A Comparative Analysis of Student Achievement & Retention in Traditional and Online First Semester Anatomy & Physiology Courses

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A COMPARATIVE ANALYSIS OF STUDENT ACHIEVEMENT & RETENTION IN TRADITIONAL AND ONLINE FIRST SEMESTER ANATOMY & PHYSIOLOGY COURSES

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The Faculty of the Educational Leadership Doctoral Program
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Doctor of Education

By
Geralyn M. Caplan

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A COMPARATIVE ANALYSIS OF STUDENT ACHIEVEMENT & RETENTION IN TRADITIONAL AND ONLINE FIRST SEMESTER ANATOMY & PHYSIOLOGY COURSES

Date Recommended 10/26/15
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Dean, Graduate School Date 11/24/15
DEDICATION

In my Master’s thesis I quoted the Beatles “You get by with a little help from your friends” in memory of friends that I had and those that I had lost. Now that I am older I realize that the Beatles limited their vision. You get by with a great deal of help from your friends and family.

I would not be who I am without the unconditional love of my parents, siblings, husband, and children. Since I wrote that thesis other friends and family have left way too soon. Too many people have taken a piece of my soul as they have left this earth which is only fair since they were my heart while they were here.

So I dedicate this to those family members that have left, Mom, Dad, Gram, and the friends that I have lost along the way particularly Peggy and Terri, I still miss you both. I also dedicate this to my husband and children who have put up with way too much.
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There is a bias that online lab science courses are inferior to their campus counterparts. Even so there is an increasing demand for online courses by the student body. The purpose of this quantitative study was to determine whether anatomy and physiology I could be taught online without affecting academic rigor through a comparison of the successful completion of student learning outcomes, as well as to learn more about the students who take A&P. The study sought to identify the causes or relationships that exist between online and face-to-face presentation of A&PI. It also considered retention related to the independent variables of online or face-to-face presentation.

There was no significant difference in the assessment scores between the online and face-to-face sections of A&PI. When the assessment was broken down into lab delivery method the students who used a lab kit scored the same as those on campus; students who used virtual labs scored lower but not significantly so.

Additionally the survey indicated that online students tended to be older and that older students score higher on the assessment. Online students also have more commitments outside of the classroom in terms of children at home and hours worked outside the home. Online students were more than twice as likely to work in the medical field. In terms of academic background and preparation there were very few differences between the online and face-to-face student in terms of remedial course work, college
GPA, ACT scores, and course load, although the online students have almost twice as many credit hours then the face-to-face students. There were also differences in the reasons the students choose a particular course format. The online students scored higher in all student satisfaction measures. There were no differences in attrition in between online and face-to-face sections although at one-third of the students it was very high.

This study can help to focus the debate on proper advising of students. Although online may not be the best learning platform for all students, that does not mean that it is not an effective means of teaching laboratory science.
CHAPTER I: INTRODUCTION

Introduction

Distance learning programs are intended to serve those students who cannot easily attend face-to-face programs on campus. The term “distance education” incorporates all off-campus programs and media offered by the institution. Online education is a subset of distance education, which allows the instructor to access a wide variety of web multimedia and resources, along with an ever expanding range of technological advances with which to teach a course. The need to reach more students, combined with evolving technology, has opened the door to increased online curricula.

Various disciplines need to overcome their own unique challenges when moving courses from the traditional face-to-face environment to an online environment. A number of pedagogical issues become apparent when developing and delivering an online laboratory course (Gallagher, Dobrosielski-Vergona, Wingard, & Williams, 2005; Murray, Pérez, Geist, & Hedrick, 2012). Due to their interactive nature and the need for costly equipment, lab courses are particularly difficult to move to an online environment. Technology has advanced to the point that lab courses can now be offered with a virtual component, or through lab kits that students purchase along with a textbook. Nonetheless, resistance continues on the part of science faculty to accept these courses (Simsek, 2013). The perception remains that online courses are less rigorous than face-to-face courses. Allen and Seaman (2014) stated that “less than one-third of academic leaders believe that there will no longer be concerns about the relative quality of online courses” (p. 5).
Students and faculty have expressed the belief that taking anatomy and physiology (A&P) in the traditional format is more appropriate for students; and student learning is less effective in an online environment, although no data support this position. Many schools and faculty members have voiced reluctance to transfer A&P courses to full online delivery due to their importance as the foundation for allied health programs, and the extensive lab or practical component that is critical to adequately cover the content (Scott, 2009). One of the common concerns voiced by faculty involves the ability of students to achieve learning objectives in an online format; however, the demand for online A&P courses is increasing (Allen & Seaman, 2011; Simsek, 2013). On a larger scale this bias is observed in the reluctance of schools to accept online lab courses for transfer credit. This bias exists despite of the lack of a rigorous analysis of the factors that hinder, or promote, success in a lab science class, such as anatomy and physiology, in either the online or traditional format. Are these criticisms accurate, or is student achievement indistinguishable between online and traditional A&P classes? This critical question needs an answer before colleges dramatically invest in the number of allied health students taking online A&P.

While a number of studies have compared the outcomes of online and traditional courses, a dearth of studies have compared science lab courses, but even less information was found on A&P courses. Additionally, many of the current general studies fail to focus on the student learning outcomes in more than one lesson plan (Bhatti et al., 2009; Daymont & Blau, 2008; Dutton, Dutton, & Perry, 2002; Emerson & MacKay, 2011; Gallagher et al., 2005; Garmen, 2012). Rather, many of the studies have compared a particular project or the overall grades between the courses.
Purpose of the Study

This study sought to determine the extent of differences in student educational outcomes in A&P classes taken online and face-to-face, using a sample of students from the Kentucky Community and Technical College System (KCTCS) who took the first semester of the two-semester A&P extended course. The purpose of this quantitative study was to determine whether A&PI could be taught online without affecting academic rigor, through a comparison of the successful completion of student learning outcomes, as well as to learn more about the students who take A&P. The study sought to identify the causes or relationships that exist between online and face-to-face presentation of A&PI. It also considered retention related to the independent variables of online or face-to-face presentation.

This study examined the ability of students in online A&P classes to successfully complete the assigned learning outcomes and compared the results with students in a traditional classroom. Furthermore, this study sought to differentiate selected demographic and academic factors between the two groups. Demographic factors such as age, gender, family responsibilities, childcare, and job commitments are important issues that can impact student success. Further academic features, such as major, grade point average (GPA), American College Testing (ACT) score, prerequisite courses in English and math, expected grade, and plans for continuing to the second semester, can impact retention; and these factors should be considered with other demographics of student success in an online science course. Moreover, the study investigated questions concerning the reasons students take a specific course format and various student
satisfaction factors. Finally the study examined the retention rates of students in face-to-face and online A&P courses.

**Need/Significance of the Study**

The academic landscape is changing and online instruction is increasing in popularity. Clark (1983, 2001) argued that no learning benefits are derived from the employment of a specific medium or format; rather he referred to the medium as a “mere vehicle” for presenting content. Clark concentrated on the content, pedagogy, and instructional strategies. Clark focused on television, which is not interactive, whereas online content can be interactive; in fact, online instruction can be much more interactive than the traditional lecture format. As the medium has changed, a reexamination of the relationship between presentation medium and learning is overdue. In many cases, separating the strategy from the media may be difficult.

Computers and associated technologies have been touted for their potentially transformative properties. No one doubts their growing impact in most aspects of human endeavor, and yet strong evidence of their direct impact on the goals of schooling has been illusory and subject to considerable debate. (Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011, p. 5)

This may be particularly problematic in difficult courses and those that contain a lab requirement.

A&P is a cornerstone for allied health professions; as such, it is a critical factor in the success of many students in two-year community colleges. In describing the important nature of A&P to allied health students, Green et al., (2006) stated that allied health students “are required to attain a broad knowledge of this topic prior to
qualification” (p. 388). In community colleges, A&P is essential to many of the allied health programs including nursing, radiography, surgical technology, physical therapy assistant, occupational therapy assistant, and dental hygiene. All of these fields are representative of the fastest growing job markets in the current economy (Torpey, 2014). These programs require the two-semester human A&P courses. The two-semester course of A&P covers the interrelationship between organ structure and histology (anatomy) and function (physiology) of each body system.

A&P and other lab courses are difficult to convert to an online program format; thus, faculty are less likely to be enthusiastic about developing online lab courses. Colleges are focused on maintaining the instructional quality and meeting learning outcomes regardless of the format in which the student is enrolled. The effect of classroom format on the performance of student learning outcomes in a lab science course, such as anatomy and physiology, is unknown. Additionally, a deficiency exists in the literature concerning the application of Tinto’s (1975) Student Integration Model to retention in online science lab programs. Various demographic factors have been considered in the literature, but they have not been applied to student success in an online science course. A plethora of studies have discussed student success in other fields, but a serious lack of studies have addressed student success in traditional on-campus versus online science lab courses. Few have addressed A&P courses, and none of those focused on specific student learning outcomes. When combined, these factors indicate a void in the literature concerning student success in online lab courses.

This lack of information suggests that many in academics continue to be reluctant to endorse online science courses or to accept online lab courses as transfer credits. This
is a critical lapse, as human anatomy and physiology serves as the core science course for most allied health programs. It is vital for program directors to assess the quality of the A&P courses. This study addressed the existing gap in the research and will allow other A&P instructors to develop an assessment to meet the program coordinator’s needs.

Accreditation bodies are increasingly utilizing assessments based on specific student learning outcomes, although many studies that compared traditional and online teaching format did not focus on the cumulative learning outcomes. This study fills that breach by developing a simple assessment carefully tied to individual learning outcomes that have been established by a governing body. Similar assessments can be developed to compare other courses that meet the needs of teachers and administrators who are developing online programs.

**Background of the Study**

Enrollment in community colleges overall has dropped 4% from fall 2011 to fall 2013, and the general enrollment most likely will continue to drop. When considering the population of only non-traditional students, those over the age of 24, the drop in enrollment was 6% (Juszkiewicz, 2014). With the overall decrease in enrollment, the number of students taking online courses has continued to double from 23% to 45% from 2008 to 2013; (Allen & Seaman, 2013; Bolken, 2013; Juszkiewicz, 2014). As of 2010, that translated into approximately 6.1 million students taking at least one online class (Lloyd, Byrne, & McCoy, 2012). These numbers indicate a pool of students that colleges need to reach. Allen and Seaman (2011) reported that more than 65% of administrators in two- and four-year colleges claimed online learning was a critical component of their long-term strategy.
Online programs target students with family and career responsibilities that cause difficulty, and often make it impossible for them to take traditional classes. Online classes are particularly convenient for non-traditional students. Those who are unable to attend classes due to jobs and families can have access to higher education through online platforms. Distance learning offers these students flexibility, which is critical for those with outside commitments, as a strict schedule of classes is unworkable (Lee & Choi, 2011). Online classes allow for flexibility and for students to work at their own rate. Dutton et al. (2002) found that convenience and flexibility were major factors in determining whether students choose online formats, whereas on-campus students felt face-to-face contact with the instructor and other students was critical in choosing the traditional course format. Dutton et al. also indicated that students choose the format of the course based on advice from their advisors. A problem may result if advisors make these recommendations without sufficient understanding of the best mode of presentation for an individual.

Distance learning is not new; courses historically have been offered through the mail, radio, television, and on video (Phipps & Merisotis, 1999; Sumner, 2000). With the advent of learning platforms such as BlackBoard and Moodle, distance learning has developed into a multimillion dollar industry. For-profit schools have been successful in using online learning platforms for a variety of subjects (Allen & Seaman, 2011). Their success has been such that a push has been observed from traditional colleges and universities to continue to offer more classes through virtual programs in order to compete for students.
Online students are not limited to one campus; they can take classes from multiple schools simultaneously. They represent an open pool of consumers who can be recruited by any school. With the surge in demand for distance education in recent years, postsecondary schools are developing increasingly diverse online curricula to meet the need. Lloyd et al. (2012) reported that 96% of colleges and universities offer online courses.

Many in academia continue to be hesitant to embrace online curricula (Kolowich, 2012). Science faculty have been particularly reluctant to embrace online programs rather than traditional laboratory courses (Lee & Choi, 2011; Scott, 2009). They are not alone. According to a survey of college administrators, more than one third of the respondents felt that online courses were inferior to traditional on-campus courses (Allen & Seaman, 2011). Many indicated that students need more discipline to succeed in online programs. Stewart, Bachman, and Johnson (2010) discovered a strong perception that online programs are inferior to traditional face-to-face programs. Kolowich (2012) reported that faculty are pessimistic about online learning and found that nearly two thirds felt that learn less in an online class than in a traditional on-campus class. Lloyd et al. (2012) identified four perceived barriers among faculty who were averse to teaching online classes: interpersonal, institutional, cost/benefit, and training and technology.

Moving lab courses to an online delivery format can be difficult. A major obstacle involves the bias between hands-on labs taught in a lab setting and simulated labs or lab kits (Corter, Nickerson, Esche, & Chassapis, 2004; Lee & Choi, 2011; Ma & Nickerson, 2006). Several options are available for teaching labs online. Virtual or simulated labs imitate experiments, but they do not allow for the students to develop
technical skills. A difference exists relative to viewing a tissue image on a virtual lab and setting up and focusing on the tissue in an on-campus face-to-face lab. A discontent occurs between the lab experience and the results. Another option similar to a virtual lab is a remote lab which students gather real-time data through the internet. Again, a disconnect occurs between gathering the data and experiencing the way in which the data is developed. A face-to-face lab allows the student to work with models, microscopes, and other equipment. Instructors are available to them work with the equipment. Ma and Nickerson (2006) and Corter et al. (2004) referred to face-to-face labs as “hands on labs.” This study did not use that terminology, as another option is available that neither paper addressed. Labs also can be developed using kits, which can be purchased through companies such as eScience© and Hands on Labs©, which allows the students to perform labs at home. The disadvantages of these kits include the cost and the concern that some material, i.e., preserved animals and microbes, should remain in the lab.

Many factors force students into online education and can result in attrition from those courses. Students have indicated that flexibility is an important factor in choosing an online class (Lee & Choi 2011). They seek flexibility as they have other commitments that make it difficult to attend school on campus and may prevent them from succeeding academically. Tinto and Cullen (1973) and Tinto (1975, 1997) suggested that the key to retention is academic success and a sense of belonging. In community colleges, other supplementary factors are involved. Students who attend community colleges tend to be classified as non-traditional, indicating that they are older and more likely to have outside responsibilities.
Bean (1980) extended Tinto’s model to include other demographic factors. Bean’s model was more extensive and reflective of the typical community college student. The feeling of belonging frequently is lost in the online environment, resulting in other demographic factors such as jobs and family responsibilities pulling on the student. The distance between the student and the instructor, as well as between the students with in the course leaves online students without the social safety net that on-campus students enjoy. The result is that attrition can be high; however, students in lab courses have more deadlines and a greater opportunity to physically interact with the material, which when combined may alter attrition.

**Conceptual Framework**

This study was guided by a solid conceptual framework through the analysis of a variety of educational and learning theories that focused on the effect of the medium on the processing of information. Clark (1983, 1994) referred to media as a “mere vehicle” for delivering content and he claimed that the delivery method did not impact learning. Many others disagreed with Clark’s theory. Kozma (1991) equated the medium to techniques that take advantage of students’ capabilities to enhance the way in which learners process information. The two theories are diametrically opposed to one another, and this study falls between the two. Many questions that have been asked about online teaching relate to the impact of the media on learning. The core of this study is centered on the question: Does the media impact learning?

Several learning theories also formed a framework for this research. Dewey (1916, 1938) concentrated on learner involvement, now referred to as “active learning.” Dewey’s progressivism model targeted the communication, collaboration, and interaction
between the learner and the instructor, and focused on experience, which translates into online programs that involve student interaction. This study also was framed by the constructive (constructivism) theory which described learning as being constructed by the individual (Yilmaz, 2008). According to Yilmaz (2008), “Learners are intellectually generative individuals (with the capacity to pose questions, solve problems, and construct theories and knowledge) rather than empty vessels waiting to be filled” (p. 162). Both theories focused on active learning and past experience that translates into online programs involving student interaction. These theories viewed learning as an active process that involves integrating knowledge by extracting information from environment, thus building on stored memory. In an online environment, students must take control of their own education in order to be successful. Online models are designed to take advantage of active learning; the courses in this study are no different.

Additional theories that framed this study focused on the unique demographics of the online student population. Knowles (1978) was a leader in the andragogy movement that emphasized adult learners. A majority of students in community colleges are considered non-traditional, as they are older or are raising families. The self-directed learner model is a critical foundation for distance education. Non-traditional students need alternative learning strategies that allow the flexibility to direct their own education, but also allow them to build on the previous experience. Non-traditional students fit with the self-directed adult learner previously described by Knowles and the constructivism models. (Kenner & Weinerman, 2011; Knowles, 1978; Yelmiz, 2008).

The final question this study sought to examine the retention of students in online and face-to-face courses. The drop/fail rate of online courses tends to be higher than
traditional courses (Angelino, Williams, & Natvig, 2007). A number of theories pertain to student retention. Tinto’s Student Integration Model brought together both Durkheim’s theory of suicide and cost-benefit analysis from economics (Tinto & Cullen, 1973; Tinto, 1975). Tinto and Cullen (1973), and later Tinto (1975), focused on the lack of consistent and rewarding interaction described in the Durkheim suicide model and expanded it to include the interaction in the social domain of the college, and interaction in the academic domain of the college. A student, who has integrated socially, but not academically, may fail. The reverse occurs when a student who is academically successful, but possesses insufficient social integration, decides to withdraw. External factors also come into play in predicting student success.

Tinto and Cullen (1973) and Tinto (1975) did not quite answer all the issues faced by the students in this study. They have more outside pressures than the typical university student described by Tinto (1975). Rather this study fits with the framework of the Bean (1980) and Bean and Metzner (1985) models. Bean and Metzner (1985) examined older non-traditional students, who faced additional external stresses outside the classroom. The authors considered retention as a series of complex behaviors and attitudes that have been shaped by experience. They also considered a student’s academic and social success as affecting student retention but they consider other influences and that which they referred to as external factors. For non-traditional students who tend to gravitate toward online mediums, those external factors can have a critical impact on successfully completing the course. The research questions proposed in this study will in well with the Bean and Metzner model of retention.
Research Questions and Hypotheses

Student success is affected by many factors. This study sought to determine the impact of the mode of presentation (online or traditional on-campus format) on the success of students in the first semester A&P lab course. Success was defined as the ability to satisfactorily complete the student learning outcomes.

The central question was divided into a number of empirical questions that addressed the definition of achievement and that sought to distinguish the core factors that differentiated the sample groups. The study attempted to answer these research questions (RQ). Each RQ was divided into several specific hypotheses that were developed from the literature.

RQ 1: To what extent is student success (measured by student learning outcomes) affected by the course delivery method (online or traditional on-campus format)?

