. There is no statistical significant interaction effect, $F(3,71) = .320$, $p = .811$. Since the overall $F$ test was significant for instructors, post hoc tests were conducted to compare the means of all teachers. The post hoc comparisons of the teachers specify that teacher 2 ($M = 17.82$, 95% CI [13.81, 21.84]), teacher 5 ($M = 16.73$, 95% CI [9.11, 24.34]) and teacher 6 ($M = 30.74$, 95% CI [24.17, 37.31]) are in a subset together and do not differ reliably. Teacher 6 and teacher 7 ($M = 33.54$, 95% CI [27.01, 40.06]) are in a subset together and do not differ reliably. Teacher 6 is not different from either group, but teacher 7 is significantly different from the first group (see Tables 4.10 and 4.11).

Table 4.10
Mean Percentage Differences in Drop Rates Between Human Anatomy & Physiology I Teachers and Course Type

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>$F$</th>
<th>$p$</th>
<th>LL</th>
<th>UL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher 2</td>
<td>17.82</td>
<td>8.386 (3, 71)</td>
<td>&lt; .000</td>
<td>13.81</td>
<td>21.84</td>
</tr>
<tr>
<td>Teacher 5</td>
<td>16.73</td>
<td>8.386 (3, 71)</td>
<td>&lt; .000</td>
<td>9.11</td>
<td>24.34</td>
</tr>
<tr>
<td>Teacher 6</td>
<td>30.74</td>
<td>8.386 (3, 71)</td>
<td>&lt; .000</td>
<td>24.17</td>
<td>37.31</td>
</tr>
<tr>
<td>Teacher</td>
<td>Percentage Drop</td>
<td>$F$ (df)</td>
<td>Sig.</td>
<td>Mean 1</td>
<td>Mean 2</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------</td>
<td>----------</td>
<td>------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Teacher 7</td>
<td>33.54</td>
<td>8.386 (3, 71)</td>
<td>&lt; .000</td>
<td>27.01</td>
<td>40.06</td>
</tr>
<tr>
<td>Face-to-face</td>
<td>18.02</td>
<td>17.804 (1, 71)</td>
<td>&lt; .000</td>
<td>13.77</td>
<td>22.26</td>
</tr>
<tr>
<td>Online</td>
<td>31.4</td>
<td>17.804 (1, 71)</td>
<td>&lt; .000</td>
<td>26.72</td>
<td>36.08</td>
</tr>
</tbody>
</table>

Table 4.11
*Post Hoc Test Subset Comparison for Human Anatomy & Physiology I Mean Percentage Drop Rates*

<table>
<thead>
<tr>
<th>Subset</th>
<th>1</th>
<th>2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>18.83</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>19.27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>24.06</td>
<td>24.06</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>33.02</td>
<td></td>
</tr>
<tr>
<td>Sig.</td>
<td>0.56</td>
<td>0.12</td>
<td></td>
</tr>
</tbody>
</table>

**Human Anatomy and Physiology II**

In Human Anatomy and Physiology II, four teachers were included in the study. A factorial ANOVA tested the effects of class type, face-to-face, type 0, or online, type 1, and teacher on grades. Results indicated a significant main effect for teacher, $F(3, 1478) = 34.020, p = < .000$. There was not a significant main effect for type of class, face-to-face versus online, $F(1, 1478) = .141, p = .708$ (see Table 4.12). The two main effects, type and teacher, did have a significant interaction between the two factors, $F(3, 1478) = 3.554, p = < .014$. 
Table 4.12
*Mean Differences in GPA Between Human Anatomy & Physiology II Teachers for Face-to-face and Online Courses and Course Type*

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>F</th>
<th>p</th>
<th>LL</th>
<th>UL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher 5</td>
<td>3.04</td>
<td>34.020 (3, 1478)</td>
<td>&lt; .000</td>
<td>2.89</td>
<td>3.18</td>
</tr>
<tr>
<td>Teacher 7</td>
<td>2.17</td>
<td>34.020 (3, 1478)</td>
<td>&lt; .000</td>
<td>2.00</td>
<td>2.34</td>
</tr>
<tr>
<td>Teacher 9</td>
<td>2.20</td>
<td>34.020 (3, 1478)</td>
<td>&lt; .000</td>
<td>2.11</td>
<td>2.23</td>
</tr>
<tr>
<td>Teacher 10</td>
<td>2.16</td>
<td>34.020 (3, 1478)</td>
<td>&lt; .000</td>
<td>1.95</td>
<td>2.38</td>
</tr>
<tr>
<td>Face-to-face</td>
<td>2.41</td>
<td>.141 (1, 1478)</td>
<td>.708</td>
<td>2.31</td>
<td>2.51</td>
</tr>
<tr>
<td>Online</td>
<td>2.34</td>
<td>.141 (1, 1478)</td>
<td>.708</td>
<td>2.25</td>
<td>2.51</td>
</tr>
</tbody>
</table>

Tukey and Scheffe post hoc comparison of the four teachers indicate that teacher 5 \((M = 3.04, 95\% \text{ CI } [2.89, 3.18])\) had significantly higher grades than teacher 7 \((M = 2.17, 95\% \text{ CI } [2.0, 2.34])\), teacher 9 \((M = 2.21, 95\% \text{ CI } [2.11, 2.23])\) and teacher 10 \((M = 2.16, 95\% \text{ CI } [1.95, 2.38])\). The last three teachers were grouped in the same subset (See Tables 4.12 and 4.13).

Table 4.13
*GPA Means for Groups in Homogeneous Subsets in Human Anatomy & Physiology II Based on observed means.*

<table>
<thead>
<tr>
<th></th>
<th>Subset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher</td>
<td>1</td>
</tr>
<tr>
<td>Tukey HSD</td>
<td>7</td>
</tr>
</tbody>
</table>
A factorial ANOVA was conducted to examine teacher’s effect on grades among their course type, face-to-face or online. Teacher 5 had a significant effect, $F(1, 278) = 11.042, p = < .005$, on grade depending on course type, face-to-face ($M = 3.24$) or online ($M = 2.83$). Teacher 7, $F(1, 413) = .035, p = .852$, teacher 9, $F(1, 670) = 2.462, p = .117$, and teacher 10, $F(1, 117) = 2.691, p = .104$, did not have a significant effect on grade regardless of course type (See Table 4.14).