- H₁ There are significant differences in the total assessment scores between online A&P and the face-to-face sections.
- H₂ There are significant differences in the sectional assessment scores between online A&P and the face-to-face sections.
- H₃ There are significant differences in total assessment scores between the virtual lab, lab kit, and on campus labs.

RQ 2: What is the relationship between selected student demographics and presentation format (online or traditional on campus format)?

- H₁ There are significant differences in ages between online and face-to-face groups.
- H₂ Student age impacts successful completion of learning objectives.
• **H₃** There are significant differences in outside commitments between the two groups. Outside commitments consist of:
  - The number of students who were parents.
  - The number of children living in the student’s home.
  - The number of hours the student worked outside the home.
  - Likelihood of working in the medical field.

• **H₄** There are significant differences between the groups’ use of financial aid.

RQ 3: *What is the relationship between selected student academic factors and presentation format (online or traditional on-campus format)?*

• **H₁** There are differences in academic readiness when a student enters college between the two groups of students. College readiness was determined by placement in remedial courses in English, reading, or math based on COMPASS test scores.

• **H₂** There are differences in academic measures such as college GPA, projected grade, ACT scores, current course load, and completed credit hours.

• **H₃** There are differences in the amount of time spent studying between the two groups of students.

RQ 4: *What is the relationship between selected student satisfaction factors and presentation format (online or traditional on-campus format)?*

• **H₁** There are differences in how online and face-to-face students rate flexibility and scheduling conflicts when choosing a course format.

• **H₂** There are differences in how online and face-to-face students rate learning environment in choosing a course format.
• H₃ There are differences in how online and face-to-face students rate social interaction in choosing a course format.

• H₄ There are differences in how online and face-to-face students value advice from faculty and students in choosing a course format.

• H₅ There are differences in how online and face-to-face students perceived that the instructor interacted with them or the class as a whole. These factors were considered communication.

• H₆ There are differences in how online and face-to-face students kept pace with the material. These factors were considered content.

• H₇ There are differences in how online and face-to-face students rated the course overall.

RQ 5: What is the relationship between student retention and modes of presentation (online or traditional on-campus format)?

• H₁ There are differences in persistence, as measured by the intent of returning to take APII in spring of 2015 between the two formats.

• H₂ There are differences in persistence, as measured by the intent of returning to take APII in the same format.

• H₃ There are differences in attrition rate between online and face-to-face courses.
Research Design

The research design described the plans to gather data and the systematic management of the data. The design dictated the way in which the research questions were answered.

Population

The population consisted of students from the Owensboro Community and Technical College (OCTC) and from the greater Kentucky Community and Technical System (KCTCS). KCTCS is comprised of 16 colleges located on more than 70 campuses throughout Kentucky. Courses in the system follow the same carefully crafted competencies and outlines, regardless of the school offering the course. BIO 137 Human Anatomy and Physiology I (A&P I) is the first semester of a two-semester A&P series; it is a four-credit course that includes a lab component which is taught through all schools within KCTCS. The face-to-face the course meets for three hours lecture and two hours lab; the online format is not defined by the same instructional time limit. In the KCTCS schools, BIO 137 courses cover basic chemistry, cell structure, cell physiology, metabolism, tissues, as well as the integumentary, the skeletal, muscular, and nervous systems (see Appendix A). The remaining physiology systems are covered in the second-semester course.

The sample of students was divided into two groups. The first was taken from the population of those taking A&PI in an online format. The second group was taken from the population of students taking A&PI in an on-campus traditional face-to-face format. Both groups took the course through KCTCS during the fall 2014 semester.
A list of all instructors for BIO 137 was developed by reviewing KCTCS’s Peoplesoft © management system. An e-mail and a reminder were sent to all instructors requesting that they forward the link to the survey. The retention data also were developed from Peoplesoft ©.

**Research Variables**

A causal-comparative/quasi-experiment quantitative research design was utilized to compare the independent variable, which was the specific course format, to determine whether the format affects student success as measured by the dependent variables, student learning outcomes, and retention for students who took A&PI through KCTCS.

The independent variable was defined as the variable that generates the dependent variable. The independent variables of class format were defined as online, which referred to classes taught almost exclusively online using BlackBoard as a learning platform, and those taught face-to-face that may have used BlackBoard but primarily met face-to-face for lectures and lab. Additional independent variables, referred to as demographic and academic factors, were self-reported by the students. The student learning outcomes were the dependent variables and were measured through a comprehensive assessment carefully designed to align with the BIO 137 course competencies.

This research study was quantitative in nature. A quantitative study allows for the analysis through objective measurement (Creswell, 2013). Due to the nature of this study, it was difficult to meet all the demands of an experimental research design, e.g. subjects could not be randomly assigned to treatments. Students self-selected into an online or traditional classroom setting based on their personal needs. As a result, the
quantitative study was designed as a *causal-comparative/quasi-experiment*, and the independent variables were not manipulated. The sample was self-selected from the population of students taking A&PI through a KCTCS school. The students will be asked to voluntarily complete an exam that is designed to address each of the learning objectives of the first semester of A&P (see Appendix B). By simplifying these studies to one course, BIO 137 Human Anatomy and Physiology (A&P I) within the KCTCS, and using one assessment administered to all sections, it was possible to determine whether students are successfully mastering specific learning objectives.

**Evaluation Instrument**

A ten-point outline for the semester was developed based on the outline and competencies established by KCTCS for all A&PI courses. All competencies were included under those headings. Many were not divided into specific systems; so those competencies appeared under multiple headings. By the end of the semester, all classes should have covered material from the established outline for A&PI (Appendix A); thus the survey was administered near the end of the semester.

Questions for the cumulative assessment were gathered from third party sources in order to avoid using any that the sample of students might have been familiar. All questions were reflective of A&PI competencies to which students were exposed throughout the semester. A 50-question comprehensive assessment was developed from these sources (Appendix B). Five questions were chosen under each topic in order to prevent overemphasis of any one topic. Additional set of questions was added to address many of the demographics. Those were divided into social, economic, and educational factors, along with a list of preferences developed by Dutton et al., (2002) (Appendix C).
The comprehensive assessment and the demographic survey were administered through Qualtrics. As it was not feasible to contact all students directly, an e-mail was sent to all A&PI instructors within KCTCS. They were asked to forward the link to the Qualtrics survey to their students, who were directed to the survey site to voluntarily take the test. The results were not incorporated into their semester grades, and they were not rewarded or punished for taking the exam. However, they were allowed to use the exam to prepare for their finals.

The first statistical tests focused on the student learning objectives. The 50-question assessment was scored for comparison. The accumulated data were compiled in SAS and an independent samples t-test was used to compare the scores for the assessment. Either a t-test or a chi-square was utilized to analyze the nominal data that involved demographics, academic data, and student satisfaction. An ANOVA also was used to compare the lab format and the assessment scores. Finally, the retention data were compared using an independent samples t-test.

Assumptions, Limitations, and Delimitations

All studies experience limitations and barriers. These challenges to the scientific method can affect or restrict the analysis of data and set the boundaries of the study.

Assumptions

Assumptions encompassed the facts that were assumed to be true in relation to the study. The underlying assumption of this study was that student learning outcomes can be accurately measured using a series of objective questions.
Limitations

All research incorporates some limitations; when working with human subjects, it is impossible to eliminate all variables. Every attempt was made to lessen the effects of the limitations and bias in this study. The study focused on the online and traditional face-to-face format, and did not consider the hybrid format due to the insufficient sample size.

One major limitation occurred in accessing students to take the survey. As it was impossible to directly contact students in all of the KCTCS sections, they were contacted through their instructors resulting in limited access to students.

Another limitation occurred as the students self-selected to take the survey. They were not rewarded; thus, they were not particularly motivated to take the survey. The processing of missing data also was a limitation. Surveys that were missing part of the exam section were not eliminated. Surveys which could not be sorted into either online or face-to-face groups due to missing information were eliminated.

The final limitation occurred because the survey could not be released prior to the end of the term. The survey was comprehensive; thus, students may not have been familiar with all of the material. This limitation may have affected the scores for the material that usually is covered by the end of the semester.

Delimitations

Delimitations refer to limitations over which the researcher has control (Bryant, 2003). This study applied to one semester of students (Fall 2014). It would have been difficult, if not impossible, to access past students, and future students could not be surveyed until they had completed the course.
Definition of Terms

The language of higher education can be unique and confusing. Terms frequently are interchanged, which can lead to some loss of clarity. As a result, defining and clarifying the terminology used in this study is critical.

- **Distance education** (or **distance learning**) – Johnson (2003) defined distance education as “a form of education in which the learner and instructor are separated during the majority of instruction. But unlike independent or self-directed study, distance education usually implies the presence of an institution that plans curriculum and provides resources for its students.” (p. 1)

- **Online education** (or **online class**) - Allen and Seaman (2011) defined an online class as a “Course where most of the content is delivered online” (p. 7). Online classes typically have no face-to-face meetings, with separation between teachers and students. Paulsen (2002) included other synonyms such as virtual education, internet-based education, web-based education, and education via computer-mediated communication as part of the definition of online education. Online education is a subdivision of distance education. The two terms are periodically used interchangeably.

- **Face-to-face, on-campus, or traditional classroom/education** - All of these terms are interchangeable. A traditional classroom was defined as one in which students attend a majority of class on campus.

- **Blackboard** - Blackboard is a learning management system that provides access to learning content and communication tools. Blackboard is the learning content management system employed by KCTCS.
• **Retention** - Retention can be measured in a number of ways; for the purpose of this study, only retention in an individual course was considered. Crawford (1999) described retention as “The maintenance of continued enrollment in classes throughout one semester” (p. 13). This study applied retention to the successful completion of the course, with success defined by a passing grade of a D or higher.

• **Student success** – For the sake of this study, student success was determined by the student learning outcomes, as measured by the assessment. In general terms, student success was measured by passing the course with a D or higher.

• **Non-traditional student** – Buerck, Malmstrom, and Peppers (2003) defined a non-traditional student as a student over the age of 25. Choy (2002) expanded the definition to include students who delayed enrollment, are considered financially independent, work at least 35 hours per week, have a spouse, or are a single parent.

• **Traditional student** - Choy (2002) described a traditional student as “One who earns a high school diploma, enrolls full time immediately after finishing high school, depends on parents for financial support, and either does not work during the school year or works part-time.” (p. 6)

• **Student Learning Outcomes (SLOs)** - Anderson, Moore, Anaya, and Bird (2005) defined student learning outcomes as “the consequences or results associated with instructional experiences; the end results of institutional, program, or curricular goals” (p. 256). The term course competency was
used interchangeably for student learning outcome, as KCTCS developed competencies for all courses taught in the system.

- **Community college** – Cohen, Brawer, and Kiske (2013) defined the community college as “any institution accredited to to award the Associate in Arts or the Associate in Science as its highest degree.” (p. 34).

- **Synchronous instruction:** According to Johnson (2006), “synchronous instruction occurs in real time and requires simultaneous participation of students and teacher” (p. 46). The participants are not required to be in the same location; therefore phone calls, closed circuit classrooms, and video conferencing are considered synchronous.

- **Asynchronous instruction:** Johnson (2006) defined asynchronous instruction as instruction that “occurs in delayed time and does not require simultaneous participation of students and teacher” (p. 46). By the nature of the postal service, correspondence courses are considered asynchronous. In the modern classroom, discussion posts and blogs are examples of asynchronous instruction.

- **Allied health:** The term allied health usually includes all medical support professions except nursing, medicine, and dentistry. For the sake of convenience the term allied health will include the nursing profession.

**Summary of Chapters**

Chapter I has introduced a variety of issues that concern the success in online and traditional A&P I courses offered through the Kentucky Community and Technical College. It discussed the dearth of studies pertaining to the unique issues of teaching lab
science courses online, and the reluctance of faculty and administrators to accept courses taught in an online format. It discussed the development of an assessment correlated directly to student learning outcomes. Moreover, it examined retention as a measure of success and considered the way in which to relate the success of online courses in terms of the Tinto (1975) model and the Bean and Metzner (1985) model.

Chapter II examines the literature by working through the history of community colleges and distance education as it has progressed to learning platforms. It also considers the development of online science courses and the perceived weaknesses involved in teaching courses online. It examines weaknesses in previous research concerning student success in online curriculum and tackles the theories of retention established by Tinto (1975) and Bean and Metzner (1985) and relates those theories to the online classroom. Finally, it addresses measuring of learning outcomes and learning theory.

Chapter III describes the methodology of the study. It examines the student learning outcomes developed by KCTCS and the development of a simple objective test to measure those outcomes. It also presents the methodology, including discussions of populations and statistical analysis.

Chapter IV reports the findings and the data analysis, including the descriptive statistics, independent samples $t$-test, chi square, and ANOVA that were employed. Tables and graphs will serve to support the data.

Chapter V discusses the findings and conclusions from the study. It focuses on the research questions that were developed and it ties in the literature from chapter II. Finally, it also suggests future directions for additional studies.
CHAPTER II: REVIEW OF THE LITERATURE

Introduction

This literature review begins with an exploration of the history and mission of community colleges and examines the nuances of the community college student population that makes the variety of education models attractive. Prior to investigating the framework of online science lab education, consideration of the community college foundation that has made online education viable is critical. The inherent flexibility in the community college paradigm allows it to offer a wide variety of educational models. This literature review examines the history of distance education in order to form a solid foundation to investigate the modern embodiment of the distance model.

The ongoing studies promoted by Allen and Seaman (2003, 2007, 2010a, 2010b, 2011, 2013 & 2014) have illustrated the changing demographics of the online landscape. Online education has many proponents and opponents. Although many administrators see a bright future for online programs, faculty, particularly in the sciences, tend to drag their feet. Several reasons for this bias may exist, including a lack of training. Online education also is addressed within the contextual framework of learning models. The framework addresses many of the concerns in the literature regarding quality and academic integrity prior to delving into the measure of learning effectiveness in online classes.

Few studies have examined lab courses taught online, and many difficulties are involved in teaching lab science courses online. An increase has been observed over the last decade in the number of tools available that allow teachers to incorporate lab studies online. Those tools focus on virtual components, remote components, and the use of
equipment in the student’s home. This study focuses on A&P, and the efficacy of teaching the course online. A&P is particularly important, as it is a difficult course that forms the foundation of many allied health programs.

The literature review investigates issues concerning retention and persistence in an online environment. Online courses have a reputation for higher attrition than the corresponding face-to-face courses (Angelino et al., 2007; Boston et al., 2014; Capra, 2011; Hart, 2012). Attrition in online programs is addressed in light of several retention and persistence theories.

Finally, the literature review addresses the value of developing assessments based on student learning outcomes. The assessment used in this study was aligned with the course competencies developed by KCTCS for the first-semester A&P course. This section considers the merit of assessments based on these competencies.

**Community Colleges - Evolving Priorities and Demographics**

Community colleges have a rich and dynamic history and have played an undervalued, but crucial, role in the development of higher education. The community college system is a unique American institution that has placed higher education within the reach of many individuals who could not attend universities (Thelin, 2011). The perception has prevailed that the open door policy common in community colleges results in lower quality programs. In actuality, this policy does not indicate that community colleges hold students to lower standards. Rather it has resulted in a greater diversity in the student population (Bahr, 2013). In turn, the diversity has strengthened the academic opportunities within the community college. Unlike their four-year counterpart the two-
year institutions are more accepting of change, thus new academic models are frequently accepted by community colleges.

Cohen et al. (2013) defined a community college “as any not-for-profit institution regionally accredited to award the associate of arts or the associate in science as it highest degree” (p. 5). Describing community colleges in terms of the highest degree possible is limiting. Students attend them for a variety of reasons that do not result in a terminal associate’s degree. Many individuals attend for a few classes, for vocational training, or to transfer coursework to a four-year university. “The overarching emphasis of community colleges is on providing access: offering open admission, affordable higher education and programs that meet the lifestyle needs of continually evolving populations of students” (Hachey, Conway, & Wladis, 2013, para. 4). The open access policy is a characteristic of community colleges that appeals to many students. The shared mission of community colleges generally is to provide access to postsecondary education in order to create more vital communities (Liu, Gomez, & Yen, 2009). This mission necessitates that they find innovative ways to make education accessible.

Community colleges offer a wide range of educational opportunities. As of 2014, 1132 community colleges were in existence with over 1600 branch campuses (American Association of Community Colleges [AACC], 2014). Over 7 million students were enrolled in community colleges in 2014. By the beginning of the 21st century, almost half of all postsecondary undergraduates were enrolled at a community college (Gergen & Roblyer, 2013).

One of the keys to the success of community colleges can be found in the flexibility and lower cost (Bahr, 2013). Flexibility is important to non-traditional
students who may have additional commitments outside of their studies. The pathway of the typical community college student does not fit the traditional view of a full-time student. Students are allowed to find their own unique and sometimes chaotic academic pathway that fits their needs and goals (Crosta, 2013). The flexibility innate in community colleges may be the result of a lack of academic traditions that are found in four-year institutions, or the result of the characteristic diversity (Bahr, 2013; Morest, 2014). Flexibility in relation to changing societal norms and advancing technology has allowed community colleges to promote a wide range of academic models including distance education programs. The flexibility also has made community colleges attractive to a wider demographic (Mellow & Heelan, 2014).

The modern community college has developed into an institution that is quite different from its early origin although the influence of its historical roots continues to be present. Its rapid growth is due to a number of unique cultural changes of the early 20th century (Mellow & Heelan, 2014). As the industrial revolution expanded, industry needed more skilled workers, and the drive for social equality meant improved access to higher education. Key to the success of community colleges in the United States is the conviction that everyone should have an opportunity to reach their greatest potential (Cohen et al., 2013). These institutions have been reinvented numerous times to meet changing societal needs.

Community colleges developed from an extension of secondary education as the schools were seeking new ways to serve the community (Mellow & Heelan, 2014). In order to meet those needs, vocational programs and teacher institutes were added. The schools broke away from the university models in order afford everyone an opportunity
for further education. Community colleges developed models based on small classes and student-faculty relations (Thelin, 2011). They continue to be characterized by smaller class sizes and greater interrelationships between faculty and students. The link between community colleges and secondary education can be seen in the dual credit programs offered at many community colleges (Pretlow & Wathington, 2013).

By the early 1900s, the extension of high school programs had morphed into junior colleges linked to four-year universities (Mellow & Heelan, 2014). These colleges offered freshman and sophomore general education preparatory classes that could be transferred to the university and were exclusively designed to lead to a baccalaureate degree. They have since developed into more comprehensive institutions. Students can now transfer to four-year schools, or they can complete programs that allow them to directly enter the workforce (Boggs, 2010).

By the beginning of the 21st century, the latest reincarnation of the community college had developed (Cohen et al., 2013). The new model was flexible and could respond to changing markets and student needs, while maintaining a link to its secondary education roots, small class size and faculty-student relationships. Additionally, the courses correspond to the requirements and learning objectives of four-year universities in order to improve credit transfer. The ability to transfer credits and to complete a program of study in only a few years have resulted in an increase in the success of allied health programs at community colleges (Jepsen, Troske, & Coomes, 2014).