<table>
<thead>
<tr>
<th>Variable</th>
<th>MF2F</th>
<th>MOL</th>
<th>$F(3, 1478)$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher 5</td>
<td>3.24</td>
<td>2.83</td>
<td>7.925</td>
<td>.005</td>
</tr>
<tr>
<td>Teacher 7</td>
<td>2.15</td>
<td>2.18</td>
<td>0.035</td>
<td>.852</td>
</tr>
</tbody>
</table>
A regression analysis was conducted and the model revealed that CGPA accounts for 34% of the variance in grades in Human Anatomy and Physiology II course with a \( R^2 = .34 \), \( F(1, 1484) = 755.302, p < .000 \) (See Table 4.3).

A factorial ANOVA to analyze mean percent drop rates in Human Anatomy and Physiology II was performed. There is a significant main effect across instructor, \( F(3, 62) = 42.085, p <.000 \) and across class type, \( F(1, 62) = 11.356, p <.001 \). There is no interaction effect, \( F(1, 62) = 2.326, p <.083 \). Since there is a reliable effect across teachers, a post hoc test was conducted to determine which teacher’s drop rate means differed from each others. Teacher 5 (\( M = 10.57, 95\% \text{ CI} [5.64, 14.49] \)) and teacher 9 (\( M = 13.79, 95\% \text{ CI} [10.38, 17.19] \)) do not differ from each other and are in the same homogeneous subset. Both are different from teacher 7 (\( M = 29.53, 95\% \text{ CI} [24.21, 34.86] \)) who is in their own subset. All three teachers are separate from teacher 10 (\( M = 45.68, 95\% \text{ CI} [40.17, 51.19] \)) who is in their own subset and whose mean differs reliably from the other teachers (See Tables 4.15 and 4.16).

### Table 4.15

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Percent Difference</th>
<th>Mean</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher 9</td>
<td>2.27</td>
<td>2.13</td>
<td>2.462, .117</td>
</tr>
<tr>
<td>Teacher 10</td>
<td>1.96</td>
<td>2.36</td>
<td>2.691, .104</td>
</tr>
</tbody>
</table>

*Note. F2F is face-to-face and OL is online.*
<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>F</th>
<th>p</th>
<th>LL</th>
<th>UL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher 5</td>
<td>10.57</td>
<td>42.085 (3, 62)</td>
<td>&lt; .000</td>
<td>56.40</td>
<td>15.49</td>
</tr>
<tr>
<td>Teacher 7</td>
<td>29.53</td>
<td>42.085 (3, 62)</td>
<td>&lt; .000</td>
<td>24.21</td>
<td>34.86</td>
</tr>
<tr>
<td>Teacher 9</td>
<td>13.79</td>
<td>42.085 (3, 62)</td>
<td>&lt; .000</td>
<td>10.39</td>
<td>17.19</td>
</tr>
<tr>
<td>Teacher 10</td>
<td>45.68</td>
<td>42.085 (3, 62)</td>
<td>&lt; .000</td>
<td>40.17</td>
<td>51.19</td>
</tr>
<tr>
<td>Face-to-face</td>
<td>20.79</td>
<td>11.356 (1, 62)</td>
<td>&lt; .000</td>
<td>17.68</td>
<td>23.91</td>
</tr>
<tr>
<td>Online</td>
<td>28.99</td>
<td>11.356 (1, 62)</td>
<td>&lt; .000</td>
<td>25.25</td>
<td>32.73</td>
</tr>
</tbody>
</table>

Table 4.16
*Post Hoc Test Subset Comparison for Human Anatomy & Physiology II Mean Percentage Drop Rates*

<table>
<thead>
<tr>
<th>Subset</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>10.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>13.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tukey HSD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>29.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>45.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig.</td>
<td>0.88</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Summary

In this chapter, the descriptive statistics for the study were presented for an overview of the samples basic demographics. Factorial ANOVAs were used to analyze if there were differences in grades between face-to-face and online biology courses. Factorial ANOVAs were also used to investigate the difference in grades between face-to-face and online biology courses taught by different and by the same instructors. A regression analysis provided the information to support that CGPA is a good predictor of a student’s success in a course, regardless of type, face-to-face or online. Last factorial ANOVAs analyzed the attrition rate in teacher’s course type and among teachers within biology courses.
Chapter 5:

Discussion, Recommendations, and Conclusion

This chapter summarizes the findings of the study, presents conclusions, and makes recommendations for further research. Assumptions and limitations are discussed as they related to the findings and the conclusions of the study.

Summary

Online learning in education has thrived due to the availability and accessibility of the Internet, thus allowing students to access information anywhere and anytime. There has been an 18.3% compound annual growth in online students from fall 2002 to fall 2010 (1.6 million to 6.1 million) based on Allen and Seaman’s research (2011), while the overall higher education population has grown just over 2% during the same time (16.6 million to 19.6 million; Hussar & Bailey, 2011). In the past 15 years, community colleges had received more online learners than any other institution allowing them to offer more educational opportunities to individuals that may otherwise not attend school (Allen & Seaman, 2008; Parsad & Lewis, 2008; Wirt et al., 2004). Today, 31% of college students take at least one online course (Allen & Seaman, 2011).

Previous studies have reported mixed results on student success in online courses at the community college level, specifically in the biological sciences (Clark, 1983; Coates et al., 2004; Jahmg, Krug, & Zhang, 2007; Sussman & Dutter, 2010; Zhao et al., 2005).

Review of Methodology

The study spanned 14 semesters and explored student’s grades in biology courses based on course type (face-to-face versus online) and instructor. The institution is the second largest institution in Louisiana, and has a very large online course offering to supplement the traditional classroom format.
The research problem investigated whether or not course type or instructor were related to grade achievement (dependent variable) at the selected institution in the biological courses chosen. The courses included in the study were General Biology I, Microbiology of Human Pathogens, Human Anatomy and Physiology I, and Human Anatomy and Physiology II. Since there are shortages of studies in the literature that have addressed student success in biology face-to-face and online courses, this study investigates four questions regarding success in biology face-to-face versus online courses. The four questions examined were:

1. Is there a difference in grades between face-to-face and online biology related courses?
2. Is there a difference in grades between courses taught face-to-face or online among biology instructors?
3. Is there a difference in grades between courses taught face-to-face and online by the same instructor?
4. Is CGPA a good predictor of a student’s grade in biology courses?

The research design implemented for this study was factorial analysis of variance and linear regression. Descriptive statistics was also performed for summary statistics such as means and frequencies.

The researcher was able to use the institution’s database to obtain the educational and demographic information for the students enrolled in the courses during the semesters of the study.
Discussion of Research Findings

General Biology I.

General Biology I had the lowest GPA among all the courses in the study for both face-to-face (M = 1.57) and online (M = 1.51) course type; it had the lowest percentage pass rate (37.1), the highest percentage fail rate (35.6), and the highest percentage drop (M = 27.3) rate. The mean age of General Biology I students was 25 years, and most high-school biology is taken during freshman or sophomore year. General Biology I is the only course in the study that did not have prerequisites. Many students entering this course are unprepared as they have not had biology in 10 plus years, and have been out of high school for seven or eight years. Many students are unfamiliar with the demands of online courses and may be under the impression that online courses are easier, and may take less time than face-to-face courses (Thomas, 2007). Students taking General Biology I online are most likely in their first science course as well as in their first online course, creating a challenging environment for even the most motivated student (Muse, 2003; Pillay, Irving, & McCrindle, 2006).

The current study did not provide any evidence that a specific delivery method resulted in higher grades. However, grades did differ based on the instructor of the course. Face-to-face grades were higher for both instructors compared to online grades, teacher 1 (M = 1.52, 1.26) and teacher 2 (M = 1.81, 1.79), respectively. Teacher 1’s online grades were significantly lower than their face-to-face grades, while teacher 2’s grades were not different. Grades not differing based on delivery method support the findings by Clark (1983), Coates et al. (2004), Jahmg, Krug, and Zhang (2007), and Zhao et al. (2005). While course guidelines and best practices are standardized throughout the department, academic freedom is permitted by each teacher in the class. Teaching methods most likely differ between teachers, which can account for differences
in mean GPA. The courses cover the same material but the instructors could emphasize different concepts and the difficulty of the tests may differ. Both instructors have been at the college for over eight years, which may have an effect on the students that take their classes. Also, the time spent in class (face-to-face or online) on learning concepts may differ between instructors. Different researchers contend that instructor immediacy in both face-to-face and online courses is an important component to success when looking at criterion such as grades and satisfaction (Garrison, Anderson, & Archer, 2001; Swan, 2002).

CGPA was a significant predictor of student success in General Biology I. CGPA is a strong predictor of student success in a course, which is often used with ACT and class rank as a predictor of success in college (Wade & Walker, 1994; see Table 4.3).

Attrition in general biology I is significant for face-to-face and online. Significant differences are also seen across both teachers (see table 4.4). The online attrition mean (M = 29.47) is considered in the normal range for face-to-face attrition based on Frankola’s 2001 and Diaz’s 2002 study in which the range for face-to-face attrition is from 20% to 50%; in Carr’s (2000) study course administrators estimated that the attrition rate for online courses would be 10% to 20% higher than the traditional classroom. The online attrition was approximately 15% higher than the face-to-face drop rate. These numbers could be attributed to a feeling of disconnect from the instructor (Vogt, 2008), time management and/or personal problems. However, at the time of the study, the college did not contact students to follow up on their reasons to withdrawal from the course. The relatively high attrition rates seen in General Biology I are not carried through to the higher level courses. This is probably due to students becoming more familiar with taking science courses regardless of delivery method. As student’s move through course sequencing they form positive relationships with faculty members, learn
how to prioritize their time, manage their other commitments, and create successful study skill routines (Astin & Astin, 1992).

**Microbiology of Human Pathogens.**

Students in Microbiology of Human Pathogens course have passed their prerequisites of a biology lecture and laboratory course, have made a 22 or higher on their ACT, passed high school biology with a B, or better, or received a passing score on the Biology Placement Exam. The prerequisites have provided the students a foundation of content; the instructor can assume a specific knowledge base, and these students have demonstrated the readiness to enroll in the upper level courses. There is no corequisite for the course so many students are able to concentrate on it as their only biology course. Microbiology of Human Pathogens had the overall highest GPA among face-to-face courses (M = 2.65), and the second highest for online (M = 2.25), as well as the highest percentage pass rate (66.3), the lowest percentage fail rate (15.8), and the lowest percentage withdrawal rate (17.9). The difference in grades between course type, face-to-face and online, was significant, \( p < .000 \). As students progress through their course sequencing, they become more prepared and better acquainted with biological concepts. Weaker students usually do not progress and students that excel will thrive. There was no difference between courses taught face-to-face and online among instructor, \( p = .132 \). At this point in the student’s course series, there was no effect of teacher, only effect of course type.

Even though grades did not differ among instructors, they did differ within the instructors. Face-to-face grades were higher for both instructors compared to online grades, teacher 1 (M = 2.61, 2.17) and teacher 3 (M = 2.69, 2.34), respectively. Teacher 1 and teacher 3’s online grades were significantly lower than their face-to-face grades (Teacher 1, \( p < .000 \);
Teacher 3, \( p < .002 \). Whereas both instructors face-to-face GPA was significantly higher than their online GPA; their online GPAs (Teacher 1 M = 2.17; Teacher 3 M = 2.34) were still above a C average. Students are still performing well, maintaining the idea that maturity, familiarity and prerequisites can help students do well with online formatted courses. This is also supported by CGPA, which were a significant predictor of student success for Microbiology of Human Pathogens (see Table 4.3).

The attrition rate for Microbiology of Human Pathogens is significant for course type, face-to-face and online, but not by instructor (sees Table 4.6). The drop rates for the study are the lowest of all the classes in the study for both face-to-face and online. Faculty characteristics, such as caring, respect, and use of andragogy in the classroom, can have a positive effect on retention rates (William, 2010).

**Human Anatomy and Physiology I.**

Human Anatomy and Physiology I (HAPI) had the second lowest face-to-face (M = 2.24) and online (M = 1.84) overall GPAs in the study. There was a significant difference in the grades between course type, face-to-face and online. As observed in the other courses, the pattern of mean GPAs being higher in face-to-face courses is consistent with HAPI. Overall its percentage fail (26.1) and withdrawal (22.8) rate, and percentage pass rate (51.1), are second lowest and highest, respectively, in the study to the entry level course General Biology I. HAPI is an information intensive course that students perceive as a memorization course. Literature has indicated that HAPI and Human Anatomy and Physiology II (HAPII) are among the most difficult courses students in the allied health field will encounter (Hinds, 1999; Johnston, 2010; Nicolel & Butler, 1996). According to students from Southern Georgia University, HAP is difficult to learn because it is a new language, and you have to understand how the systems and
chemicals work together. The students do not make connections between major concepts, and instead of seeing the connections, they try to memorize it and “crush” everything in their brain the night before the test. Time management and perseverance is also important to be successful in HAP, but the teachers often expect the students to learn too much, and the teachers should explain things in simpler terms (Sturges & Maurer, 2011).