The modern embodiment of the community college serves a unique and diverse population with a wide variety of programs, technical training, and general education courses. Expanded educational opportunities include dual enrollment for high school
students, adult work force programs, certificates, diplomas, and associate degrees (Clotfelter, Ladd, Muschkin, & Vigdor, 2013). According to Morest (2014), “there is a complexity not only in the background of the community college students but also in their educational goals. Individuals are brought together in community college classrooms with seemingly little more in common than the classes they are taking” (p. 37). The result has been the creation of unique learning environments. Furthermore, community colleges focus on serving the community and developing opportunities for lifelong learning (Bahr, 2013).

The common mission of community colleges includes an open admissions policy, which allows for the acceptance of all students regardless of academic experience or test scores. In addition to the open admissions policy, they offer lower tuition and fees and a flexible curriculum and class schedule (Bahr, 2013; Cohen et al., 2013; Kolesnikova, 2009; Crosta, 2014). Community colleges focus on expanding opportunities to everyone (Goldrick-Rab, 2010). Moreover, many programs offered have corresponding articulation agreements with four-year institutions.

Community colleges are innovative and flexible in meeting the needs of students and the community (Boggs, 2010).

Because of the flexibility offered to students, community colleges make the impossible possible. Students who otherwise would be excluded from postsecondary education for any number of reasons (e.g., obligations to work or family, financial limitations, inadequate preparation for college) find opportunity in the community college. (Bahr, 2013, p. 4)
No other branch of postsecondary education has been as responsive to student and community needs. Through all of the generations and changes experienced by these institutions, the core mission has remained the same: To reach those students who could not attend a university for economic, personal, or academic reasons. Community colleges were intended to reach students who could not, or would not, leave home to continue their education (Bahr, 2013).

Students have cited a wide range of reasons for attending a community college. The diverse reasons include “ease of access, low cost, excellent academic programs that meet learners’ and employers’ needs, a broad array of support services, proximity to students’ homes, flexibility of scheduling, a welcoming campus environment, and links to other levels of education” (Phillippe & Sullivan, 2005, p. 19). In an attempt to reach all students, community colleges have stretched the bounds of the classroom. The basic goal has been to serve individuals that which they desire or need (Cohen et al., 2013). To reach this goal, these institutions have sought creative methods to teach subjects while maintaining high standards; thus, they are more likely to offer transfer agreements, dual credit, bi-term programs, night courses, and distance education. Distance education fits with the basic mission that education should be available to everyone.

Community colleges have been differentiated from other institutions of higher education by their open door policy. Crisp and Delgado (2014) reported, “it is estimated that at least two-thirds of community college students are not academically prepared to engage in college-level work in at least one subject area on placement exam” (p. 2). This was supported by Bettinger, Boatman, and Long (2013), who reported that “only one-third of high school graduates finish ready for college work; the proportion is even lower.
among older students” (p. 93). Bailey (2009) and Bailey and Cho (2010) suggested that approximately 60% of students entering community college need remedial work in English, reading, or math. The AACC (2014) reported that 68% of community college students take at least one remedial English, reading, or math course, whereas 40% of those in public four-year universities take one remedial course. This appears to be a dramatic increase in remedial students, when compared to the 29% of first-time freshmen enrolled in a remedial course reported by Phipps (1998). The difference in numbers may be the result of improved testing and placement, as well as the increasing numbers of non-traditional students entering college. Clearly, students can expect to take a remedial course when entering college (Attewell, Lavin, Domina, & Levey, 2006; Bailey, 2009; Bailey & Cho, 2010; Bettinger et al., 2013; Crisp & Delgado, 2014).

The open door mission indicates that the traditional concept of the college student who attends college full time immediately following completion of high school is an inaccurate portrayal of the community college student. Only a small percentage of students fit this portrayal (Cohen et al., 2013; Hainline, Gaines, Long-Feather, Padilla, & Terry, 2010). Most students are considered non-traditional, as they attend school part time or delayed their entry into college. Non-traditional students compromise the largest percentage of students entering community colleges, and these institutions continue to examine the best methods to serve this population.

Unlike universities in which the students live on or near campus, community colleges serve commuter students (AACC, 2014; Cohen, et. al, 2013; Vaughan, 2006). They serve an eclectic population with a wide range of needs, resulting in an ideal
breeding ground for new and creative educational models. According to Horn, Nevill, and Griffith (2006), 47% of college students were under the age of 24.

Nearly 40 percent of community college students were dependent students (i.e., under 24 years old and not independent financially from their parents), 26 percent were 24 years old or older and financially independent from their parents, 20 percent were independent and married with children, and 15 percent were independent, single parents. (Provasnik & Planty, 2008, p. 120)

The AACC (2014) reported that 49% of the students attending community colleges were between the ages of 22-39, and an additional 14% were over the age of 40. The average age of a community college student was 28 years, whereas the average age of students in four-year schools was 21 (AACC, 2014; Horn et al., 2006). Students attending community college were more likely to be older, female, and from low-income families. The vision of the new student as 18 years old and directly out of high school no longer is valid.

The demographics of the student body have changed dramatically in the last 30 years. Many of the challenges faced by schools are the result of the changing demographics of the student body, which will continue to play a major role in access to higher education. The fastest growing segment of the student body can be considered non-traditional (Wyatt, 2011). In the next decade, a 25% increase is projected in the number of non-traditional students over the age of 25. Most will be women, as 61.5% are anticipated to be female (Hainline et al. 2010).

Cohen et al. (2013) reported that 96% of community college students live within a median distance of 10 miles from campus. These colleges appeal to independent or non-
traditional students, including those 24 years and older who are financially independent and those under 24 years who are married or have children. Independent students compromise 61% of the population (Horn et al., 2006). Gault, Reichlin, and Román (2014) found that overall 26% of undergraduates are raising children. According to Horn et al. (2006), 35% of the community college population have children. The AACC (2014) identified 17% as single parents. Unlike the undergraduates at universities, nearly 62% of full-time community college students work outside the home and another 22% work part time. Full time employment for part-time students increased to over 40%. Two thirds had parents who also attended college.

The allied health fields are among the most popular majors at community colleges, accounting for 16% all majors (Horn et al., 2006). Students entering nursing are more likely to be older, having left high school years earlier, and they are more likely to be employed and have family responsibilities (Shelton, 2012). Allied health students generally are non-traditional students who are more likely to be interested in alternative course delivery. Community colleges are in an optimum position to offer programs in a variety of formats.

**Traditional Course Delivery**

Many studies have sought to compare traditional and distance learning courses without defining traditional course delivery. A number of these described the format of the online component, but they did not describe the traditional component (Bhatti et al., 2009; Buerck et al., 2003; Dutton et al., 2002; Emerson & MacKay, 2011; Gallagher et al., 2005; Garmen, 2012; Rozenzwieg, 2012; Sharma, Bryant, & Murphy, 2013). In
order to develop a valid comparison, this chapter advances a description from the literature of a traditional classroom prior to exploring distance and online education.

The lack of a definition a traditional classroom results in muddling of the terminology. Traditional courses have been referred to as face-to-face, on-campus, paper-based, teacher-centered, or lecture-based presentations in the literature (Allen & Seaman, 2013; Ary & Brune, 2011; Bhatti et al., 2009; Daymont & Blau, 2008; Emerson & MacKay, 2011; Khodamoradi, & Abedi, 2012). All of these terms are used interchangeably, which can lead to confusion. If a course is student-centered, can it be referred to as traditional? If the course relies on a presentation other than lecture, can it be considered traditional? What is the role of technology in traditional courses? The literature has not specifically addressed the definition of a traditional classroom; however, a workable definition can be distilled by compiling several sources.

Students traditionally left home after high school and entered the university. They lived and studied on campus. Classes may have been offered in a large lecture hall of several hundred students with little interaction between students and faculty, or they may have been in smaller classrooms in which the teacher and student interacted to a greater degree (Hagedorn, Perrakis, & Maxwell, 2002). As community colleges developed, they mimicked the university model and taught classes on campus, but to a commuter population. As the served commuter students, the immersion in the college environment and campus residency was not applicable to the definition of traditional course delivery.

The role of the instructor in an online classroom compared to a traditional classe often is used to distinguish one from the other. Relan and Gillani (1997) described the different roles of an instructor. In a teacher-centered curriculum, the teacher determines
the direction of instruction, communication flows in one direction from teacher to students, and instruction occurs with the entire classroom. Conversely, student-centered curriculum instruction occurs in small groups. The students determine the direction of the instruction, and the role of student engagement equals or surpasses that of the teacher-directed presentation (Relan & Gillani). Both formats can be used in either a traditional or distance program; therefore defining traditional delivery by who controls the curriculum does not clarify the definition.

In their annual reports on online education Allen and Seaman (2003-2013) categorized courses by the proportion of content delivered online. A traditional classroom was defined as one in which “no online technology is used and content is delivered in writing or orally” (Allen and Seaman 2012, p. 11). They listed the proportion of content delivered online as 0% (Figure1). Allen and Seaman differentiated traditional format from web-facilitated or web-enhanced by the use of technology. They referred to web-facilitated courses as those that use “web-based technology to facilitate what is essentially a face-to-face course. (It) May use a course management system (CMS) or web pages to post the syllabus and assignments” (Allen & Seaman, 2012, p. 11). They also listed the proportion of content delivered online as less than 30%. Courses with 30% to 79% online delivery were considered blended or hybrid. A hybrid course “blends online and face-to-face delivery. (A) Substantial proportion of the content is delivered online….typically has a reduced number of face-to-face meetings” (Allen & Seaman, 2012, p. 11). Using their definitions, very few contemporary courses would be considered traditional. A question arises in the way in which they defined technology. They characterized technology based on interaction with the internet. According to this
definition, the use of e-mail for communication indicates that a course no longer is considered traditional. Any use of Blackboard or other learning platform by the instructor also changes the characterization of the course.

<table>
<thead>
<tr>
<th>Proportion of Content Delivered Online</th>
<th>Type of Course</th>
<th>Typical Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>Traditional</td>
<td>Course where no online technology used —— content is delivered in writing or orally.</td>
</tr>
<tr>
<td>1 to 29%</td>
<td>Web Facilitated</td>
<td>Course that uses web-based technology to facilitate what is essentially a face-to-face course. May use a course management system (CMS) or web pages to post the syllabus and assignments.</td>
</tr>
<tr>
<td>30 to 79%</td>
<td>Blended/Hybrid</td>
<td>Course that blends online and face-to-face delivery. Substantial proportion of the content is delivered online, typically uses online discussions, and typically has a reduced number of face-to-face meetings.</td>
</tr>
<tr>
<td>80%+</td>
<td>Online</td>
<td>A course where most or all of the content is delivered online. Typically have no face-to-face meetings.</td>
</tr>
</tbody>
</table>

*Figure 1.* Categorization of courses by online content. Adapted from Allen and Seaman’s annual reports on online education (Allen & Seaman, 2003-2013).

With the development of learning platforms such as Blackboard, WebCT, Angel, and Moodle, many on campus classes involve the internet for non-learning centered activities such as posting grades and syllabi. According to Allen and Seaman (2003-2013), any use of a learning platform denotes that the course is at least web-enhanced, but many instructors continue to classify it as traditional. In reality, technology can be used extensively in courses that are considered traditional (Lawless & Pellegrino, 2007). The use of learning platforms such as Blackboard is not limited to distance learning programs. Many instructors use information technology for increased communication, access to information, and for presenting content in courses that may be considered
traditional (Ituma, 2011). However, many distance learning programs use very little technology outside of the learning platforms.

The key component of a traditional course may involve communication as opposed to the location of the student and the technology. The traditional model involves communication that is synchronous. Issues will continue to exist, even when a traditional course is defined by the synchronicity of the delivery method there are still issues. Johnson (2006) defined synchronous instruction as communication that “occurs in real time and requires the simultaneous participation of students and teacher” (p. 46). Johnson (2006) described asynchronous instruction as communication that “occurs in delayed time and does not require the simultaneous participation of students and teacher” (p. 46). Traditional courses can utilize asynchronous communication in discussions, videos, or e-mail. Online courses can use a combination of asynchronous and synchronous communication or focus on either asynchronous or synchronous communication (Oztok, Zingaro, Brett, & Hewitt, 2013).

Distance education generally is characterized by distance and asynchronous communication. Technology, however, has made it possible to teach a synchronous course over a long distance. Both Skylar (2009) and Oztok et al. (2013) described a growing movement to use synchronous chat rooms as a means of enhancing student learning outcomes. Additionally, courses offered over video links are synchronous, but they also are considered distance programs. Furthermore, a traditional course may have asynchronous components (Skylar). Many instructors in all types of formats use e-mail (Li, Finley, Pitts, & Guo, 2010). The end result of classifying a traditional course by the type of communication continues to be difficult.
Shachar and Neumann (2003) offered a definition that incorporates parts of the previous concepts. They described the traditional classroom in very narrow terms: traditional classrooms meet on campus, the professor lectures, and the students take notes. Direct interaction between the student and the professor is an essential learning component. Their definition was teacher-centered, but the critical point may be that the course meets on campus. Morabito (1997) limited the definition of a traditional class to “enrollment and study within a physical building where students meet face-to-face with their teachers” (p. 4). Morabito identified a traditional learning environment as one with buildings, study materials, and personnel. Although the definition may be somewhat dated, as traditional institutions expand their distance education programs, it is a straightforward description of a traditional classroom.

Distance Education

Description

Distance education encompasses a wide variety of modes of education. Online education is the latest model. Distance education is not a new concept, and many of the arguments both for and against it have been debated since the first correspondence courses. In order to trace those arguments, an examination is needed of the history of distance education and the various modes of under the umbrella of distance education.

Distance education is characterized by a physical distance between the instructor and the student. Johnson (2003) defined distance education as “a form of education in which the learner and instructor are separated during the majority of instruction. But unlike independent or self-directed study, distance education usually implies the presence of an institution that plans curriculum and provides resources for its students” (p. 1).
Moore, Dickson-Deane, and Galyen (2011) simplified the definition by stating that distance education refers to “the effort of providing access to learning for those who are geographically distant” (p. 1). They also included the physical distance and temporal difference between the instructor and the learner.

Simonson, Schlosser, and Orellana (2011) offered a much more detailed description of distance education. They defined it as “institution-based, formal education where the learning group is separated, and where interactive telecommunications systems are used to connect learners, resources, and instructors” (p. 126). They focused on the influence of the educational institution in the development of the program, which separates it from an independent or teach-yourself type of program. Their second component involved the quasi-permanent separation of the students and the teacher. The third component in can be found in the media in which the content is embedded and how it connects the student and teacher. They used the term “telecommunications,” which brings to mind computer and audio means. In reality, the third component can consist of various types of media, including print, audio, video, or computer with which to carry content (Keegan, 1996). Keegan’s (1996) earlier description of media available for distance education was much more flexible, as it focused on a variety of media that other studies did not clearly specify (Moore et al., 2011; Simonson et al., 2011; Wang & Sun, 2013). Keegan identified the lack of a learning group throughout the length of the class, resulting in the student being taught as an individual. Simonson et al. (2011) disagreed with Keegan’s earlier work, as many teleconference scenarios encourage the development of learning groups.
Tabs, Waits, and Lewis (2003) defined distance education as “education or training courses delivered to remote (off-campus) sites via audio, video (live or prerecorded), or computer technologies, including both synchronous (i.e., simultaneous) and asynchronous (i.e., not simultaneous) instruction” (p. 1). They noted that the temporal relationship in distance education programs could be either synchronous or asynchronous. With the evolving technology, this becomes an important feature, as students can now have access to real-time feedback.

**History of Distance Education**

Distance education is not a new concept, although its latest merger with technology has made it appear so. In order to understand the promise of the future of distance education, an investigation of the past is important. There is a “connection between the history of distance education and contemporary online education because the visionary promises and concerns that many current educators claim as novel actually have a past” (Larreamendy-Joerns & Leinhardt, 2006, p. 568). Distance education developed due to the “geographic isolation of students from educational institutions” (Natarajan, 2015, p. 74).

Distance education existed in various forms prior to the internet and learning platforms, videos, and teleconferencing. Early programs used other tools to communicate with students. St. Paul’s (5-57 ACE) letters in the Bible to the Corinthians could be considered a form of early distance education as could not teach face-to-face; however, distance education typically refers to a course associated with an educational program (Power & Morven-Gould, 2011; Simpson, 2013).
The first true manifestation of distance education can be found in correspondence courses. Distance education for college credit, in the form of correspondence courses, can be traced back to the 19th century (Caruth & Caruth, 2013; Simpson, 2013). The first documented evidence of correspondence courses offered at an institution of higher education occurred in the mid-1800s and involved the instructor sending material through the postal mail to the student. The student would submit work to the instructor through the mail. Correspondence education in this form provided educational opportunities to those who could not access the physical institution (Natarajan, 2015). Correspondence courses depended upon a reciprocal dialogue common in letters and a personal tone in communication that is also common in written correspondence (Wedemeyer, 2014). By the end of the century a number of schools offered correspondence distance education programs. At their height, correspondence courses served over a quarter of a million students (Moore, 1995). At the conclusion of the 1800s more than 60% of those graduating with an arts degree had studied through a correspondence school (Demiray & İşman, 2001).

The popularity of correspondence courses continued despite the advent of improved technology. Markowitz (1983) found 72 college-based correspondence programs with enrollments of over 140,000 students. Clearly, a need existed for off-campus programs. Some correspondence programs developed a negative reputation for quality due to limited interaction with faculty, and a number of non-accredited programs were grouped with those offered from accredited colleges (Bower & Hardy, 2004). However, correspondence courses left their mark on distance education.
Advances in technology and difficulties and limitations within the postal system eventually forced correspondence courses to become obsolete. The second incarnation of distance education consisted of one-way communication in the form of radio broadcasts and television. Radio transmissions became popular, followed by visual technology in the form of videos and television programing in the 1960s (Wang & Sun, 2013). One-way programs merged into two-way programs with the advent of teleconferencing. The students could sit in an off-campus classroom and interact with the teacher. This advance changed the dynamics of the student-teacher relationship by moving the distance class from an asynchronous environment to one in which communication was synchronous (Wang & Sun, 2013). The downside was that teleconferencing removed the flexibility that was an attractive feature of distance education.