There was a significant main effect for the teacher, teacher 2, teacher 5, teacher 6 or teacher 7. All teachers face-to-face mean GPAs were higher than their mean online GPAs (see Table 4.7). The teachers’ results of HAPI are similar to the previous classes’ teachers, and students have a higher mean GPA in face-to-face sections. The lowest overall combined (mean face-to-face and online) GPAs are teacher 6 (M = 1.78) and teacher 7 (M = 1.81); these teachers are not significantly different from each other, but they are significantly different from teacher 2 (M = 2.16). All of the teachers are significantly different from teacher 5 who has the highest combined GPA (M = 2.63) (see Tables 4.8 and 4.9).

Delivery of HAPI and HAPIII material has traditionally been presented with drawings and models, and only recently supported with videos and images in the classroom. This suggests that face-to-face lectures may have actually been a contributing factor to the difficulties encountered by students and the increase use of technology may actually be essential to increase student performance (Clancy, McVicar & Bird, 2000). A brief survey sent to the instructors asked about the use of BB in face-to-face courses. Teacher 6 and 7 responded that BB helps increase contact with the students and provides more interactivity between the student and the teaching material. The students can become acquainted with the material in a less formal environment and when they come to class, there can be more transparency. The students can more easily see how the course works and how they work through it. In this study, the teachers’ comments about concept
connections align closely with the comments stated by the Southern Georgia University students in Sturges and Maurer 2011 study.

For HAPI, there is an effect for one instructor within course type. Teacher 2’s face-to-face mean GPA (M = 2.44) was significantly higher than their online mean GPA (M = 1.81), \( p < .000 \). This particular teacher did use BB in their course and indicated that they have increased their contact with students, have better organization of course material, more convenient online assessment and better alignment of course objectives. While the students are in a face-to-face course, it is similar to the benefits of a hybrid course, which links the benefits of online courses and face-to-face courses while promoting learner autonomy and reducing time on campus. The difference between a mid C average, and a high D average is seen between the face-to-face course and the online course for teacher 2. Whereas teacher 5 and 7’s face-to-face mean GPA were not significantly different from their mean GPA online courses based on the predetermine \( p = .05 \), both teachers levels were \( p = .051 \). Teacher 5 seems to be an exception in HAPI because their face-to-face GPA (M = 2.83) and online GPA (M = 2.43) is higher in every category when compared to every HAPI teacher. Teacher 5’s online mean GPA is the same as teacher 2’s face-to-face mean GPA and higher than teacher 6 and 7’s face-to-face mean GPAs (see Table 4.7). Teacher 6’s class grades across class type were not significantly different.

CGPA continues to be a good predictor of student success in class but this does not take in account difficulty of topic or teacher influence (Baily, 2011). Past research in the allied health fields have supported the strong correlation between prerequisites and program grade point averages (Hawley-Oliver, 1985).

Attrition in HAPI is significant for face-to-face and online courses. Significant differences are also seen across teachers. A post hoc test was run to compare the means of all
teachers. Teachers 2, 5, and 6’s mean percentage drop rates do not differ significantly from each other and teacher 6 does not differ from significantly from teacher 7. However, teacher 7 differs significantly from teachers 2 and 5 (see Table 4.11). Teacher 5 had the lowest combined percentage drop rates (M = 16.73), whereas teacher 7 had two times the amount of students withdrawal. Teachers 5 and 7 were almost a full point different from each other in terms of mean GPA. Since tests are created by the instructor and instructors can supply their own supplemental material in the face-to-face and online sections, it is hard to address the large discrepancies between the two instructors for GPA and drop rates.

The mean percentage drop rates in face-to-face and online courses are comparable and slightly higher than General Biology I courses (see Tables 4.4 and 4.10). Although the material in HAP is considered harder to learn by both instructors and students (Michael, 2007; Sturges & Maurer, 2011), the students should be more comfortable with using technology, and more familiar with online courses helping them perform better. As students advance through their course sequencing, they are more prepared and have a better understanding of biological concepts. Weaker students usually do not excel and students that stand out will thrive as seen in Microbiology of Human Pathogens, another upper level classman course.

HAPI is a requirement to apply to most allied health programs and nursing, and many of the community college students will fail HAPI with a D or F, or they will withdrawal; the amount of students moving forward at the required level is less than desirable. Failure in HAPI is not surprising considered the demographic background of students enrolling in community colleges; many of these students have weak academic skills with little prior biology knowledge (Abdullahi & Gannon, 2012). Students do have to take General Biology I as a prerequisite, but it is not uncommon for students to take the course two or three times before passing, and they often
do not see the relevance of the prerequisite to the course they are in or to their future career (Abdullahi & Gannon, 2012). Determining ways to increase retention are necessary and one study showed an increase in retention rate occurred when technology was integrated into the course (Raynor & Iggulden, 2008). Regardless if it is face-to-face or online, integration of technology is relevant and essential for the success of students in today’s educational environment.

**Human Anatomy and Physiology II.**

HAPII is the last course that students will take as a prerequisite for either an allied health program or the nursing program. The prerequisites have provided the students a firm understanding of concepts needed to successfully progress through the material presented throughout the curriculum. Depending on the program that the students apply to, there may not be an associated laboratory required to be taken. HAPII had the second highest face-to-face GPA ($M = 2.41$), and the highest online GPA ($M = 2.34$), as well as the second highest percentage pass rate (62.7), the second lowest percentage fail rate (17.9), and the second lowest percentage withdrawal rate (19.4). In research, students have reported that HAPII has been associated with high anxiety, and is general perceived as a hard subject. Because of this perception, students’ confidence may waiver, affecting their abilities to perform, and leading to self doubt during examinations and performance (Hinds, 1999; Johnston, 2010; Nicolel & Butler, 1996).

Unlike the previous two upper-level course types, there were no significant differences between class type, face-to-face versus online. HAPII is the highest level class taught in the course sequence for transferability or for a degree program offered at SCC. At this point,
students should have acquired the knowledge, and necessary study skill through prerequisites to successfully maneuver, and pass class regardless of the format, face-to-face or online.

There was a significant main effect for teacher, either teacher 5, 7, 9 or 10. The two main effects, course type and teacher, did have a significant interaction. This was the first time in the study that this has occurred. This trend is seen in HAPII because two teachers, teachers 7 and 10 have a higher online mean GPA than their face-to-face course mean GPA. The differences between the two means are not significant, but this is the first instance that this tendency has occurred when online GPAs were overall higher than face-to-face GPAs (see Table 4.14).

Teacher 5 had higher grades, combined GPA (M = 3.04), than teachers 7, 9 and 10. Teachers 7, 9 and 10 were all low C averages and were within .04 GPA rankings of each other. Teacher 5’s mean GPA was a low B average and .7 GPA rankings higher than the other three teachers. As seen in Microbiology of Human Pathogens, teacher 5 consistently has higher grades. One can conclude that this teacher’s course is organized differently, or their tests are not as rigorous, or that they may have a reputation of being easier to pass.

Teacher 5 was the only instructor to have a significant difference between course type, face-to-face (M = 3.24) and online (M = 2.83). Teacher 5’s course types had GPAs higher than the other three teachers in HAPII. Teacher 5’s mean online GPA was higher than any other teachers mean face-to-face or mean online GPAs by a .45 GPA ranking. This trend maintains the idea that teacher 5 has a different teaching style than the other three instructors; especially since teacher 5’s GPA is significantly higher than the other teachers in HAPII.

CGPA is still a good predictor of course success. However, when compared to the other three courses in the study, in HAPII it accounts for the least amount of variance. This could be because either the class difficulty is not taken into account or the teacher influence (Baily, 2011).
The attrition rate for HAPII is significant for course type, face-to-face and online, and by instructor. The pattern is consistent across all classes for course types. The mean percentage attrition rates were not higher than research (Frankola, 2001; Vogt, 2008) suggested they should be for face-to-face or online classes, except for one teacher, teacher 10 in HAPIII. Teachers 5 and 9 had the lowest mean percentage drop rate than any other instructor, in any class, in the entire study. At this point in student’s academic career, regardless of course type, the student should have established their study skills and developed proficiency in the biological courses. Teacher 10 is an irregularity and has a drop rate of almost 50%, which is the highest withdrawal rate in the entire study. In contrast to teacher 5, teacher 10 may have not provided enough support to their students to help retention. Teacher 10’s students who did persevere and remained throughout the semester did not have significant different GPAs from teachers 7 and 9 for both face-to-face and online courses (see Table 4.14). Since teacher 10 stated that they did not use BB in the face-to-face classroom, the lack of technology could have hindered the student-teacher immediacy and student-content relationship. Clancy et al. (2000) suggested technology in the face-to-face classroom fostered student comfort and increased student success in HAP courses.

**Limitations and Recommendations for Future Research**

This study was subject to the following limitations:

1. The study was limited to biology students at one community college. The sample may not be representative of all face-to-face and online students across all disciplines in community colleges.

2. The study used four biology courses. Three of the courses are specific for the allied health and the nursing field. The results may limit generalizability, even within the institution.
3. The learning outcomes and textbooks for both face-to-face and online courses are the same; it is assumed that the students are exposed to the same material during the course even if they receive different tests.

4. The study employed only quantitative methods of analysis over student data. Mixed research connected with student interviews, or other qualitative data, to discuss reasons for withdrawal or reasons for failing a course might provide different results. Retention rate is difficult to measure, so follow up surveys and information to understand attrition numbers is important for colleges (Doyle, 2003; Simpson & Kogan, 2003). Also, student perception of instructor influence is extremely important. Instructors age, gender, personality and immediacy influences student’s success, as much as a student’s age, gender and personality (Sprinkle, 2008; Zhang, 2004).

5. There may not be common grading standards across courses at the school. Grades in the courses are awarded for individual merit and a low fail or withdrawal rate suggests that students are achieving an acceptable level of competency. However, academic environment, course curricula influenced by teacher preference, and pedagogical techniques used by the instructor can also affect student success. All of these are factors were not controlled or accounted for in the study. The only consistency among grades in the same face-to-face and online class was the final. The final is worth 25% of the grade, but is written by individual teachers. While it is the only clear, consistent grading strategy between all sections, there are no mandatory, standard questions that address the students’ knowledge on course objectives to help address student’s competency when exiting the course. Clear grading strategies, post-tests or questions on the final that are the same in all sections, can help identify that all
students are exiting a course with a similar level of knowledge. Students advancing to higher level courses may actually enter the courses at different levels based on their previous, prerequisite experience and their teacher.

The review of literature revealed that many factors lead to student success in the community college environment, face-to-face and online. This particular study was limited by different factors that do not have to be restraints. This study can be built upon in the future by comparing all three course formats, face-to-face, online and hybrid (blended) courses. In previous research, grade performance in all three types of teaching platforms is not significantly different (Schachar, 2008; Shachar & Neumann, 2003). Students are still responsible for their assignments and mastering their learning outcomes (Shachar & Neumann, 2003). In the future, hybrid course formats should be included when comparing student outcomes based on instructional delivery and instructor at a community college.

When conducting future studies, all campuses should be included in the study. This would expand the study to include a wider demographic, and increase the sample size. This would increase the number of teachers included in the study. To develop the soundness of the study, increasing the study to community colleges throughout the state or throughout the region would help the results be generalized throughout the entire southern region, if not community colleges throughout the nation. The inclusion of more general education transferable biology courses would help make the results more widely applicable. Courses such as General Biology II, Microbiology, Evolution, and Genetics could be used in future studies. Non-major courses such as Introductory Biology I and Introductory Biology II could also be used.

Colleges cannot assume that student’s have the ability, the necessary skills, and financial means to be successful in a face-to-face and online environment. The college needs to provide
access and support to students so they have the best possible chance to successfully complete a face-to-face or online course (Muse, 2003; Pillay et al., 2006). Having a more robust student counseling office can help students make better academic choices. Somehow, when students enroll in online courses, they need to be aware that cell phones are the less-than-ideal access to the Internet (Rooks, 2012). While online education sounds beneficial and seems to promote opportunities to all, if the students do not have the proper tools (i.e. computers and a stable Internet connection) then despite the intentions of the courses, the students may be hurting themselves financially and academically.

Potential solutions to increase academic performance for entry level science courses would be to create a biology preparatory workshop that would help prepare students for science classes. Topics covered would include computer usage, time-management, study skills, and entry level laboratory and math skills. In a study performed by Abdullahi and Gannon (2012), they conducted a two-week pre-anatomy and physiology workshop to help increase student success in anatomy and physiology. They conducted pre and post-surveys and tests to assess knowledge and feelings of the participants. The preliminary results showed that the participants had a higher passing rate in both HAPI (51% versus 36%) and HAP II (85% versus 48%) of the students that participated in the workshop and a lower withdrawal rate. Students were able to voice concerns about concepts that they find difficult, and teachers were able to use this information to develop depth coverage of material in the HAPI curriculum.