The development of the internet was a game changer for distance education. Programs suddenly could be more interactive, student and teacher communication increased, and the courses were flexible around the student’s needs. Allen and Seaman (2003) reported that 1.6 million students had taken at least one online course in the fall of 2002. After a decade, the number of students dramatically increased to 6.7 million (Allen & Seaman, 2013), indicating that 32% of all students were taking an online class. The demand is clear; the question now concerns the quality of the education: Is the quality of the education equivalent between online presentations and traditional presentations on campus?
Online Education

Popularity of Online Education

Distance education clearly is not a new concept, although its latest merger with technology has made it more convenient and, thus, more popular. One of the major trends shaping society as a whole, and distance learning in particular, is the rapid advancement of technology (Anderson & Dron, 2012; Moore et al., 2011; Wang & Sun, 2013). Computers are faster and less expensive, technical infrastructure in terms of high-speed data networks has become more common, and technology in general is merging and has become more user friendly (Larreamendy-Joerns & Leinhardt, 2006). By 2014, more than 87% of adults had access to the internet, a dramatic increase from the previous decade in which only 14% had internet access (Fox & Rainie, 2014). All of these advances impact the ability of instructors to develop and implement online programs. However, more important, they greatly improve the student’s ability to interact with the material.

As early as 2003, Howell, Williams, and Lindsay noted that online students had developed into a new subpopulation in higher education. Reports have indicated that 96% of colleges and universities offer online courses (Lloyd et al., 2012; Varela, Cater, & Michel, 2012). Online education has grown at a rate that far exceeds the “growth rate of the overall higher education student population” (Allen & Seamen, 2010, p. 2). Approximately 31% of all college students took at least one online class in the 2010 fall semester (Allen & Seaman, 2011). Current estimates indicate that up to 25-30% of faculty in higher education have been involved in online education (Lloyd et al., 2012). The rapid rise in these programs has far reaching implications for the future of higher
education. A need clearly exists that has to be addressed, but barriers are also present that prevent faculty from developing and accepting online education.

Allen and Seaman (2003-2013) defined an online class as one in which “most of the content is delivered online” (p. 11) (Figure 1). Lim, Morris, and Kupritz (2007) defined online education in a similar manner as “any form of learning and/or teaching that takes place via computer network” (p 28). The Lim et al. definition is too vague, as they referred to “any form of learning.” The Lim et al. definition can easily include independent programs from non-credentialed institutions. Although various trainings can be offered online, for the most part in academia and in this chapter the term “online education” refers to courses delivered through accredited educational institutions.

According to annual reports by Allen and Seaman (2003-2013), 80% or more of the content must be delivered through the internet in order for a course to be considered online. (Figure 1). Other descriptions require that all content be delivered through the internet (Tallent-Runnels et al., 2006). Moore et al. (2011) attempts to combine several descriptions, resulting in a general definition of online education as “access to learning experiences via the use of some technology” (p. 2). This definition was too general, as many traditional classes use some form of technology to increase learning experiences. Aly (2013) described the elements that form the backbone of online courses: Online courses allow for interaction between content, other learners, and instructors, and through virtual media in order to build an understanding of the content.

Mitchell, Parlamis, and Claiborne (2014) pointed to four conditions that precipitated the rise in online education. The conditions included an increase in personal computer ownership, improved access to high speed internet, the continuous
improvement of technology to deliver online courses, and the increase in the demand for online courses from both traditional and non-traditional students. As the number of non-traditional students increased, particularly in community colleges, the demand for alternative forms of course delivery increased as well.

**Success of Students in Online Education**

The book, *The No Significant Difference Phenomenon*, by Thomas Russell first appeared in 1999. Russell theorized that online education was no different than traditional courses. His book supported Clark’s 1983 theory that media does not affect learning (Russell, 1999). Russell did not explore online education in the initial text. Similar to Clark, he focused on other distance media and extrapolated those conclusions to online education. Means, Toyama, Murphy, Bakia, & Jones published in 2009 what was thought to be the definitive decision on the efficacy of online education. According to their meta-analysis, online education is as effective as face-to-face presentation. Their study supported Clark’s 1983 theory that media does not affect learning. Much has been said about the review of online programs by Means et al; however, questions remain concerning the quality of online education.

Other authors have cautioned against accepting as fact that the media does not impact learning. “Learning occurs as a result of motivation, opportunities, an active process, interaction with others, and the ability to transfer learning to a real-world situation” (Oblinger & Hawkins, 2006, p. 14). According to Oblinger and Hawkins (2006) the media can impact motivation, opportunities, active learning, interaction, and transfer; thus, by default, the medium used to present content also affects learning.
Jaschik (2015) noted that students in online classes may lag behind those in face-to-face programs in course completion and completion with a grade of A or B. According to Jaschik, students who complete an online course are more likely to have a lower end-term grade. Barbeau, Johnson, Gibson, and Rogers (2013) reported a perception that “online courses inherently limit student access to the instructor and thus weaker students taking an online course may be at a disadvantage” (p. 8). Stuckey-Mickell and Stuckey-Danner (2007) detailed a similar issue. Their students commented on the lack of student/student and student/instructor interaction in the virtual labs, as compared to the face-to-face labs. It is important to note that the instructors in the Stuckey-Mickell and Stuckey-Danner study did not initiate any communication in the virtual component although they did so in the face-to-face section. Numerous methods can be used to initiate communication: synchronous discussions, e-mail, phone calls, and social media. A lack of communication is not necessarily an inherent problem in an online section (Giesbers, Rienties, Tempelaar, & Gijselaers, 2014).

Many of the early shortcomings of online programs were a result of not using the available technology (Lim et al., 2007; Parker, 2004). The initial problems involved the lack of appropriate infrastructure to support online programs. Morabito (2008) listed four major infrastructure components necessary for a successful online program: technical support, hardware, software, and ancillary resources. Schools spent years developing sufficient infrastructure to support large online programs. Many of the early programs attempted to replicate the classroom format as much as possible; thus, they did not utilize the tools available in the online format. The flexibility inherent in the asynchronous environment of an online classroom meant that imitating the traditional classroom did not
represent the best practices in an online program. As the technology developed, the view began to evolve of what constitutes best practices in an online classroom (Lim et al., 2007).

The advances in technology have improved student engagement with the content, faculty, and other students (Dixson, 2012). Dixson (2012) found that developing multiple communication channels increased both student engagement and success. Dixson’s model included a strong focus on instructor presence in order to increase student engagement. According to Young and Bruce (2011), student engagement is positively linked to student grades. Young and Bruce found that “students who felt connected with peers and also engaged in course activities, in turn feel confident in their achievement and expectation of higher grades” (Discussion, para. 1). Learning platforms allow for a wide variety of asynchronous and synchronous forms of communication that include discussions, blogs, announcements, e-mails, videos, etc.

Online education has many advantages over the face-to-face classroom. Both El Mansour and Mupinga (2007) and Ramanujam, (2012) pointed out that one of the major advantages of an online course is the elimination of time barriers. Students can attend class at any time of the day and are no longer constrained to a location or a specific school. They have the flexibility to explore classes at any time or location. Depending upon the design of the course, students can work independently and at their own pace.

**Development of Online Education**

For every article that purports the advantages of online education, others appear to predict doom and gloom and the end of teaching and higher education (Flew, 2014; Jaschik, 2015; Kim & Bonk, 2006; Noble, 1998; Wojciechowska, 2010). The general
paradigm shift in the delivery of higher education has met with both enthusiasm and reluctance. The most dramatic predications occurred in the mid to late 1990s as the technology was beginning to develop.

Proponents ooze with blind adoration, declaring that online learning can resolve all the problems confronting traditional education. Opponents insist that courses taught on the net are incapable of living up to the standards of the traditional bricks and mortar classroom. (Phipps & Merisotis, 1999, p. 7)

The reality is somewhere in between the two points of view. Allen and Seaman (2007) reported that chief academic officers found online programs require more time and effort on the part of both the faculty and the students. They also noted that students need more discipline to be successful in an online class, and faculty are reluctant to accept the value of online instruction. Allen, Seaman, Lederman, and Jaschilk reported in 2012 that two thirds of faculty believe that the learning outcomes for online classes are inferior to the comparable traditional course. According to Power and Morven-Gould (2011), “online learning appears to have what we describe as feet of clay because it has not been widely embraced by mainstream academia” (Introduction, para. 1). The question becomes: Is this a biased perception or is it based on solid evidence?

A variety of factors have impacted the field of online education. Leasure, Davis and Thievon (2000) surveyed students and found that many selected online over face-to-face programs for reasons of cost, flexibility, and convenience. Fifteen years later student priorities have not changed. Platt, Raile, and Yu (2014) confirmed that students who choose online courses are concerned about flexibility. Non-traditional students with other demands on their time are attracted to the flexibility that allows them to choose
when and where to complete coursework. They also are attracted to the lower cost and convenience of the courses. The prime attraction of online education has not changed; however, the technology has changed and the institutions of higher education can meet the demands of the market.

Howell et al. (2003) claimed that a number of societal issues have driven the demand for online education. Changing demographics and improved access to higher education results in an academic insufficient academic infrastructure to accommodate the growing student body indicating that online education is a critical component of serving students’ needs. Computer technology can support a wide variety of needs and capacities of students, while simultaneously providing for deeper understanding and critical thinking (Lavin, Korte, & Davies, 2011).

Wright (2011) described traditional classrooms as extremely instructor-centered which worked “against students becoming successful, mature learners” (p. 92). Both Howell et al. (2003) and McComb (2000) described the beginning of a shift in the institutional landscape to learner-centered instruction, which moves away from the lecture format to instruction that is self-directed. The changing pedagogical focus created an opening that allowed for major changes in the modes of presentation. A similar pedagogical shift can be seen in online programs that are becoming more interactive in order to help students become more responsible for their learning. Yen, Tu, Sujo-Montes, Armfield, and Chan (2013) focused on the need for goal setting, environmental structuring, task strategies, and time management, with an emphasis on student responsibility for learning and moving from a teacher-focused pedagogy.
Online programs over the last two decades have succeeded in removing many of the barriers to higher education. With the expansion of online education, many individuals continue to be reluctant to believe that a quality education can be achieved through an online medium (Lloyd et al., 2012). Some of these hurdles are the result of prejudices that developed between traditional campuses and correspondence schools. Many other issues are due to the initial difficulties with technology that limited the way in which online instructors could present content, making it difficult for student’s to receive timely feedback (Allen & Seaman, 2012). Early technology that involved limited access to content and personal computers with dial-up modems may have influenced some of this reluctance; however, it does not account for all of it. Allen and Seamen (2012) stated that “Faculty report being more pessimistic than optimistic about online learning. Academic technology administrators, on the other hand, are extremely optimistic about the growth of online learning, with over 80% reporting that they view it with more excitement than fear” (p. 2). This statement indicated that some of the obstacles to online education are the result of a lack of experience on the part of faculty, as well as instructors without a sufficient technical background.

**Faculty Reluctance to Accept Online Education**

Allen and Seaman (2010a) had reported previously that the acceptance of online education varied widely in different institutions. Faculty in baccalaureate programs strongly rejected the value and legitimacy of online education. Only 11% of faculty in universities accepted the validity of online programs; whereas, 44% in community colleges accepted and valued online education. The dichotomy may reflect the flexibility that is innate in the community college model. By working to attract non-
traditional students, community colleges are more likely to embrace alternative modes of delivery.

By 2013, Allen and Seamen reported that one third of academic leaders believed learning outcomes for online programs were inferior to those of traditional face-to-face programs. Allen and Seaman included a caveat in their polling data. They found that institutions with more online offerings had administrators who more positively rated the quality of the online learning outcomes. Once again, a lack of familiarity with online programs appeared to be the cause for the bias.

According to Allen and Seaman (2009, 2013) and Allen et al. (2012), unfamiliarity with the medium may be a factor in administrator and faculty perceptions of the quality of online education. As may be expected, faculty with experience in designing and teaching online classes have a more favorable view of the quality of online instruction than those without online experience. As only 34% of faculty have experienced online teaching, the perception of inferior quality clearly may be the lack of experience in the format, rather than an actual difference in the quality of the programs (Lloyd et al., 2012; Seaman, 2009). Supporting and training faculty into branching out to online programs is a challenge faced by many institutions. Faculty may find it difficult to move the traditional face-to-face lecture format to an online medium and, at the same time, maintain high standards for delivery (Kampov-Polevoi, 2010; Kim & Bonk, 2006; Meyer & Murrell, 2014). As a result, schools should consider investing in training for faculty to keep up with the available learning platforms and supportive infrastructure.

Faculty have expressed concern that the developing and teaching of an online program requires more time and energy than a comparable traditional course. Whether
real or perceived, the actual effort involved is one of the major barriers faculty have voiced regarding teaching online (Kampov-Polevoi, 2010; Seaman, 2013). Lloyd et al. (2012) reported both intrinsic and extrinsic barriers made faculty averse to teaching online classes. Many barriers resulted from a lack of training and technology which made the development of online programs overwhelming. Lloyd et al. (2012) found that almost 20% of all institutions do not offer training to teach online courses, and those that offer training programs furnish only informal guidance. Additional institutional barriers, such as a lack of standards for the development for online courses, limited property rights, and value of online work toward promotion, result in more reluctance to teach online programs.

Herman (2013) reported similar findings those of Lloyd et al. (2012), Kampov-Polevoi (2010) and Seaman (2013). Herman investigated the effect of incentives such as extra remuneration, release time, consideration for promotion, or additional technical support and found that 30% of schools do not offer any incentive to teach courses online. Additionally, instructors perceived that the incentives were inadequate. As instructors already had established traditional courses, with no incentive in terms of tenure and promotion, they were reluctant to participate in online course development. Faculty in the Lloyd et al. (2012) study also felt that as a cost/benefit decision, the additional time and energy involved in an online course was not worth the benefit. Seaman (2013), Herman (2013), and Lloyd et al. (2012) suggested that the labor and time demands required to develop and teach online modules are major factors in faculty resistance. Additionally, administrators may not consider teaching online as a valuable or important professional accomplishment (Roby, Ashe, Singh, & Clark, 2013).
Studies also have reported the perception that online programs limit the relationship between students and teachers. Instructors accustomed to teaching in traditional classrooms fear the lack of direct face-to-face interaction can impair student learning (Stewart et al., 2010). Early in the development of online programs, Noble (1998) described the move toward online education as being coercive in nature, as it was forced on professors and students due to its lower cost than the traditional classroom. The perception of usefulness was a key factor when faculty viewed the role of an online teacher. Undergirding many of these concerns was the fear that education was becoming automated. Dixson (2012) disproved this prediction by stating that instructor presence and engagement are major pillars in the success of an online program.

Some of Noble’s (1998) pessimism continues in faculty perceptions of online education years later. Stewart et al. (2010) suggested that faculty may be resistant to move from the position of “sage on the stage” in a traditional lecture hall to that of “coach” in an online course. Noble’s fear appeared to be deeper than Stewart’s. Noble resented the perception of the forcing of technology, i.e, releasing the control of pedagogy. According to Noble, once “faculty converts its courses to courseware, their services are in the long run no longer required” (Redundant Faculty in the Virtual University, 1998, para. 1). The basic loss of job security and control of pedagogy was reflected in the quote and may be behind much of the reluctance verbalized by faculty regarding online curricula. Noble’s dire predictions in 1998 have not materialized. Online courses are not automated. Faculty are needed to continue to develop and modify content and to guide and interact with students. Faculty also make the final decision to
convert a course to an online format, although pressure from institutions appears to play a part in the decision (Kampov-Polevoi, 2010).

These impediments are critical barriers to the development, implementation, and eventual transfer of online courses. Some of the concerns can be overcome with experience and information. Faculty with experience in online education and teaching believe that the learning outcomes are as good as, or better than, comparable courses taught on campus in face-to-face environments (Lloyd et al. 2012; Seaman, 2009). Faculty who are engaged in online education have a more positive attitude toward online education. Upon overcoming the barriers, faculty become strong supporters of online education. Despite this, the plethora of technology can be overwhelming even to the most tech savvy instructors (Kim & Bonk, 2006; Rienties, Brouwer, & Lygo-Baker, 2013).

One of the keys to engaging faculty may rest on developing more user-friendly technology to allow faculty to view it less as a replacement and more as a support tool. The development of learning content management systems (LCMS), such as Blackboard (once called WebCT), eliminated many of the early technical difficulties associated with online education. Dahlstrom, Brooks, and Bichsel (2014) reported that 99% of institutions use some type of LCMS, and over 70% of all faculty indicated that the LCMS improved both teaching and student learning. Although a number of learning content management systems exist, Blackboard is among the most popular found in the academic setting. It is established in the majority of college campuses (Coates, James, & Baldwin, 2005; Dahlstrom et al., 2014). Blackboard incorporates a wide range of pedagogical tools to provide a means with which to create virtual learning environments for students.
These learning management systems also are adaptable for use in traditional courses, making it difficult to draw the line between traditional and online courses (Coates et al., 2005).

Blackboard allows for more interaction between the student and the instructor, resulting in the instructor’s ability to use both asynchronous and synchronous communication depending on the pedagogy. Contrary to Noble’s (1998) prediction, the modern learning management system does not replace the instructor; rather, it gives the instructor the tools to develop and deliver the course and content in a myriad of ways (Skylar, 2009). The technology is winning the hearts of minds of higher education academics, but some biases are ingrained in higher education (Allen & Seaman, 2010, 2011, 2012). Blin and Munro (2008) reported that approximately 95% of academic staff in higher education felt that the traditional lecture presentation of a course was the most effective means for students to reach learning outcomes.

Schools need to offer a wide variety of online programs, as modern students shop for specific classes to fit their needs. Education is trending toward an “a la carte approach,” in which students simultaneously take courses from a number of schools (Williams, 2009). Students selecting courses from alternative schools can drain an already tight academic budget.

Quality in Online Programs

“Public opinion has long been negatively affected by media accounts of cheating scandals, diploma mills, fake degrees, and the aggressive advertising of for-profit online colleges” (Wright, 2014, p. 19). One of the major concerns expressed regarding online education is in relation to accountability and the quality of the education. Although the
pedagogy employed by an instructor on campus frequently is not subject to quality assurance, teaching online is different. Defleur and Adams (2004) reported that instructors have concerns about the efficacy of online education. Wright (2014) and Allen and Seaman (2014) reported similar concerns a decade later. Allen and Seaman (2014) found that 26% of academic leaders felt the learning outcomes for online courses are inferior to the comparable face-to-face courses. For faculty, that number is nearly two thirds of all respondents who believe learning outcomes are inferior in online courses when compared to face-to-face courses (Allen & Seaman, 2013). Many issues drive this fear. Some are focused on students cheating, others are based more on ineffective teachers, and others involve lack of familiarity with the online format.

Quality control of the content and determining the extent to which teaching and learning occur are important measures of accountability (Meyer, 2014). Many attempts have been made to develop best practices for online programs, but these have yet to dispel the skeptics in academics who are accustomed to traditional class formats (Parker, 2004; Shelton, 2011; Sloan Consortium, 2015; Wright, 2014). Quality and accountability concerns relative to online education result from the viewpoint that learning can occur only in a classroom under the watchful eye of the instructor. Many instructors have difficulty in believing that students work when they are not scrutinized. This negative perception can affect the acceptance of credits earned through online programs.