Other options to help increase retention in entry level science courses would be to invest in a robust student resource tutor laboratory where students could work with tutors and other students to help increase their knowledge and their confidence (Ryan & Pintrich, 1997). As seen in the current study, academic performance increased and drop rates decreased as students
moved through the course sequences. The students become more proficient as they learned the required information to move on. If the students are better prepared and come into pre-requisites with more pre-knowledge, this may have a positive effect on performance in class, help avoid feelings of discomfort, and increase participation in class and decrease attrition rate (Coates et al., 2004; Durden & Ellis, 1995; Velez & Cano, 2008). Another option to address student online performance would be to create an online readiness module. Before students enroll in an online science course, they would need to demonstrate proficiency in computer usage by completing an online computer orientation component; the school has a responsibility to the student to allow them the best opportunity to thrive.

In general, the online mean GPA and retention numbers were lower for all classes than the face-to-face courses. Baily (2011) did a study on the role of class difficulty in cumulative grade point averages. The study predicted that GPAs are a good predictor when using grades as a measure of ability. The higher and lower the GPAs, the harder the classes seem. The study suggests that when students entering the class have a CGPA around a 2.0, the class difficulty and the attrition rate is a better predictor than the GPA will be of the grade. Literature does support CGPA in college being a good predictor of success in course work (Hawley-Oliver, 1985), but the definition of CGPA is not clearly defined throughout literature, so consistency may not be seen across studies. Some studies may consider their CGPA to be based on specific coursework for a program, such as science GPA. Previous CGPA can be affected by the time since previous coursework was completed. A study conducted by Goodyear and Lampe (2004) concluded that grades earned five year prior to a course being taken were not a reliable indicator of a student’s success in the current course. Unrelated coursework does not always correlate well with positive program outcomes (Goodyear and Lampe, 2004). A study conducted by Peddicord-Whitley and
Chadwich (1986) determined that there was a strong correlation between baccalaureate nursing students success on a graduate board examination and CGPA; however, they found that the same students prerequisite science GPA was a better predictor, showing a stronger correlation.

Alzahrani, Thomson, Bauman and Shuman (2005) reviewed prerequisites (microbiology, anatomy, and physiology) and the courses by themselves did not show significance but when combined as one variable of GPA became of good predictor of success in programs. Alzahrani et al. also found that students who repeat courses to receive higher scores or to receive a passing grade were not a significant predictor of success on examinations. While CGPA was a great predictor for all courses in the current study, it may reflect coursework that is not associated with allied health and nursing programs. Time that previous courses were taken was also not considered in the CGPA prior to the course being reviewed in the study. In the sciences, GPA is generally a good predictor of success, but since the health sciences demand application in the field and have laboratory components, a science GPA should be looked at in future studies (Hawley-Oliver, 1985).

Conclusion

With a large percentage of two-year colleges and a large number of non-traditional student enrolled moving into allied health and nursing programs, the schools are relying on different means to educate the population. Since science coursework is a part of every health profession curriculum, the success of the students in these prerequisite courses into their programs, or transferability into four-year programs, is essential for the college to understand. To benefit both the program and the student, the school, administration, faculty and students, need to best identify the predictors most reflective of student success, while keeping in mind the initial cost, and type of course, face-to-face or online. The information in this study can assist the school, administration, faculty, and the
students of the characteristics (grades, instructors, withdrawal rates, experience) that are needed for all of them to be successful.

As advances in the medical industries grow, the need to educate students continues to grow. Schools require significant investments in resources from classroom space, equipment, technology, and training of the individuals in the teaching roles so colleges must make the best use of their resources, and will want to see the maximum amount of capable students graduate and be accepted to their program or four-year college.

The inclusion of online biology courses has been beneficial to the students in the study. Overall grades were lower with online courses, but students were still able to succeed and move forward through their course sequences. Institution wide investment in online preparedness (computer usage, up to date technology, student online competency, and teacher development) would help close the gap between face-to-face and online mean student performance.

Online courses are here to stay (Allen & Seaman, 2010) and with an investment in these courses the student will be able to fulfill their educational goals regardless of course delivery type.
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<th>Total enrollment in college</th>
<th>Enrollment in Distance Courses</th>
<th>Percentage of enrollment</th>
<th>Distance Courses offered</th>
<th>Number of Classes</th>
<th>Avg. class size</th>
<th>Course Completion Rate</th>
<th>Success Rate</th>
</tr>
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<td>Multiple online courses</td>
<td>Distance course only</td>
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<td>Summer 2011</td>
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<td>2,370</td>
<td>3,404</td>
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<td>14.9%</td>
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<td>176</td>
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Table 3.4

Demographic Makeup of Population in Study Compared to the Main Campus which the Study was Conducted

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<tr>
<th>Variable</th>
<th>General Biology I</th>
<th>Microbiology</th>
<th>Human A &amp; P I</th>
<th>Human A &amp; P II</th>
<th>Main Campus</th>
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<td>n</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Ethnicity</td>
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<td>white</td>
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<td>39.21%</td>
<td>512</td>
<td>46.46%</td>
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<td>Latino</td>
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<td>643</td>
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<td>405</td>
<td>36.75%</td>
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<td>3.55%</td>
<td>46</td>
<td>4.17%</td>
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<td>other</td>
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<td>7</td>
<td>0.64%</td>
<td>12</td>
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<td>unknown</td>
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<td>7.38%</td>
<td>74</td>
<td>6.72%</td>
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<td>Age</td>
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<td>17</td>
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<td>18-19</td>
<td>122</td>
<td>8.50%</td>
<td>16</td>
<td>1.45%</td>
<td>63</td>
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<tr>
<td>Age Group</td>
<td>Total</td>
<td>Rate</td>
<td>Ethnicity</td>
<td>Total</td>
<td>Rate</td>
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<td>-------</td>
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</tr>
<tr>
<td>20-21</td>
<td>366</td>
<td>25.49%</td>
<td>144</td>
<td>13.07%</td>
<td>430</td>
</tr>
<tr>
<td>22-23</td>
<td>327</td>
<td>22.77%</td>
<td>255</td>
<td>23.14%</td>
<td>596</td>
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<tr>
<td>24-29</td>
<td>292</td>
<td>20.33%</td>
<td>279</td>
<td>25.32%</td>
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</tr>
<tr>
<td>30-34</td>
<td>153</td>
<td>10.65%</td>
<td>171</td>
<td>15.52%</td>
<td>268</td>
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<tr>
<td>35-39</td>
<td>81</td>
<td>5.64%</td>
<td>119</td>
<td>10.80%</td>
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<tr>
<td>40-49</td>
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<td>5.08%</td>
<td>100</td>
<td>9.07%</td>
<td>148</td>
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<tr>
<td>50-64</td>
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<td>1.11%</td>
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*Note. A & P is Anatomy and Physiology. Ethnicity and age groupings were modeled after the college.*
Table 3.5  
Student Majors within Each Course over the Span of the Study

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<tr>
<th>Major</th>
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<td>n</td>
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<td>n</td>
<td>%</td>
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<tr>
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<td>2</td>
<td>0.14%</td>
<td>1</td>
<td>0.09%</td>
</tr>
<tr>
<td>Accounting</td>
<td>15</td>
<td>1.04%</td>
<td>4</td>
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</tr>
<tr>
<td>Administrative Office Technology</td>
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<td>0.07%</td>
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</tr>
<tr>
<td>American Sign Language Studies</td>
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<td>0.07%</td>
<td>1</td>
<td>0.09%</td>
</tr>
<tr>
<td>XX Transfer Associate of Science</td>
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<td>0.28%</td>
<td></td>
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</tr>
<tr>
<td>Business Administration</td>
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<td>2.51%</td>
<td>7</td>
<td>0.64%</td>
</tr>
<tr>
<td>Business Management</td>
<td>9</td>
<td>0.63%</td>
<td>2</td>
<td>0.18%</td>
</tr>
<tr>
<td>Computer Aided Design and Drafting</td>
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</tr>
<tr>
<td>Care and Development of young Children</td>
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<td>0.97%</td>
<td>1</td>
<td>0.09%</td>
</tr>
<tr>
<td>Computer Information Technology</td>
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<td>0.28%</td>
<td>1</td>
<td>0.09%</td>
</tr>
<tr>
<td>Computer and Electronics Service Technician</td>
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<td>0.09%</td>
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</tr>
<tr>
<td>Computer Network Technology</td>
<td>2</td>
<td>0.14%</td>
<td>1</td>
<td>0.04%</td>
</tr>
<tr>
<td>Criminal Justice</td>
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<td>Construction Technology-Construction Management</td>
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<tr>
<td>Dietetic Technician</td>
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<td>10</td>
<td>0.70%</td>
<td>1</td>
<td>0.09%</td>
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<tr>
<td>Electrical-Electronics Engineering Technology</td>
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</tr>
</tbody>
</table>
Table 3.5, cont.

*Student Majors within Each Course over the Span of the Study*

<table>
<thead>
<tr>
<th>Major</th>
<th>GenBioI</th>
<th>Micro</th>
<th>HAPI</th>
<th>HAPII</th>
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<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Emergency Medical Technician - Basic (TCA)</td>
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</tr>
<tr>
<td>Emergency Medical Technician - Paramedic</td>
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<td>2</td>
<td>0.18%</td>
</tr>
<tr>
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<tr>
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<td>0.04%</td>
</tr>
<tr>
<td>Computer and Electronics Service Technician</td>
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<tr>
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<td>3</td>
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<td></td>
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<td>5</td>
<td>0.22%</td>
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<tr>
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<td>1</td>
<td>0.05%</td>
<td></td>
</tr>
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<td>Fire Science Technology</td>
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<tr>
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<td>1.32%</td>
<td>4</td>
<td>0.36%</td>
</tr>
<tr>
<td></td>
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<td>9</td>
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<td></td>
</tr>
<tr>
<td>Hospitality Management</td>
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<td>0.07%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interior Design</td>
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<td>0.28%</td>
<td>1</td>
<td>0.04%</td>
</tr>
<tr>
<td>Legal Secretary</td>
<td>1</td>
<td>0.07%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical Coding</td>
<td>3</td>
<td>0.21%</td>
<td>3</td>
<td>0.27%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>0.27%</td>
<td>7</td>
</tr>
<tr>
<td>Medical Laboratory Technician</td>
<td>5</td>
<td>0.35%</td>
<td>10</td>
<td>0.91%</td>
</tr>
<tr>
<td></td>
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<td>14</td>
<td>0.63%</td>
<td>7</td>
</tr>
<tr>
<td>Management</td>
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<td>0.04%</td>
</tr>
<tr>
<td>Massage Therapy</td>
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<td>0.49%</td>
<td>14</td>
<td>0.63%</td>
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<tr>
<td></td>
<td></td>
<td>5</td>
<td>0.27%</td>
<td></td>
</tr>
<tr>
<td>Music</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear Medicine Technology</td>
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<td>0.35%</td>
<td>3</td>
<td>0.27%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
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<td>11</td>
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</table>

| Total | 115 |


Table 3.5, cont.

Student Majors within Each Course over the Span of the Study

<table>
<thead>
<tr>
<th>Major</th>
<th>GenBioI</th>
<th>Micro</th>
<th>HAPI</th>
<th>HAPII</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Nursing</td>
<td>606</td>
<td>42.17%</td>
<td>773</td>
<td>70.15%</td>
</tr>
<tr>
<td>Ophthalmic Medical Assistant</td>
<td>2</td>
<td>0.14%</td>
<td>1</td>
<td>0.04%</td>
</tr>
<tr>
<td>Pastry Arts - Technical Studies Certificate</td>
<td>1</td>
<td>0.04%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Care Technology</td>
<td>1</td>
<td>0.04%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance and Media Arts</td>
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<td>0.90%</td>
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<td>0.09%</td>
</tr>
<tr>
<td>Pharmacy Technician</td>
<td>11</td>
<td>0.77%</td>
<td>2</td>
<td>0.18%</td>
</tr>
<tr>
<td>Practical Nursing</td>
<td>4</td>
<td>0.28%</td>
<td>14</td>
<td>1.27%</td>
</tr>
<tr>
<td>Physical Therapy Assistant</td>
<td>61</td>
<td>4.24%</td>
<td>6</td>
<td>0.54%</td>
</tr>
<tr>
<td>Radiologic Technology</td>
<td>192</td>
<td>13.36%</td>
<td>45</td>
<td>4.08%</td>
</tr>
<tr>
<td>Radiation Therapy</td>
<td>6</td>
<td>0.42%</td>
<td>2</td>
<td>0.18%</td>
</tr>
<tr>
<td>Respiratory Therapist</td>
<td>16</td>
<td>1.11%</td>
<td>33</td>
<td>2.99%</td>
</tr>
<tr>
<td>Surgical Technology</td>
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<td>0.28%</td>
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<tr>
<td>Teaching</td>
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<td>1</td>
<td>0.09%</td>
</tr>
<tr>
<td>Veterinary Technology</td>
<td>25</td>
<td>1.74%</td>
<td>1</td>
<td>0.09%</td>
</tr>
<tr>
<td>Visual Communications-Graphic Design</td>
<td>4</td>
<td>0.28%</td>
<td>1</td>
<td>0.04%</td>
</tr>
</tbody>
</table>

Note. Gen Bio I is General Biology I and HAP is Human Anatomy and Physiology.
September 20, 2011

Dear Professors,

I am a graduate student under the direction of Professor Richard B. Speaker in the College of Education and Human Development at the University of New Orleans. I am conducting a research study to review the biology grades based on instructional delivery and instructor at community colleges in biology face-to-face and online courses.