Online education at one time was the wild west of academics. It was challenging to assess the quality of the wide variety of programs and to determine whether learning objectives were being met. Those days are gone, but the perception lingers (Parker, 2004; Allen & Seaman, 2011, 2012, 2013). Defining quality in a classroom is difficult.
The old colloquial expression, “I will know it when I see it,” applies to describing quality in any educational program. No one definition describes a quality classroom experience (Shelton, 2011). Definitions of quality in consumer products are focused on a comparison of expectations for performance; this definition may not be the ideal description in higher education (Bailie, 2014). The consumers of education (students) may not be the best arbiters of that which determines quality in the classroom (Brockx, Spooren, & Mortelmans, 2011). Another problem involves determining the way in which academic freedom fits within the measure. The end result is that many of the benchmarks and standards were developed to fit only the particular institution’s needs, goals, and students (Parker, 2004; Meyer, 2014; Shelton, 2011).

The Sloan Consortium (2015) identified 5 Pillars of Quality Online Education that form the foundation of a quality online program. The Sloan Consortium framework is nearly too broad for developing an online course, but it serves as a guide to identify an effective online program. The pillars include general concepts such as “online students’ learning should at least be equivalent to that of traditional students” (Our Quality Framework, 2015, para 4). They do not suggest a way to implement the pillars. Shelton (2011) examined 12 paradigms for evaluating the quality of online education. Most of the programs that Shelton discussed focused strongly on institutional support. Stewart, Goodson, Miertschin, Norwood, and Ezell (2013), as well as Sims, Dobbs, and Hand (2002), described a proactive evaluation over the normal reactive student evaluations of instruction. A proactive evaluation for an online course involves addressing all factors associated with a successful evaluation at the beginning of the course, rather than at the end, when it is too late to make adjustments.
The perception of low quality in online distance education courses may remain from fraudulent distance education correspondence schools or from a lack of clear research data (Baron & Crooks, 2004). Over the last decade, numerous general studies have compared online and traditional courses, although a dearth of studies have involved science lab courses. The problem is magnified when a school refuses to transfer or to accept an online course for a program prerequisite due to a bias of poor quality. All though most four-year schools offer online classes, the academic administrators are reluctant to accept online degrees or partial online degrees for faculty appointments or for admission into graduate programs (Adams & DeFleur, 2005; DeFleur & Adams, 2004; Karl & Peluchette, 2013). Several sources have reported that given comparable histories, candidates with traditional degrees are scored higher than those with online degrees (Karl & Peluchette, 2013; Wright, 2014). This reluctance to accept online credentials can bleed into the acceptance of online courses for transfer or for prerequisites.

Very little research has been conducted concerning the acceptability of online courses, particularly science courses, as criteria for transfer. Faculty are more likely to accept online courses in the arts, humanities, history, or social interaction than in methods programs such as science (Adams, Lee, & Cortese, 2012). A great deal of anecdotal evidence has indicated that schools are reluctant to accept online science courses for transfer credit. West Virginia University clearly states that “Lab course credit that is earned through self-taught, online or correspondence will not transfer as direct equivalent course credit” (West Virginia University, 2015, para. 3). The University of Connecticut refuses online credits in laboratory sciences and foreign language (University of Connecticut, n.d. para. 3). Although some schools post their reluctance to accept online
courses for transfer, few studies have supported this reluctance, and fewer track the success of online students (Adams et al., 2012; DeFleur & Adams, 2004).

**Academic Integrity in Online Programs**

Accountability also should focus on the student and academic integrity. A perception exists that it is easier to cheat in an online course; thus, students are more likely to do so (Grijalva, 2006; Wright 2014). “Some educators cast doubt on the quality of online courses and make a point that online degree programs are too susceptible to fraud and can devalue a college degree” (DeFleur & Adams, 2004, p. 152). This fear has developed from a lack of trust in the student enrolled in the course, but it also has developed from past experiences with cheating behavior. Rutgers University clearly states on their website that “courses without mechanisms to insure academic integrity, such as secure testing practices, may not be awarded transfer credit” (Rutgers School of Arts and Sciences, n.d. para. 6). Students may experience difficulty in proving that all of their courses meet this criterion. “In fact, this belief is so pervasive that our administrators demand to know what methods we are employing in our online classes to reduce the frequency of cheating, yet make no such demands for our face-to-face classes” (Dietz-Uhler & Hurn, 2011, p. 74).

The quality of an online program is linked to the integrity of the students taking the course. Unfortunately, cheating is common on American campuses and extends to online classes as well (Raines et al., 2011). Cheating on campuses is not a new phenomenon. A study of 11 colleges in 1952 found that two thirds of the students admitted to cheating (Harp & Taietz, 1966). In 2011, Jones found that 59% of students intentionally cheated on an assessment. Additional studies also have indicated that a
majority of students have or are willing to cheat (Davis, Drinan, & Gallant, 2011; McCabe, Butterfield, & Trevino, 2012). Although cheating has been an ongoing problem, the potential for cheating should not be ignored.

It has long been assumed that cheating in an online class is a larger problem than in a traditional face-to-face class (Dietz-Uhler & Hurn, 2011; King, Guyette, & Piotrowski, 2009; Watson & Sottile, 2010). This perception may remain from fraudulent distance education correspondence schools or a lack of clear research data. It is of no consequence, as the perception of embedded dishonesty negatively impacts the integrity of all online courses (Baron & Crooks, 2004). Perceptions of dishonesty may be greater than actual occurrences of cheating. Plenty of anecdotal stories about cheating online have caused one to pause, but anecdotes are not data. The data in many cases are inconclusive and incomplete (Baron & Crooks, 2004; Raines et al., 2011; Watson & Sottile, 2010). Although this may not a critical issue, as previously considered, it is still central to online course management because:

in the absence of the physical proctoring of course work and confirmation of the student’s identification, the question of who is taking an examination or completing an assignment and how information is being accessed is problematic to some faculty and administrator. (Raines et al., 2011, p 80)

Interestingly, face-to-face courses are not required to check student identification or to inquire as to the individual taking an exam. Watson and Sottile (2010) found that academic dishonesty is more prevalent in face-to-face classes. Regardless finding ways to develop pedagogy that limits cheating as a concern is crucial.
Heberling (2002) and Moten, Fitterer, Brazier, Leonard, and Brown (2013) suggested that it may be harder to cheat in an online class, as the format is easier to prevent and detect cheating behavior. However, cheating is not inevitable simply because a class is online. Pedagogies developed through a learning platform can reduce and prevent cheating. The learning platforms include tools that allow the instructor to examine work for plagiarism. Learning platforms also can limit the amount of time for an exam which inhibits a student’s ability to find answers (Moten et al., 2013).

Grijalva (2006) found that cheating and academic dishonesty are the same in online and traditional courses. Other studies have indicated that more dishonesty occurs in face-to-face courses than in online courses (Dietz-Uhler & Hurn, 2011; Stuber-McEwen, Wiseley, & Hoggatt, 2009; Watson & Sottile, 2010), as students in online classes are spread out geographically. Thus, the ability of a student to panic and to cheat by looking at another’s paper is non-existent. Planned cheating, or using notes, is somewhat harder to prevent online, but it can be mitigated by limiting the time the test is open and by randomizing the questions. Developing a strong policy that defines cheating and plagiarism and the costs associated with dishonesty is an important deterrent to unethical classroom behavior, whether on campus or online (Grijalva, 2006; Watson & Sottile, 2010).

**Students Who Take Online Courses**

In the final analysis, the efficacy of online programs, whether in terms of student learning outcomes or retention, is directly related to the suitability of the format to the audience (Yu, Digangi, Jannasch-Pennell, & Kaprolet, 2008). Colleges are rapidly expanding online programs without a true understanding of the reason students choose
online courses (Jaggars, 2014). Describing the typical online student has become more difficult, as more students take at least one online class in order to complete a degree (Allen & Seaman, 2010b). Online students typically do not always fit the mold of the traditional student with whom colleges are used to working. Peters (2001) and Colorado and Eberle (2010) described the online student as having more experience in life through personal encounters and the working environment. Online students study and process information differently than those in traditional courses, resulting in enhanced study if they work in the field about which they are studying. Students taking A&P while working in the allied health field fit this description. As online students have more work experience, this affects their motivation and success. Learning and teaching in online courses should consider the special conditions in which distance students live (Colorado & Eberle).

Many students find it prohibitive to attend traditional campus programs. Older students with full-time jobs and children cannot find the necessary flexibility in a traditional classroom (Colorado & Eberle, 2010). Online classes provide the flexibility to meet their responsibilities and to attend to their classwork. Online programs also serve military personnel posted at distant bases. Online courses generally serve working adults, particularly women with young children who cannot access a traditional campus (Colorado & Eberle, 2010; DeFleur & Adams, 2004).

Wallace (2007) stated that flexibility, which is the core for distance and online education in particular, is attractive to two primary groups of students: those employed full time, and those who live a geographic distance from the school. The reasons that students in the Dutton et al. (2002) study took online classes aligned with the Wallace
study. The primary reasons listed by the students in the Dutton et al. study were to avoid conflicts with other responsibilities and to avoid travel to campus. Work and childcare appeared to be the two greatest outside responsibilities of the students. The Allen and Seaman (2007) survey of chief academic officers agreed with both Dutton et al. (2002) and Wallace (2007). They found that 73% felt “online education reached students not served by face-to-face programs” (Allen & Seamen, 2007, p. 11).

According to Dutton et al. (2002), 43% of the online computer students were taking only one class, compared to 9% of the traditional lecture students. They stated that “82% of the lecture students carried 12 or more semester hours while only 38% of the online students were full-time” (p. 6). Driscoll, Jicha, Hunt, Tichavsky, and Thompson (2012) reported similar findings. In the Driscoll et al. study, online students took an average of 10.6 credit hours compared to the 14.59 taken by face-to-face students, but the difference in credit hours did not impact the overall success of the student.

A prediction is difficult to make regarding the existence of an age differential between students who select an online course versus a face-to-face presentation. Dutton et al. (2002) found that online computer students were slightly older, at 27.6 years, than lecture-based students who were 22.5 years old. Until recently, online learners were considered to align with the non-traditional student model; however, recent data appears to indicate a change in demographics. Driscoll et al. (2012) found no difference in age between undergraduate students taking online sociology. In their study, mean age of online students was 22.6 years and 21.4 years for face-to-face students. Yu et al. (2008) reported that younger students were more likely to take online classes. These results are
counterintuitive, as older students tend to have more outside commitments that would cause difficulty in taking conventional classes. They hypothesized that the younger students were more tech savvy and thus more comfortable in an online environment. Conversely, Colorado and Eberle (2010) discovered that younger students have a more difficult time in online programs, which they attributed to student motivation and self-discipline. Radford (2012) found that “Older undergraduates and those with a dependent, a spouse, or fulltime employment participated in both distance education classes and degree programs relatively more often than their counterparts” (p. 3). In Radford’s study, 15% of undergraduates under the age of 23 took online classes, whereas 26% of the 24-29 age group and 30% of the students over the age of 30 took online classes. The age of the students appeared to depend upon the courses and school in which the data were derived.

Wojciechowski and Palmer (2005) noted that computer literacy was a major challenge facing online students. Yu et al.’s (2008) hypothesis that younger students may be more tech savvy was in agreement with Wojciechowski and Palmer. The younger demographic had fewer problems with computer literacy than older students who may not have been raised with computers. Without access to high speed electronic connections, computer literacy, and computer navigation skills, students will fail in an online course.

The success of online learners may relate more to their motivation, rather than to their age. Allen and Seaman (2007) found that 67% of the polled chief academic officers felt students need more discipline to succeed in online courses than in traditional classroom courses. Online students must be comfortable working on their own; typically
they do not need constant interaction with instructors and other students (Chen & Jang, 2010; DeFleur & Adams, 2004; Knowles & Kerkman, 2007).

Jaggars, (2014) questioned students as to their reasons for choosing an online class and flexibility and convenience were found to be the primary reasons. Students expressed that online courses allowed them to use their academic time more efficiently. Jaggars’ results align with those of the Radford (2013) study. Jaggars’ subjects focused on their busy lives and responsibilities, specifically childcare and 80% had jobs outside of school. The other reason students chose online courses was due to the online pedagogy that allowed for more active learning then a lecture format. Most students were uninterested in taking all classes online, specifically the more difficult classes. “Different students found different subject areas easier or harder, for many students it seemed that the words easy and difficult were code words for humanities versus math and science” (p. 12).

**Learning Models in Relation to Online Education**

In order to utilize the tools available on Blackboard, or on other learning platforms, educators must understand the way in which students learn. “The development of effective online learning materials should be based on proven and sound learning theories” (Anderson, 2008). Anderson (2008) argued that online learning needs to be addressed in terms of learning theory to best utilize enhanced communication and information retrieval that is available through the internet.

Schunk (2011) described learning as the “acquiring and modifying of knowledge, skills, strategies, beliefs, attitudes, and behaviors” (p. 2). Houston (2014) found it difficult to define learning and settled on a definition that incorporated the concept of a
“relative permanent change in behavior” (p. 5). De Houwer, Barnes-Holmes, and Moors, (2013) defined learning as “changes in the behavior of an organism that result from regularities in the environment of the organism” (p. 631). All of these definitions focused on changes in behavior. Additionally, previous experience also has played a critical role in learning, as learning occurs through experience. Historically, the bias has been that, although learning may not be confined to a specific environment, teaching can occur only within a traditional classroom. Schools are beginning to accept that both learning and teaching can take place outside of the classroom, which a critical concept that creates the foundation for distance learning.

The progressivism model by Dewey’s (1916, 1938) concentrated on the communication, collaboration, and interaction between learner and instructor. Dewey originated the theory of active learning or learner education. The progressivism model focused on experience, which translated into online programs that involve student interaction and non-traditional students with preconceived knowledge and life experiences. Knowles’ (1978) andragogy movement also emphasized adult learners.

Students enter higher education with a range of preconceived ideas based on prior knowledge, skills, and beliefs. This prior knowledge significantly affects their organization and interpretation of information (Van Doorn & Van Doorn, 2014). This is particularly important when working with non-traditional students. A constructivist’s view of learning focuses on building on preconceived information (Yilmaz, 2008; Kiraly, 2014). Learning is viewed as an active process that involves integrating knowledge from information extracted from the environment, thus building on stored memory.
Constructivism fits the online model for education, as students need to be more active participants in their learning experience (Van Doorn, & Van Doorn, 2014; Yilmaz, 2008).

An ongoing debate exists on the influence, if any, of the educational format on student learning. Clark (1983) referred to the media as a “mere vehicle” for the delivery of content, sentiment that he often reinforced (Clark, 1983, 1994, 2001). According to Clark, the delivery vehicle had no impact on learning “any more than the truck that delivers our groceries causes changes in our nutrition” (p. 446). He clearly stated “that media do not influence learning under any conditions” (p. 445). Clark’s medium was educational television. Although a number of papers refer to his study (Ally, 2004; Anderson, 2008; Bell & Federman, 2013), one can question as to whether these conclusions can be extrapolated to online learning. Television is not an interactive medium, whereas online education tends to have interactive and active learning components. Clark claimed that the educational strategy impacts learning, but he failed to grasp that it may be impossible to separate the strategy from the method of presentation. Thus, by default, the educational strategy applied to a face-to-face classroom is unlikely to be identical to the strategy applied to an online environment.

The result indicates that learning in an online environment may not be equivalent to learning in a face-to-face environment. The meta-analysis by Means et al., (2009) found that “on average, students in online learning conditions performed better than those receiving face-to-face instruction” (p. ix). The extent to which Clark’s theory regarding the medium’s affect on learning may not be applicable to online conditions.

Kozma (1991) and, later, Tamin et al. (2011) were diametrically opposed to Clark’s (1983) vehicle analogy. The authors asserted that the medium can serve as a way
to enhance a learner’s processing of information, as the learner needs the computer to access images and simulations. Schmid et al. (2014) stated that the “crux of the contrary argument revolves not around the impact of technology per se, but how it is used” (p. 272). The role of technology continues to be debated. However, as technology improves and expands, Clark’s theory concerning the impact of media on learning is falling by the wayside.

Cognitive learning theory focuses on dual channels for processing information: visual or pictorial channel and auditory or verbal channel (Mayer 2005; Swann, 2013). Multimedia learning theory focuses on the use of media for promoting learning. “Multimedia learning refers to learning from words and pictures” (Issa et al., 2011, p. 819). Multimedia learning capitalizes on cognitive learning theory by combining both visual and auditory components. According to Mayer (2005), multimedia instruction that is designed in accordance with the manner in which the mind works will lead to more meaningful learning. By necessity, online programs take advantage of multimedia learning.

Anderson (2008) went beyond Mayer’s (2005) multimedia learning and proposed a model correlated directly to the specific media of the internet. Anderson’s model focused on the interaction between teacher and learner, and on the student’s acquisition of knowledge in an online environment. The development of a community was key to quality learning. Although online learners work independently, they are not alone, as a community forms within the medium and the online learner gathers support from family and peers.
Active learning is typically characterized as any instructional method or pedagogy that engages students and requires their participation in the learning process (Morgan, Martin, Howard, & Mihalek, 2014). Active learning focuses on the activities within the classroom, as opposed to homework activities outside the classroom. In an online format, active learning components can be inserted as part of the learning platform and module (Dixson, 2012). Active learning has attracted strong advocates both inside and outside the classroom. Research has supported active instructional strategies over passive lecture-based modes of teaching to improve student learning outcomes in science courses (Haak, HilleRisLambers, Pitre, & Freeman, 2011; Maldarelli et al., 2009; Stuckey-Mickell & Stuckey-Danner, 2007). Science lab courses by their very nature involve student participation and, thus, characterize active learning. Additionally, online education can be constructed to encourage student interaction through discussion and interactive programming. An online environment that encourages persistent active participation with interactive programming and outside laboratory assignments maintains student engagement (Haak et al., 2011; Maldarelli et al., 2009).

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

Allen and Seaman in 2013 reported the results of 10 years of studies comparing online to face-to-face education. When they initiated the series in 2003, 57.3% of all academic leaders listed the learning outcomes in online courses as the same or superior to traditional programs. Over the course of 10 years that number has increased to 77%. Experience with online programs was correlated to a positive outlook in reference to student learning outcomes. Allen and Seaman did not examine specific comparisons between online and traditional courses.
The efficacy of online programs has been evaluated for a number of subjects. Emerson and MacKay (2011) sought to answer the following questions: “Did students studying online have more positive or negative learning experiences than those who studied the set of lessons online?” and “Which of these groups achieved better mastery of the material, and how did these results correlate with students’ prior attitudes and expertise, experience of the set of lessons, and workload stress?” (p. 727). The authors investigated an individual lesson plan on apostrophes taught through both online and traditional classroom settings. Prior to the beginning of both lessons, Emerson and MacKay administered a pretest on the students’ prior experience and confidence in using apostrophes. Questions were open ended or presented as a Likert 1-7 based format that indicated the students’ confidence in using the punctuation. After completion of the lesson, the students were tested on their ability to properly use apostrophes and provided general feedback on the lesson. They were then given another questionnaire that “focused on their levels of cognitive workload stress” (p. 729).