I am requesting your participation, which will involve a 15-question survey to be completed through www.surveymonkey.com. The survey will take you approximately 20 minutes to complete. You have been chosen to participate because you have taught both online and face-to-face sections of specific biology courses between spring 2006 and summer 2011. Once the survey is complete your name will be coded and your identity deleted. Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty. The results of the research study may be published, but your name will not be used.

If you have any questions concerning the research study, please call me (504) 671-6470 or you may contact Dr. Ann O’Halen at 504-280-3990 at the University of New Orleans for answers to questions about research, your rights as a human subject and your concerns regarding a research-related injury.

Completion of the questionnaire will be considered your consent to participate.

Sincerely,

Amanda Rosenzweig
Associate Professor of Biology
Delgado Community College
615 City Park Avenue
New Orleans, LA 70119
CP 01, room 201w
arosen@dcc.edu
504-671-6470
1.

1. Please answer the following information.

Name: 
Email Address: 
Phone Number: 

2. How long have you taught or did you teach at Delgado Community College?

- [ ] 1 year
- [ ] 2 years
- [ ] 3 years
- [ ] 4 years
- [ ] 5 years
- [ ] 6 years
- [ ] 7 years
- [ ] 8 years
- [ ] 9 years
- [ ] 10 or more years
3. Please choose all the courses you have taught or currently teach online and face-to-face. The courses are denoted by OL for ONLINE or F2F for Face-to-Face.

- Biol 101 F2F
- Biol 101 OL
- Biol 141 F2F
- Biol 141 OL
- Biol 142 F2F
- Biol 142 OL
- Biol 161 F2F
- Biol 161 OL
- Biol 210 F2F
- Biol 210 OL
- Biol 211 F2F
- Biol 211 OL
- Biol 251 F2F
- Biol 251 OL
- Biol 252 F2F
- Biol 252 OL

*4. Do you (or have you used) currently use Blackboard (course management system) in your face-to-face courses?

- Yes
- No
2.

* 1. If you answered no to Blackboard use, why do you not use Blackboard?

- I did not know that they were available
- I have not received adequate training
- Course management system are too time consuming to use
- I have no teaching or pedagogical reason to use a course management system
- I am concerned that the course management system is unreliable
- I think that the tools within the course management system are not powerful or good enough for my needs

Other (please specify)

3.

* 1. How long have you been using Blackboard?

- Not at all
- 1 semester or less
- 2 semesters
- One year
- 2 years
- 3 years
- Longer than 3 years
1. How would you describe your expertise or skill in using Blackboard?
   - Beginning
   - Intermediate
   - Expert

2. How do you use Blackboard? (Check all that apply)
   - to enhance face-to-face courses
   - to teach hybrid
   - to teach online
   - Other (please specify)

3. What factor(s) is most important in persuading or prompting you to use Blackboard? (Check all that apply)
   - Recommendation from peers
   - Departmental chair asking you to use it
   - Learned about it through training
   - Because of specific teaching or pedagogical problem
   - Student requests
   - Other (please specify)
4. What features of Blackboard do you use in a face-to-face class? (Check all that apply)

- [ ] Announcements
- [ ] Syllabus or course info
- [ ] Course documents or course content
- [ ] Quizzes or assessments
- [ ] Gradebook
- [ ] Discussion area
- [ ] Email broadcast
- [ ] Elluminate
- [ ] Digital dropbox
- [ ] Calendar
- [ ] Tegrity

Other (please specify)

5. Rate the usefulness of the following features in Blackboard specific to your face-to-face course.

<table>
<thead>
<tr>
<th>Feature</th>
<th>1 (Very Important)</th>
<th>2 (Important)</th>
<th>3 (Moderately Important)</th>
<th>4 (Of Little Importance)</th>
<th>5 (Unimportant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Announcements</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Syllabus or course info</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Course documents or course content</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Quizzes or assessments</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Gradebook</td>
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<td>Discussion area</td>
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<td>Email broadcast</td>
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<tr>
<td>Other (please specify)</td>
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<td>☐</td>
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<td>☐</td>
</tr>
</tbody>
</table>
*6. Compared to when you first started using Blackboard are you making greater use of it in your face-to-face courses?

- I am using it more
- I am using it less
- My usage has remained the same

7. If you have increased the use of Blackboard in your face-to-face class, what factors persuaded you to increase your use of Blackboard in your class. (Check all that apply)

- You began to see increased uses for it in your teaching
- Your level of comfort with the technology increased and so you began to use it in new ways
- Students requested that you use it more
- Your departmental chair requested that you use a course management system more frequently or extensively
- You received more training on the product
- More features were added or became available within course management systems and so they became a more useful tool

Other (please specify)

8. Why do you choose to use Blackboard in the teaching of your face-to-face classes? (check all that apply)

- To increase contact with your students
- To increase time on task with your students
- To supplement lecture material
- To increase student contact and cooperation
- To provide more interactivity between students and the teaching materials
- To provided more prompt feedback to your students
- To provide more transparency for your students (i.e. so that your students can more easily see how the course is working and how they are progressing through it.)

Other (please specify)
9. What do you see as being the major advantage of using Blackboard in face-to-face courses?

- It organizes your course material
- It provides course security
- It provides additional course material to students
- It provide a convenient online assessment environment
- It provides a convenient gradebook
- It facilitates greater contact with students

Other (please specify)


*10. Do you think the use of Blackboard in your face-to-face class has increased the amount of contact you have with your students?

- Yes (increased)
- No (decreased)
- Had no effect on student faculty contact

*11. How much work would you estimate you assign to face-to-face students through Blackboard?

- 0-20%
- 21-40%
- 41-60%
- 61-80%
- 81-100%
Amanda Rosenzweig is an Associate Professor of Biology at a community college in New Orleans, Louisiana. Dr. Rosenzweig has been teaching at the college level for 12 years. Originally from Monroe, Louisiana, Dr. Rosenzweig earned her bachelor’s in biology at a university in Missouri before returning back to Monroe to earn her masters of biology. Dr. Rosenzweig’s interests include e-learning, student success, active learning, metacognition, and learning styles. Dr. Rosenzweig enjoys spending time with friends, family and volunteering for different animal charities.