The goal of the Emerson and MacKay (2011) study was to limit as many outside factors as possible, including teaching quality, by focusing on one individual lesson. That also may have been a weakness, as one lesson cannot cover enough material to clearly address the efficacy of an online program, and the study’s length was insufficient. One lesson cannot be compared to the dynamics of an entire semester. Emerson and MacKay found no significant difference between the two groups on the preliminary questionnaires prior to the lesson. The posttest indicated a statistically significant difference in scores. The students in the traditional classroom scored 24% higher in their use of apostrophes than the online students. In this case, students may not have had an opportunity to
become accustomed to the format. Emerson and MacKay could not draw a conclusion as to the reason these results varied. They suggested that the issue may involve the way learning is assessed in an online environment, although they did not expand upon this conclusion. These weaknesses in the study prevented the authors from drawing a formal conclusion about the efficacy of online education.

Bhatti et al. (2009) studied the efficacy of teaching a lesson on hemorrhoids in a medical school. They covered the material in a podcast. Similar to Emerson and MacKay (2011), Bhatti et al. (2009) compared the results using a pre- and posttest. The students also were given a Likert (1-7) questionnaire on their preference for general teaching styles. Bhatti et al. randomly divided the class of 148 students in their first clinical rotation in surgery into two groups. One group was directed to a website for colorectal surgery and given access to a podcast on colorectal surgery. The other was directed to the face-to-face lecture. Concluding exams and satisfaction surveys were then administered. Bhatti et al. found no significant difference in the two groups on the baseline preliminary test, although the e-learning group had significantly higher scores on the posttest when compared to the group in the traditional setting. The authors concluded that e-learning packages can be effective tools for teaching.

One of the major strengths of the single lesson studies was ability to control for teacher quality; however, these studies also were limited due to their focus on only one lesson plan as opposed to a complete course or curriculum. There is a dramatic difference can be seen between one lesson and an entire course. Over multiple lessons, students could adapt to the format and improve their scores.
Urtel (2008) expounded the single lesson study and compared the effectiveness of a face-to-face and an online 300-level course. Urtel controlled for content and instructor by administering the online course through video lectures. Through these lectures, he was able to control for reading schedule, lecture progression, and performance assessments; however, he failed to utilize many of the features that strengthen an online presentation. Urtel also did not consider the topic, as the title of the course was not included in the study. His research found a significant difference in the final grades for both sections.

Driscoll et al. (2012) examined and compared student performance and satisfaction in both face-to-face and online sociology courses. The study built upon that of Urtel (2008), in that the sample courses were kept as similar as possible, but they also considered demographic and student satisfaction factors. Contrary to Urtel, Driscoll et al. concluded that “equally effective teaching format when the online course is designed using appropriate pedagogy” (p. 323).

Other studies followed student performance in business courses offered in different formats that used learning platforms. Daymont and Blau (2008) compared the performance of management students in online and traditional formats. When controlling for factors such as major, grade point average (GPA), and year in college, no significant differences were noted in the student semester scores. Other studies had similar results. Ary and Brune (2011) reviewed online and traditional finance courses through a comparison of points collected over the course of the semester as a measure of student performance, as well as the scores on pre- and post-tests. They concluded that the delivery method made little difference in student scores.
Xu and Jaggars (2013a) expanded their study beyond the confines of one school and followed a wide variety of online and face-to-face courses in the state of Washington’s community and technical college system. They found that online students who persisted to the end of the semester received a final grade that was lowered by 0.3 points. In another study, Xu and Jaggars (2013b) believed the deferential in grades may have been the result of student adaptability to the difference in format. They determined that younger students with lower grade point averages, as well as males and African American students, did not adapt and struggled with the different format. Although their sample was much larger than other studies, the wide variety of courses may have been a weakness.

Daymont and Blau (2008) and Ary and Brune (2011) reported the results of a comparison of semester total grades and total points; however, it was difficult to make a comparison between an online course and a traditional course, as the modes of assessment can be dramatically different. Means et al. (2009) identified over a thousand studies between 1996 and 2008 that compared learning objectives in online situations and found that approximately 50 were suitable for analysis. In order to be considered, the studies had to use a rigorous research design, measure student learning outcomes, and contrast online and face-to-face learning. The Means et al. mega analysis indicated very little consistent scientific design for comparing online and traditional classes. The most effective measure can be drawn only by giving the students in the compared courses the same assessment based on the course competencies or student learning outcomes.

In the face of these results, it is important to note that the presentation and assessment of online and traditional course formats are inherently different; thus, a
comparison of semester grades or collected points may not result in an accurate impression of student learning (Beleche, Fairris, & Marks, 2012; Sapp & Simon, 2005). Semester grades may be dependent upon differing assessments, resulting in a skewed comparison. The weakness of using a semester grade involves the way in which the grade is calculated. Assessments that work well in an on campus setting may not transfer to an online setting, and vice versa. Additionally, semester grades between instructors may be calculated on a different basis. Ideally a grade represents learning outcomes but that may not be the case (Beleche et al., 2012).

**Offering College-Level, Lab-Based, Science Courses Online**

According to Jaggeas (2014), students do not take science classes that they consider to be difficult through an online delivery method. That reluctance can be found on both sides of the classroom. Many instructors have had difficulty envisioning science lab courses online. The barrier is slowly breaking, but hesitancy continues on the part of instructors to teach online science lab courses and for advisors to recommend online labs (Allen & Seaman, 2012). Research has been minimal on successfully implementing an online lab science course, which is reflected in the general bias concerning teaching them.

Lab-based courses are critical in science education. The investigational skills developed in a lab course are crucial to the development of a student’s learning outcomes (Ma & Nickerson, 2006). A large number of scientists have found it difficult to imagine students experiencing or taking laboratory courses outside of a formal lab situation (Carnevale, 2003; Jeschofnig & Jeschofnig, 2011; Ma & Nickerson, 2006; Scott 2009; Steinke, 2012). The reluctance to accept online labs is the result of a number of factors.
In a 2012 dissertation submitted to Cappella University by Sherri Steinke, she noted that faculty were reluctant to develop online labs due to a lack of time, lack of skills, and limited face-to-face interaction. Jeschofnig and Jeschofnig (2011) found that faculty were uncertain as to ways to develop and offer a lab component in an online format. They also found that faculty have “difficulty moving outside of the box of the campus laboratory experience” (Why Science in Not Often Taught, 2011, para. 1). Faculty also were worried about safety issues when students work without supervision. Change is hard for individuals and should not be overlooked in analyzing the resistance to teaching labs online. Faculty who have been trained in a campus laboratory environment, and who have spent years teaching in such an environment, find it very difficult to change the way they present a lab. Maldarelli et al. (2009) stated, “Visual demonstration of laboratory procedures is a key element in teaching pedagogy” (para. 1). Many science educators are focused on the concept that the instructor should be present to demonstrate key scientific concepts.

Ma and Nickerson (2006) expressed concern regarding the future of lab experiences. They described a future in which instructors believe that technology, in the form of virtual experiences, are an improvement over hands-on laboratory experiences. Their argument was that students who do not take lab courses within the confines of the academic laboratory cannot acquire the hands-on skills necessary to understand and experience the scientific method. As stated by Bird (2010), “The 'hands on' approach has the potential to stimulate student interest in the subject matter, teach laboratory skills, enhance the learning of knowledge, give insight into the scientific method and develop scientific attitudes such as objectivity” (p. 13). Bird’s belief was that science can be
learned only in a formal laboratory. This bias is particularly focused on virtual labs, but it also encompasses all forms of laboratory courses taught outside the campus setting.

The bias against distance education lab courses has no scientific foundation. Andrea Scott’s (2009) dissertation for the Mississippi State University stated that, “Despite the ability to offer laboratory experiences at a distance, there is pervasive skepticism for teaching the laboratory based course online as a viable means for educating students in the sciences” (p. 4). Scott suggested that the reasons for the skepticism may be linked to a lack of understanding concerning the tools, kits, and software available to teach science laboratories online. Ma and Nichols (2006) suggested that the different camps between virtual and hands-on lab experiences were the result of measuring different educational objectives.

Although a number of studies have compared the efficacy of online and traditional courses, little research exists on student performance when technical laboratory courses have been moved to online platforms. Teaching a lab in an online environment is a new concept, and a great deal of the research can be found in dissertations that have yet to be published. In 2012, Deanna Essington Garmen submitted a dissertation to Tennessee State University comparing a series of biology courses in online and traditional formats. Her study involved a review of data from 170 traditional and 127 online biology sections over the course of three years. She examined grades, success rates by gender, success rates by health and non-health majors, and success rate based on non-traditional (≥25) and traditional (<25) ages. She found significant differences in the success rates of face-to-face students over online non-traditional students. The results did not apply to the traditional sample of students. Garmen’s study
was a review of past semester grades in all biology courses; therefore, she was unable to search for specific learning objectives.

The dissertation submitted by Regina Foster in 2012 to Oklahoma State University investigated the success of students taking online non-major general biology with a lab. The lab component was presented using household materials, in order for the students to have hands-on experience as opposed to virtual labs. Foster was interested in demographic factors that lead to success, and studied GPA, ACT, gender, age, socioeconomic status based on financial aid factors, interaction, and racial factors. Results revealed that the number of visits to the course material was a more important factor in determining online success than academic standing, gender, or age.

Barbeau et al. (2013) compared two histology courses, one taught online and the other face-to-face, that were taught simultaneously. The students in the study were senior undergraduates. The online labs were replaced with virtual microscope slides, although the face-to-face students continued to use a microscope. The students utilized the virtual slide images to locate and label structures. Barbeau et al. compared a number of independent assessments including laboratory assignments, laboratory quizzes, practical examinations, written examinations, and final grades. They reported no significant differences among the outcome between the two formats.

Amanda Rozenzwieg’s 2012 dissertation, submitted to the University of New Orleans, reviewed all biology courses at community college and compared the traditional and online semester grades and demographics. The study examined four courses: General Biology I, Microbiology of Human Pathogens, Human Anatomy and Physiology I, and Anatomy and Physiology II, the variable that may have affected grade performance.
in each class. The course format was found to impact grade performance in Microbiology of Human Pathogens and Anatomy and Physiology I. It did not appear to affect grade performance in Anatomy and Physiology II (Rozenzwieg 2012). Neither Rozenzwieg nor Garmen (2012) directly assessed student learning outcomes; therefore a determination of whether if student learning outcomes were impacted by mode of delivery was not possible.

Online education creates a fertile ground to develop instructional technology that can both motivate students and create active learning situations (Stuckey-Mickell & Stuckey-Danner, 2007). A growing list of tools is available for teaching labs online. The very nature of teaching these laboratories has been changed by developing technology. Laboratories can be taught with hands-on equipment, virtual components through purchased discs or programs, and remotely. Gopal et al. (2010) described their development of a cardiovascular lab using tools they found online. The lab was broken down into two sections: the heart and the vascular system. They concluded that technology helped to accommodate learners to achieve learning objectives but did not suggest that a virtual component should replace the traditional lab format. They clarified that “technological tools cannot completely replace the traditional teaching method to ensure high performance” (p. 509). This statement was biased as they tested only one virtual lab component. Attardi and Rogers (2015) worked with students who had more advanced biology backgrounds and came to a different conclusion: “Systemic Human Anatomy laboratory demonstration, whether it be the F2F or online format, will provide our students with a solid foundation for the next level of anatomical studies” (p. 9).
Ma and Nichols (2006) pointed to two characteristics unique to hands-on lab experiences. The first was that the “equipment required to perform is physically set up” and the second was that “the students who perform the laboratory are physically present in the lab” (p. 5). By focusing one’s presence in a lab, Ma and Nichols omitted an important option for hands-on lab experiences. Students can purchase laboratory kits from a number of sources including Hands on Labs©, eScience©, and several lesser known companies. In some cases, instructors assemble a specific kit that can be sent to the student. These kits contain all or most of the equipment necessary to complete the laboratory assignment (Scott, 2009). Hands-on practice allows students to experience the frequent disconnect that can occur between theory and practical application, and gives them the opportunity to solve problems that arise during the execution of the experiment. One disadvantage is hands-on experiences, whether in a traditional lab or through a kit, can be expensive (Ma & Nickerson, 2006).

Simulated or virtual labs are imitations of actual experiments that students can access through a disc or program. The advantages of virtual programs include the ability for students to repeat the lab several times, and they are much cheaper than kits. Students can also enter extreme variables to investigate the possible the end results. In a hands-on situation, both expense and safety prevent the repetition of lab experiences. Stuckey-Mickell and Stuckey-Danner (2007) used a combination of labeling labs, common in anatomy and physiology, wet labs, and virtual labs through the use of Virtual Physiology Lab from McGraw-Hill in a human biology course. They found that 87% of the students felt that face-to-face or hands on labs improved their understanding of scientific principles, whereas only 60% felt that the virtual labs had the same impact. They
hypothesized that the hands-on labs were written into the course content by a faculty member in order to fit into the pedagogy more so than the virtual labs that were simply added on. The students commented in the study that they felt they could receive immediate feedback from the instructors, which enhanced their understanding of the content.

Virtual components are becoming more common in on-campus traditional labs to replace expensive procedures and equipment (Ma & Nickerson, 2006; Stuckey-Mickell & Stuckey-Danner, 2007). A technical skill that is nearly universal in all biology labs is microscopy (Bird, 2010). Bird (2010) combined both a virtual component and a face-to-face experience to cover basic microscopy skills. The online module reinforced the laboratory experience. Bird found that the virtual component improved students’ understanding of the learning outcomes. As Bird has shown often a clean line no longer exists between virtual tools and traditional laboratory tools. If a traditional lab makes use of a virtual component to replace expensive equipment, how is that different than using a virtual component for teaching a distance lab? The running debate between distance labs and traditional labs may no longer be valid.

Remote labs have become a third option for teaching science labs online. Although originally designed for engineering and physics, remote laboratories are beginning to become more popular in other scientific fields as well. Remote labs allow students to manipulate real equipment through a web uplink (Corter et al., 2004; Hossain, Chung, & Riedel-Kruse, 2015). Corter et al. (2004) tested a small population of fewer than 30 students. When asked about the students’ perceptions of the value of the remote, 90% found them to be as effective or better than face-to-face labs. The student learning
outcome score for both hands-on labs and remote-lab content were nearly the same. Remote labs in biology are limited to only a few experiments that are specifically developed. Hossain et al. (2015) found that “biology online platforms are technologically feasible and have significant promise for future applications – especially for online education” (p. 89). In order for this to be a practical solution, automation will need to become more affordable.

**Anatomy and Physiology and Its Importance in Allied Health Programs**

A&P courses function as gateway courses to most allied health programs and form a critical backbone in those programs (Abdullahi & Gannon, 2012; Nguyen & Tawde, 2014; Sturges & Maurer, 2013).

New nurses must understand a range of nursing knowledge and science, from normal and pathological physiology to genomics, pharmacology, biochemical implications of laboratory medicine for the patient’s therapies, the physics of gas exchange in the lungs, cell-level transport of oxygen for the acutely ill patient, as well as the human experience of illness and normal growth and development – and much more. (Benner, Sutphen, Leonard, & Day, 2009, p. 1)

A&P typically is taught in a two-semester format that combines both a lecture and lab arrangement. A&P is a common prerequisite across a majority of allied health programs (Abdullahi & Gannon, 2012; Sturges & Maurer, 2013). A&P forms the foundation for a variety of allied health programs including nursing, radiography, physical therapy assistant, occupational therapy assistant and many others. Students need the knowledge and foundation gained in A&P to succeed in healthcare professions and to pass licensing exams (Sturges & Maurer, 2013). It has been well documented that
success in A&P courses correlates to later success in the allied health programs (Crane & Cox, 2013; Harris, Hannum, & Gupta, 2004; Maurer, Allen, Gatch, Shankar, & Sturges 2012; Sturges, & Maurer, 2013).

Abdullahi and Gannon (2012) found that A&P was a major obstacle for community college students who attempt to enter allied health careers. Harris et al. (2004) found that one third of their students received grades of D or F, and an additional 8% (9 of 107 students) withdrew from A&P. Maurer et al. (2012) found that as many as 50% of A&P students failed to earn a C in class; thus, they were unqualified for an allied health program. Maurer’s students were forced to retake the class, change to a non-allied health major, or drop out. The high attrition and fail rate in A&P can prevent students from continuing with their course of study. Success in A&P clearly has been identified as problematic in pre-registration students, and has been a major source of anxiety for students (Raynor & Iggulden, 2008; Maurer et al., 2012; McVicar, Andrew, & Kemble, 2014). Crane and Cox (2013) stated “the importance of bioscience education to nursing practice has been long recognized, nursing students, as a group, have a well-documented struggle with science subjects” (p. 26).

Harris et al. (2004) found that student success in the first semester A&P was correlated to four factors. They considered a number of independent variables:

- age, sex, type of degree desired, desired (associate’s, bachelor’s or master’s),
- number of hours per week of paid employment, number of credit hours of coursework during the study semester (including the 4 credits of Anatomy & Physiology), number of children at home, number of mathematics and science
courses taken in high school, number of credit hours of mathematics and science coursework completed in college, and science attitude score. (p. 168)

Their study found that success was linked to the number of mathematics and science courses of the student in both high school and college, the number of credit hours in college that the student was currently taking, and the number of employment hours the student worked outside of school.

Harris et al. (2004) developed a model based on the results of their study. They predicted that the student’s grade would decrease 0.77 points for every credit hour they took, and it would decrease 0.20 points for every hour the student worked per week. They also predicted that the student’s grade would increase for 2.9 points and 0.481 points for every additional high school and college mathematics and science course taken. Harris et al. also found a non-significant negative correlation in grade related to the number of children the student had. The Harris et al. equation is as follows:

\[
\text{Final grade} = 74.7 + 2.9 \cdot \text{HP} + 0.481 \cdot \text{CP} - 0.77 \cdot \text{CC} - 0.20 \cdot \text{WT}
\]

Where:

- \( \text{HP} \) = high school preparation (the number of high school mathematics and science courses completed)
- \( \text{CP} \) = college preparation (the number of college mathematics and science credit hours completed prior to taking Anatomy and Physiology)
- \( \text{CC} \) = current credits (the number of credit hours of college coursework being taken during the study semester)
**WT** = work time (the number of hours per week of paid employment during the study semester). (p. 171)

Although Harris et al. made some interesting points; they also made some questionable assumptions. They did not focus on the time that students study or take into account non-traditional students (Ryabov, 2012). For non-traditional students high school courses may have a lesser impact on overall success. The formula also does not factor in motivation (Hart, 2012). Additionally, the Harris et al. equation was not tested on future semester A&P students. However, one import finding, was that nursing students tended to have more negative indications, such as poor science preparation, more work hours, and more dependent children. The result was that more nursing students fail to reach the grade of C or above that allows them to continue with their programs (Harris et al., 2004).

The Harris et al. (2004) equation was not reiterated in future papers, although their general conclusions were repeated. Abdullahi and Gannon (2012) and Crane and Cox (2013) both supported Harris et al. (2004), reporting that students in community colleges perform poorly in A&P due to a limited background in the introductory material. Student success in A&P was found to be related to a decreased external workload and improved academic preparation. The high failure rate in A&P translated into fewer students meeting the basic entry requirements to successfully progress into their selected program (Crane & Cox 2013).

Tallitsch et al. (2012) noted that computer-assisted learning (CAL) provided an effective supplement to the teaching of A&P. CAL was able to provide additional resources and alternative modes of learning. Stirling and Birt (2014) expanded their
study beyond CAL, and utilized multimedia eBooks in the teaching of cardiac anatomy. The eBook content delivery resulted in higher practical and final scores (Stirling, & Birt, 2014). As online programs can offer a variety of modes of presentation, it is possible to extrapolate the results from Stirling and Birt and Tallitsch et al. (2012) to the teaching of A&P online.

A&P and allied health faculty should examine methods to improve student success while maintaining high learning standards. According to Scott (2009), students and faculty have expressed a bias that taking an A&P in the traditional format is better for students, and student learning is less effective in an online environment, although no data support this position. Whether this bias is supported by research, it can lead to problems when students attempt to transfer online A&P into allied health programs.

**Retention and Persistence in Online Courses**

Attrition is one of the more common concerns for online courses. The drop/fail rate tends to be higher than traditional courses (Angelino et al., 2007; Boston et al., 2014; Capra, 2011; Hart, 2012). Attrition, is not only detrimental to student success, but it also negatively affects the institution financially (Johnson, 2012; Liu et al., 2009). Low student success can impact accreditation as well. As a result, gauging those students who will be successful candidates for online programs is important (Boston et al., 2014; Hart, 2012).

Willging and Johnson (2009) reported that attrition in an online program is related to issues of isolation, disconnectedness, and technological skills and problems. Other problems included the demanding nature of the program and lack of communication which relates to feelings of isolation. Jones, Packham, Miller, and Jones (2004), as well
as Jones (2011), divided the reasons for withdrawal from online courses into intrinsic barriers or school controlled issues, and extrinsic barriers outside of the school’s domain. Intrinsic barriers include technical problems, readiness for the course, the quantity of coursework, and the nature of the course. Extrinsic barriers include “student’s academic profile, their family situation, employment and nature of job, and available study time” (Jones et al., 2004, p. 119). The most pressing issue facing students appeared to be employment issues, with 40% of the students reporting that job issues were the cause of their withdrawal from class. The difficulty of the coursework appeared in both studies (Jones, 2011; Jones et al., 2004). A&P is a demanding program; combining a demanding program with non-traditional students who have outside commitments, and the isolation that can be found in online environments, may be a recipe for major attrition issues.

Urtel (2008) found that students enrolled in online sections had a statistically significant higher D-F-Withdraw rate (40%) than their peers who took the face-to-face section (21%). Shea and Bidjerano (2014) examined long-term persistence and hypothesized that students who took online classes would have a lower rate of graduation than those who did not. Upon controlling for high-risk backgrounds, they discovered that the opposite occurred. Contrary to their expectations, Shea and Bidjerano found that students who took online courses had a higher rate of graduation than those who did not. They also found that more at-risk students take online courses, thus skewing the success rates of online courses.

A number of studies have indicated that online courses are not ideal for all students (Ary & Brune, 2011; Sharma et al., 2013). Personal situations and stress can be important indicators of student success. Family situations such as marriage, number of
children, outside employment, and income also should be examined, as these factors impact the student’s need for flexibility and the time available to study (Aragon & Johnson, 2008; Cochran, Campbell, Baker, & Leeds, 2014). Lee and Choi (2011) found 69 factors that can affect online retention, which they classified into three categories: student factors, course factors, and environmental factors. Environmental factors include outside employment and financial and emotional support. In order to improve the success of individual students in A&P, it is important to find a measure that can predict the delivery system that works best for their individual situation (Cochran et al. 2014).

Knight et al. (2012) considered the reverse of attrition by questioning nursing students on the reason they remained in the program. Knight et al.’s subjects stated that support from family, friends, peers, and tutorial staff were critical in their success in the nursing program. They also listed financial costs for them and for their families as important factors. Although Knight et al. did not examine online courses specifically, their conclusions reflected the findings of Jones et al. (2004) and Lee and Choi (2011). Support from family, friends, peers, and the instructors is critical in retaining students in both online and face-to-face courses.

Integrating students into the campus or classroom communities is a key to student retention and persistence (Tinto & Cullen, 1973; Tinto, 1975, 1997, 1999, 2001). The Tinto model linked both formal and informal factors that can affect student attrition. Tinto’s model of social integration brought together Durkheim’s theory of suicide and the cost-benefit analysis from economics (Tinto & Cullen, 1973; Tinto, 1975). Prior models focused on academic potential and social status. Tinto focused on the lack of consistent and rewarding interaction described in the Durkheim suicide model and expanded it to
include the interaction in the social and academic domains of the college. According to Tinto, a student who has integrated socially, but not academically, may fail college. The reverse occurs when a student who is academically successful, but with insufficient social integration, withdraws (Tinto & Cullen, 1973; Tinto, 1975). External factors also can come into play. According to the cost-benefit side of the model, individuals choose activities for which they perceive the benefits outweigh the costs (Tinto, 1975).

According to Tinto (2003), “it remains the case that most students experience universities as isolated learners whose learning is disconnected from that of others” (para. 1).

In later works, Tinto focused on the manner in which colleges can foster student success. According to Tinto (1999), campuses should make a serious commitment to student success by focusing on high expectations and learning. Schools should provide students with academic, financial, and social support, as well as with feedback, should encourage academic and social integration (Tinto, 1999, Tinto & Pusser, 2006). Although Tinto did not emphasize it, he also included curriculum and pedagogy in these institutional policies. Although Tinto’s model can be applied to a number of pedagogies, it focused on traditional students living on campus. Tinto (2006a) suggested collecting a variety of data “on student attributes, abilities, goals, commitments, and pre-entry expectations, on the character of student social and academic experiences within the institution” (What Information is Needed, para. 1). Non-traditional students and those in online programs spend more time on social experiences outside the campus and those situations were not addressed in the evaluation. Tinto (2006b) did not entirely discount the student’s the external social network: “Where it was once argued that retention required students to break away from past communities, we now know that for some if
not many students the ability to remain connected to their past communities, family, church, or tribe is essential to their persistence” (p. 4). Knight et al. (2012), Jones et al. (2004), and Lee and Choi (2011) also noted that the student’s family and peers played a significant role in student success.

Academic and social integration cannot sufficiently describe the wide variety of school environments, student populations, and roles faced by students (Davidson & Wilson 2013). The proportion of students considered non-traditional has grown dramatically subsequent to Tinto’s model being published (Brock, 2010). Despite this, the foundations of the Tinto model remain the same. Tinto’s key to student retention and persistence was integrating students into the campus communities. This becomes a very different task when considering students who have a number of commitments and who, in many cases, are taking classes through an online program. Online students create a unique challenge, and rarely set foot on campus. Thus, incorporating these students into campus life is incredibly difficult. The Tinto model should be expanded to incorporate these students. Allen and Seaman (2007) painted a dismal picture of they can by asserting that online courses potentially distance students from academic integration, social integration, and the overall on campus experience.

Although Tinto did not apply the model to an online community, that does not indicate that it cannot be considered when addressing online student retention and persistence (Tinto & Cullen, 1973; Tinto, 1975, 1997, 1999, 2001, 2006a, 2006b). Creating an online community can be difficult, but it can significantly impact student retention. Online programs and learning platforms allow for communication between students and between the student and the instructor. They allow for one-on-one
relationships that may not be available in traditional classrooms. The significant factor for the instructor is to maintain open communication. Students who feel abandoned will not form the social and academic interactions that lead to success (Hart, 2012).

Studies have found Tinto’s model to be limiting when applied to non-traditional students (Park & Choi, 2009). Bean (1980) proposed a model for non-traditional undergraduate student persistence, that included the increased external pressures faced by non-traditional students (Bean, 1980; Bean & Metzner, 1985). Bean focused on four factors that influence retention of non-traditional students. The first, academic performance, reflects part of Titno’s persistence model. Students with a low grade point average are not academically integrated into the school environment. Bean also added educational goals, intent to leave, and environmental factors; but the Bean model did not focus as much on social interaction within the school environment (Barnett, 2011).

Non-traditional and online students tend to have fewer ties to the school community. In a number of ways, the Bean model described persistence in an online class more appropriately than Tinto’s model. Tinto did not focus on the external pressure face by non-traditional and online students, whereas Bean (1980) addressed these issues. A weakness with Bean’s model was that it did not focus on the social integration factor found in Tinto’s model. Thus, it did not address the increased isolation that can develop in the online environment (Hart, 2012).

Non-traditional students with families are consistently pulled in two directions. They face family stress due to academic obligations, while they simultaneously face academic stress due to family obligations (Wormus, 2009). They also may have jobs that put demands on their time and energy. Non-traditional and online students frequently
work more hours outside the home and are more likely to withdraw due to external demands. An online program allows these students the flexibility to work around their schedule. Despite the increased flexibility, “online courses have significantly higher attrition than face-to-face courses” (Hachey et al., 2013). Most persistence models discount the pressure faced by these students. Thus, they fail to describe the entire student population, particularly that of community colleges. These students consider school to be another job, and they tend to distance themselves from the social community of the campus. Online classes provide these students with flexibility to balance family and academics, but unfortunately, online classes also tend to isolate the off-campus student (Hart, 2012).

Communication, meaningful feedback, and support are critical to forming a social network that supports the student (Liu et al, 2009). Faculty must reach out to online students, but it also means that the student needs support from their external network of family and friends. Many schools fail to focus on the issues that face students as parents. Some attempts to incorporate the family unit into persistence models have focused on the student as the child, and not the student as the parent (Dennis, Phinney, & Chuateco, 2005).

Hart (2012) attributed personal resolve and determination as significant contributions to online persistence, which aligns with cost benefit analysis. Online students with the resolve and belief that the benefits of an education outweigh the cost tend to succeed (Knight et al., 2012). Students should be convinced that the challenges are worth the struggle. In order to accomplish this and to improve non-traditional student persistence in an online program, lines of communication must remain open, and faculty
must be available to provide encouragement and support throughout the learning experience.

**Assessing Learning with Student Learning Outcomes**

A shift has occurred from theoretical assessment toward outcomes-based competencies. According to Tam (2014), the move to measuring learning outcomes represents a “paradigm shift in educational philosophy and practice” (The Paradigm Shift, para. 1). Student learning outcomes-based assessment has become the norm in terms of accountability, accreditation, and performance indicators (Keshavarz, 2011; Kuh, Jankowski, Ikenberry, & Kinzie, 2014). Assessments based on student learning outcomes have become standard throughout higher education. Kuh et al. (2014) reported that 84% of institutions of higher education require the common learning outcomes for their students. Additionally, 84% of biology faculty considered learning outcomes to be useful learning aids (Dobbins, Brooks, Scott, Rawlinson, & Norman, 2014)

“Learning outcomes are concerned with the achievements of the learner rather than the intentions of the teacher” (Kaur, 2013, p. 8). All regional accrediting agencies have incorporated some form of student learning outcome assessment in their criteria. Student learning outcomes focus on that which students need (Howell et al., 2003; Kuh et al., 2014). The development of student learning outcomes has implications, not only on curriculum design and assessment, but also on quality assurance. Measuring student learning outcomes improves the transfer outlook for a course.
Learning outcomes concentrate on measurable changes. Davis (2003) defined learning outcomes as:

A culminating demonstration of learning; it is what a student should be able to do at the end of a course. Outcome-based education is an approach to education in which decisions about the curriculum are driven by the exit learning outcomes that the students should display at the end of the course. (p. 227)

Keshavarz (2011) described learning outcomes as a move from teaching to learning. Tam (2014) also focused on the student-centered nature of learning outcomes.

Kirtman (2009) found that much of the research has attempted to compare online and traditional classes, rather than focus on academic achievement or learning outcomes. The advantage of standard learning outcomes is that they are not dependent on pedagogy. Semester grades can reflect the combination of many assessments and assignments, thus the grades from two sections of the same course may not be equivalent. Brookhart (1993, 2013) discovered a wide range in grading practices among instructors. The inherent variation in grading results in grades being an unreliable form of comparison, despite the end of term grades being intended to express a level of achievement. In order to make a comparison between pedagogies and modes of instruction, the assessment method should be standardized.

Learning outcomes focused on student achievements and skills and frequently have been referred to as competencies. Kennedy (2008) described a competency as “a combination of attributes in terms of knowledge and its application, skills, responsibilities and attitudes” (p. 391). According to Kennedy, the lack of a precise
definition has led to confusion in the literature. Competencies that are written in terms of skills are interchangeable with learning outcomes.

Student learning outcomes should describe the skill or that which the student can demonstrate. They are active as well. Student learning outcomes should employ active verbs that describe the way in which the students demonstrate a skill (Kennedy, 2008). Student learning outcomes also should be collaboratively authored and aligned with the institution’s curriculum. They should be measured and assessed during the course (Maki, 2012). The key to developing learning outcomes is that they are specific, measureable, attainable, and tailored to the course or program.

Advantages and disadvantages exist in utilizing student learning outcomes. They can help instructors to better facilitate student learning and can supply schools, departments, and instructors with valid feedback (Kennedy, 2008). They allow for consistency when applied to courses that are delivered by numerous instructors. However, they are better suited for technical and vocational training than for more theoretical general education courses. They also may constrict the learning process, and often require a revamping of established pedagogy.

Summary

The increase in non-traditional students at community colleges has resulted in an increase in the demand for online science lab courses. To fulfill the demand, instructors have explored ways in which to teach labs online. The instructors at the Kentucky Community and Technical College have responded to this pedagogical issue by using virtual labs and lab kits. As has been discussed, a number of biases inhibit the development and transfer of online science lab courses. In order to increase transfer and
acceptance, a comparison of student learning between the two delivery formats is crucial. Bias will continue regarding the efficacy of online lab science courses, such as A&P, until a clear study is conducted to compare learning outcomes and retention. Part of the bias relates to the preparation of faculty. All online programs in the Kentucky Community and Technical College System (KCTCS) undergo a review process prior to implementation. Additionally, all online instructors in the Owensboro Community and Technical College (OCTC) and KCTCS undergo professional development specifically designed to train them in the skills needed to teach online, in accordance with Stewart et al. (2013).

A number of weaknesses can be detected in many of the online education studies. Kirtman (2009) found that most focused on specific teaching pedagogy without considering the learning outcomes, or they involved small samples resulting in difficulties in extrapolating the data to the larger population. It also is difficult to randomly assign subjects into treatments due to the nature of education, which is an inherent limitation in most course comparison studies. Other studies have focused on grades or individual lessons, which also could not be generalized to larger populations (Brookhart, 2013). It is possible to develop a valid instrument to test for learning outcomes that can be generalized to other similar courses. The KCTCS developed skill-based competencies for all biology courses taught in the system. These competencies can be used as learning outcomes. The current study uses an assessment developed from learning outcomes established by KCTCS for A&P. It also examines student attrition, demographics, choice of course format, and student satisfaction.
CHAPTER III: METHODOLOGY

Introduction

This study examined the extent to which learning outcomes are affected by instructional delivery method. The study also considered selected demographic and academic factors, as well as student satisfaction as they relate to choice of instructional method. Demographic factors such as age, gender, childcare, and job commitments are important issues that can impact student success. Academic features, such as grade point average (GPA), American College Testing (ACT) score, prerequisite courses in English and math, expected grade, and plans for continuing to the second semester, can impact retention and should be considered with the demographic factors. The study also examined questions concerning student satisfaction and choice of mode of instruction. Finally, the study addressed the attrition and persistence of students in the different modes of presentation.

This chapter describes the design and development of the study, including the processes employed to collect the data. The statistical model used to analyze the data also is discussed. The development of the instrument used to gather data is presented as well. Additionally, this chapter discusses the population and the description of the course studied.

Research Questions and Hypotheses

The purpose of this quantitative study was to determine whether A&PI could be taught online without affecting academic rigor, through a comparison of the successful completion of student learning outcomes, as well as to learn more about the students who take A&P. The study sought to identify the causes or relationships that exist between
online and face-to-face presentation of A&PI. It also considered retention related to the independent variables of online or face-to-face presentation.

The study was designed to answer the following research questions which were divided into hypotheses that were based on studies cited in the literature review.

**RQ 1: To what extent is student success (measured by student learning outcomes) affected by the course delivery method (online or traditional on-campus format)?**

- **H₁** There are significant differences in the total assessment scores between online A&P and the face-to-face sections.
- **H₂** There are significant differences in the sectional assessment scores between online A&P and the face-to-face sections.
- **H₃** There are significant differences in total assessment scores between the virtual lab, lab kit, and on campus labs.

**RQ 2: What is the relationship between selected student demographics and presentation format (online or traditional on-campus format)?**

- **H₁** There are significant differences in ages between online and face-to-face groups.
- **H₂** Student age impacts successful completion of learning objectives.
- **H₃** There are significant differences in outside commitments between the two groups. Outside commitments consist of:
  - The number of students who were parents.
  - The number of children living in the student’s home.
  - The number of hours the student worked outside the home.
  - Likelihood of working in the medical field.
• H₄ There are significant differences between the groups’ use of financial aid.

RQ 3: What is the relationship between selected student academic factors and presentation format (online or traditional on-campus format)?

• H₁ There are differences in academic readiness when a student enters college between the two groups of students. College readiness was determined by placement in remedial courses in English, reading, or math based on COMPASS test scores.
• H₂ There are differences in academic measures such as college GPA, projected grade, ACT scores, current course load, and completed credit hours.
• H₃ There are differences in the amount of time spent studying between the two groups of students.

RQ 4: What is the relationship between selected student satisfaction factors and presentation format (online or traditional on-campus format)?

• H₁ There are differences in how online and face-to-face students rate flexibility and scheduling conflicts when choosing a course format.
• H₂ There are differences in how online and face-to-face students rate learning environment in choosing a course format.
• H₃ There are differences in how online and face-to-face students rate social interaction in choosing a course format.
• H₄ There are differences in how online and face-to-face students value advice from faculty and students in choosing a course format.
• H₅ There are differences in how online and face-to-face students perceived that the instructor interacted with them or the class as a whole. These factors were considered communication.

• H₆ There are differences in how online and face-to-face students kept pace with the material. These factors were considered content.

• H₇ There are differences in how online and face-to-face students rated the course overall.

**RQ 5: What is the relationship between student retention and modes of presentation (online or traditional on-campus format)?**

• H₁ There are differences in persistence, as measured by the intent of returning to take APII in spring of 2015 between the two formats.

• H₂ There are differences in persistence, as measured by the intent of returning to take APII in the same format.

• H₃ There are differences in attrition rate between online and face-to-face courses.

**Limitations**

All research involves limitations which were discussed in Chapter I. When working with human subjects, the elimination of all variables is impossible. Every attempt was made to lessen the effects of the following limitations from this study.

• KCTCS policy made it difficult to contact students directly. Students had to be contacted through their instructors. Thus, instructors were contacted and passed the survey link to the students. This limitation affected the size and range of the study.
• Students could not be rewarded for taking the survey, thus they may not have been motivated to do so. The end result was that students self-selected into the study sample, impacting the student representation and sample size.

• Surveys were submitted with omitted material, e.g., surveys missing information that was needed to sort them into the online or face-to-face groups could not be processed and were eliminated. Surveys that were missing parts of the exam section were not eliminated, and they may have resulted in lowering of the overall student learning scores. Surveys that were missing other demographic or academic material were included in the study.

• The survey was not to be released prior to the end of the term. The survey was comprehensive, thus students may not have been familiar with all of the material. This limitation may have affected the scores for the material that is usually covered by the end of the semester.

**Description of Anatomy and Physiology I Course**

Several human biology courses are taught in colleges and universities that are entitled *Anatomy and Physiology*. Some of the lower level courses are offered for only one semester. The two-semester A&P courses explored the interrelationship between structure and function of each body system. In most schools, the two-semester, four credit hour A&P course with a lab served as the foundation and the gateway courses for many allied health programs. In the Kentucky Community and Technical College System, the first semester class is called *BIO 137 Human Anatomy and Physiology I* (A&PI) and includes basic chemistry, cell structure, cell physiology, metabolism, tissues,
integumentary, skeletal, muscular, and nervous systems. The full course description in the 2014-2015 KCTCS catalog is as follows:

The interrelationship and structure and function of each body system in two-semesters. The first semester will include basic chemistry, cell structure, cell physiology, metabolism, tissues, and integumentary, skeletal, muscular, and nervous systems. (Kentucky Community & Technical College System [KCTCS], 2014, p. 244)

The prerequisites for A&PI require that students (a) achieve reading and English assessment scores that allow them to enter the 100 level English courses or (b) they have completed remedial courses in English and reading. They also should have completed Basic Algebra (MAT 065) or received a math score above that which is prescribed for MAT 065 (KCTCS, 2014). Instructors also can give consent for a student to enter BIO 137.

The second semester, BIO 139 Human Anatomy and Physiology II (A&PII), extends the study of the interrelationship of structure and function and includes the endocrine, reproductive, cardiovascular, lymphatic, digestive, respiratory, and urinary systems. In order to limit other factors that may have contributed to students taking different modes for the two sections of the course, only students in the A&PI course were considered for this study.

In 2005, KCTCS developed a series of competencies and topic outlines for all biology courses (Appendix A). Biology faculty representatives (including the author of this study) from each of the 16 colleges within KCTCS agreed upon the competencies or learning outcomes. All BIO 137 courses offered in the KCTCS schools were required to
meet those competencies. An advantage for this study was that A&PI students from any of the KCTCS schools could have been considered part of the sample, as they were all expected to meet the same learning outcomes.

**Population**

KCTCS was founded in 1997 and consists of 16 colleges located on more than 70 campuses throughout Kentucky. Figure 2 shows the geographic distribution of KCTCS colleges throughout the Commonwealth of Kentucky. In the fall of 2014 semester, 87,027 students were enrolled in KCTCS. Table 1 shows the breakdown of student enrollment in each of the 16 colleges.

![Figure 2. Regional distribution of KCTCS campuses. The figure illustrates the distribution of campuses across the Commonwealth of Kentucky (KCTCS, “Colleges and campuses” 2015b).](image)

The sample for this study was derived from the population of students taking BIO 137 A&PI systemwide in the fall 2014 semester who voluntarily took the survey. According to KCTCS PeopleSoft, 4130 students were enrolled in BIO 137 at the beginning of the semester. Of those, 525 were enrolled in online courses and 3537 were taking the traditional face-to-face presentation. The remaining students were taking
hybrid or on-demand courses. An insufficient sample size of hybrid and on-demand students was available for this study.

Table 1

*Fall 2014 Total Student Enrollment at Individual KCTCS Colleges*

<table>
<thead>
<tr>
<th>Campus</th>
<th>Student Enrollment</th>
<th>Campus</th>
<th>Student Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashland Community &amp; Technical College</td>
<td>3,356</td>
<td>Jefferson Community &amp; Technical College</td>
<td>13,667</td>
</tr>
<tr>
<td>Big Sandy Community &amp; Technical College</td>
<td>4,659</td>
<td>Madisonville Community College</td>
<td>4,434</td>
</tr>
<tr>
<td>Bluegrass Community &amp; Technical College</td>
<td>10,961</td>
<td>Maysville Community &amp; Technical College</td>
<td>3,510</td>
</tr>
<tr>
<td>Elizabethtown Community &amp; Technical College</td>
<td>7,353</td>
<td>Owensboro Community &amp; Technical College</td>
<td>4,162</td>
</tr>
<tr>
<td>Gateway Community &amp; Technical College</td>
<td>4,594</td>
<td>Somerset Community College</td>
<td>7,017</td>
</tr>
<tr>
<td>Hazard Community &amp; Technical College</td>
<td>3,465</td>
<td>Southcentral Community &amp; Technical College</td>
<td>4,115</td>
</tr>
<tr>
<td>Henderson Community College</td>
<td>2,000</td>
<td>Southeast Community &amp; Technical College</td>
<td>3,661</td>
</tr>
<tr>
<td>Hopkinsville Community College</td>
<td>3,568</td>
<td>West Kentucky Community &amp; Technical College</td>
<td>6,505</td>
</tr>
</tbody>
</table>

(KCTCS, “ Colleges and Campuses,” 2015b)

**Procedures, Data Collection, and Analysis**

**Ethical Considerations**

In accordance with the guidelines of both Western Kentucky University and KCTCS regarding protection of human subjects, the survey was submitted for both
Institutional Review Board (IRB) approval and Human Study Review Board (HSRB) for approval (Appendix D). In accordance with KCTCS policy, participation in the survey was voluntary and anonymous. Only subjects over the age of 18 were accepted and students were not rewarded in any way. However, in order to encourage participation, students were told that the survey may help them as a practice test for their final.

As A&PI students plan to enter allied health fields that generally appeal to women, more women were expected to take the survey. It should be noted that OCTC and KCTCS are equal educational opportunity institutions. The following policy applies to all admissions within KCTCS:

The Kentucky Community and Technical College System is an equal educational and employment opportunity institution and does not discriminate on the basis of race, religion, color, sex (including pregnancy and gender identity), national origin, age, disability, family medical history, or genetic information. Further, we vigilantly prevent discrimination based on sexual orientation, parental status, marital status, political affiliation, military service, or any other non-merit based factor. (KCTCS “Privacy and Terms,” 2015a)

The KCTCS policy promises that students cannot be prevented from taking a course if they meet the prerequisites.

The survey initially directed subjects to the informed consent document (Appendix E), which included an acceptance link. Subjects over the age of 18 who accepted the conditions set forth in the informed consent document were directed to the survey. If subjects did not accept the conditions, they were thanked and the link directed
them out of the survey. Subjects who indicated they were under the age of 18 also were thanked and directed out of the survey.

**Data Collection**

The survey was assembled and loaded into *Qualtrics* prior to submission to both IRB (for Western Kentucky University) and HSRB (for KCTCS) (Appendix D). The students were contacted through their instructors. The KCTCS PeopleSoft © management system was used to obtain the names and e-mail addresses of the KCTCS instructors who were teaching BIO 137 in the fall 2014 semester. The A&P instructors were contacted through e-mail (Appendix F). The first outlined the study, and the second contained a study link and a message to be forwarded to their students (Appendix G). A reminder e-mail was sent one week after the study was opened. The survey was open for three weeks; beginning two weeks prior to the end of the semester and terminating at the end of the semester. As students were not contacted directly to determining a response rate was not possible.

Attrition data could not be gathered through the Qualtrics survey. Once grades were submitted, PeopleSoft © was utilized to locate information from all of the KCTCS BIO 137 sections. Attrition was measured for each section by adding the number of students who failed to those who withdrew and dividing by the total number of students who began the semester (see Figure 3).

\[
\frac{\text{# of students who failed} + \text{# of students who withdrew}}{\text{# of students who started the course}} \times 100 = \% \text{ student attrition}
\]

*Figure 3.* Equation used to calculate student attrition.
Data Analysis and Statistical Models

Prior to initiating statistical analysis the data was sorted and invalid results were removed. Incomplete surveys were evaluated; if insufficient information was available to categorize the student into either online or face-to-face, it was removed. In an attempt to avoid this issue, the study asked several questions, including section number and instructor, in order to improve the odds sorting the responses into either treatment (Table 2).

Table 2

Questions Used to Categorize the Respondents

<table>
<thead>
<tr>
<th>Question</th>
<th>Response Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>In which mode of BIO 137 are you currently enrolled?</td>
<td>(online, face-to-face, hybrid)</td>
</tr>
<tr>
<td>Which school is your home school?</td>
<td>(select from list of schools)</td>
</tr>
<tr>
<td>Please list the section number for your BIO 137 course.</td>
<td>(fill in the blank)</td>
</tr>
<tr>
<td>Please list the name of your instructor.</td>
<td>(fill in the blank)</td>
</tr>
<tr>
<td>How is the lab component for your class presented?</td>
<td></td>
</tr>
</tbody>
</table>

As the learning outcomes assessment was a critical factor, surveys in which the subject did not attempt the assessments were removed. Surveys from participants who had begun the assessments, but had not completed them were retained. Determining whether the respondent could not or chose not to answer the question was difficult to ascertain. The assumption was made that they could not answer the questions, and left them blank.

Open-ended questions included the time spent working and studying. Answers to both questions presented a problem, depending on the units of measure that the students used. The studying and working time units were converted into hours for consistency.
Once the data were gathered, statistical comparisons were made using SAS (Statistical Analysis System) software. Descriptive statistics of mean and significant difference were calculated for the variables. Chi square, \( t \)-tests, and ANOVA were used to compare the variables. An alpha level of \( p \leq .05 \) was utilized for all statistical tests.

A \( t \)-test was used to examine the differences between two groups on a specific variable. An independent samples \( t \)-test was utilized when comparing the means of two independent populations. The groups were assumed to be independent when a factor in one group did not affect what was known about the other group. Measures are considered to be appropriate when the mean is a good measure of the distribution of the variable. A \( t \)-test was used to examine the differences in a normally distributed variable between two groups (Spatz, 2011). This study utilized a \( t \)-test when comparing the factors of attrition, scores on learning outcomes, number of children, hours spent working outside the home, distance to campus, GPA, projected grade, ACT score, course load, completed credit hours, time spent studying, student choice, and student satisfaction. In situations that involved comparing the means of more than two groups, an analysis of variance (ANOVA) was employed (Spatz, 2011). A 1 x 3 ANOVA was utilized to compare the learning objectives between the lab formats of face-to-face, virtual, and lab kits.

The remaining variables were analyzed using a chi-square test, which is best utilized when examining categorical variables found in yes or no type questions. The chi-square test compared observed frequencies of independent variables with expected frequencies of those variables (Spatz, 2011). Chi square tests were utilized when comparing non-traditional and traditional student populations; experience in the medical
field; financial aid needs; completion of math, reading, and English remedial courses; and being the first person to attend college in their family.

Some of the measures required random sampling within the populations, i.e., with more face-to-face than online sections in Peoplesoft, an equal sample was created to compare attrition. When considering the attrition data, all online sections were considered; however, it was statistically necessary to use an equal sample size of face-to-face sections. In order to create these samples, a random number generator was employed using the SAS (Statistical Analysis System) Survey Select.

**Instrument Development**

The survey was developed as a causal-comparative/quasi-experimental, quantitative study in accordance with Creswell (2013) and Fowler (2014). Causal-comparative studies seek to link correlations between factors. In this study, the independent variables were the mode of the course presentation: online or traditional face-to-face. The dependent factor was the assessment of student learning outcomes (Slavin, 2007). The study sought to identify the causes or relationships that existed between the two factors, as well as other demographic, academic, and student satisfaction factors (Appendix C). It also considered retention as it related to the independent variables.

A quasi-experiment is so named because subjects cannot be randomly assigned to study groups (Fowler, 2014). Assigning students to a treatment group is unethical when the treatment group is a particular course (Barbeau et al., 2013). Additionally, a pre-test would not have had significant value, as students entering A&P had very little experience
with the topic. When combined, these aspects resulted in the study being a quasi-experiment (Fowler, 2014). The test instrument was developed with these issues in mind.

“Validity means that a tool measures what it sets out to measure” (Twycross & Shields, 2005, p. 36). Validity includes the entire survey method, and it is critical in determining whether a study meets the requirements of scientific research. A valid instrument must be able to address the hypothesis; and validity should be examined in light of content, prediction, criterion, and construct validity. Content validity can be measured by asking experts whether the instrument measured that which it was designed to measure (Twycross & Shields, 2005). The survey questions in this study were derived from a number of related research studies. Predictive and construct validity were measured by relating this study to current literature. Predictive validity is a measure of criterion validity. For this study, a correlation coefficient determined criterion validity.

Reliability also is a critical measure of a well-crafted survey tool. A reliable instrument can measure the variables, and it must be repeatable in the same circumstance. Reliability is frequently determined with retesting. In this study, the subjects remained anonymous due to the requirements of the KCTCS Human Study Review Board. Retesting of this sample was impossible; as the subjects were anonymous and scores could not be matched to individuals to determine any changes. Thus, reliability was established through the literature.

To maintain both reliability and validity, the survey questions were derived from other sources. This study examined a combination of unique factors; thus, finding one study tool that incorporated all factors was difficult. To solve this problem, the survey consisted of several tools to improve both reliability and validity. The general quasi-
experiment design was found in the Driscoll et al. (2012) study. Individual questions were supported by a variety of other studies.

The initial questions were used to categorize the respondents into the presentation method and home school (see Table 2). The name of the instructor and home school ensured that the survey was distributed throughout all of the KCTCS schools. The remainder of the survey was broken into demographic, academic, and student satisfaction questions and a 50-point exam feature based on student learning outcomes.

**Student Learning Outcomes Survey**

Measuring student learning outcomes is a critical means of assessing student learning (Anderson et al., 2005). Various studies have used student learning outcomes to measure learning (Ary & Brune, 2011; Bird, 2010; Driscoll et al., 2012; Helms, 2014; Khodamoradi & Abedi, 2012). Learning outcome questions for this study were based on the competencies developed by KCTCS. As previously stated, KCTCS developed a series of competencies for each biology course taught in the system. The competencies for BIO 137 can be found in table 3. A 10-point framework was developed based on both the course outline and competencies for A&PI (Appendix A). Five multiple-choice objective questions were fit into each level of the framework creating a 50-question exam (Appendix B). Students may have been reluctant to answer more than 50 questions for this portion of the survey.
Table 3

*Competencies for BIO 137 Human Anatomy and Physiology*

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Explain basic principles of inorganic and organic chemistry as they apply to physiological processes.</td>
</tr>
<tr>
<td>2.</td>
<td>Describe basic cell structure and physiology.</td>
</tr>
<tr>
<td>3.</td>
<td>Describe the structure and function of major tissue types.</td>
</tr>
<tr>
<td>4.</td>
<td>Recognize the complementarity of structure and function.</td>
</tr>
<tr>
<td>5.</td>
<td>Describe basic metabolic processes of organ systems.</td>
</tr>
<tr>
<td>6.</td>
<td>Explain the interrelationships between organ systems and physiological processes.</td>
</tr>
<tr>
<td>7.</td>
<td>Explain the major homeostatic mechanisms utilized in each body system in response to internal and external environmental changes.</td>
</tr>
<tr>
<td>8.</td>
<td>Explain physiological and anatomical mechanisms of common dysfunctions.</td>
</tr>
</tbody>
</table>

Locating pre-validated questions was critical in order to eliminate any validity issues that could have arisen due to a poorly designed assessment (Brown, Bice, Shaw, & Shaw, 2015). Bird (2010) used specific learning objectives when measuring the impact of learning online or face-to-face presentation of a microscopy lesson. Griff and Matter (2013) used the publishers’ test bank to assess student learning outcomes in undergraduate students. Brown et al. (2015) also utilized the publisher test bank questions in their study of in-class test performance in introductory anatomy and physiology. The validity of the learning outcome assessment questions could be demonstrated by the generally accepted use of publishers’ test banks, as well as these and other studies.

The questions to meet each learning outcome were developed from both the McGraw Hill Education and Pearson Higher Education test banks (McGraw Hill Education, 2014; Pearson Higher Education, 2014) (Appendix B). Both Pearson and
McGraw Hill publish several widely used A&P textbooks; therefore questions derived from their textbooks are commonly used to assess learning outcomes when teaching A&P. KCTCS does not use a standard A&P textbook. Rather, textbooks are chosen by the individual instructors or schools. As a result, more than one test bank was used to ensure that students had no advantage in the exam because of their familiarity with the questions. The general acceptance of the test banks and experience with the material were used to determine the validity and reliability of the questions for each learning outcome.

**Demographic and Academic Survey Questions**

Various demographic and academic factors were examined to determine differences in the sample groups between the online students and those in the face-to-face courses. Certain demographic issues, such as the number of children a student has at home and the number of hours they work at an outside job, can impact the time spent studying and, thus, impact academic success. Academic issues such as GPA, number of developmental courses taken, and ACT scores can inform the student preparation for the course and, thus, the likelihood of their success on the learning outcome questions. Students self-reported their GPA, ACT, and predicted grade in the course.

Demographic factors considered were age, gender, number of dependent children, the number of hours the student works outside the home, and experience in the medical field (Table 4). Other studies have considered the same factors. Murray et al. (2012) included gender and age in their study of a digital literacy course. The Harris et al. (2004) study of online A&P also asked gender, age, number of dependent children, and hours worked outside the home. Jaggars (2014) addressed the distance from campus as a

Table 4

*Questions that Address Demographic Issues*

<table>
<thead>
<tr>
<th>Question</th>
<th>Response Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is your age? (open ended)</td>
<td></td>
</tr>
<tr>
<td>What is your gender? (male or female)</td>
<td></td>
</tr>
<tr>
<td>Do you have any children? (yes or no)</td>
<td></td>
</tr>
<tr>
<td>How many children do you have living at home? (open ended)</td>
<td></td>
</tr>
<tr>
<td>Did you work outside the home this semester? (yes or no)</td>
<td></td>
</tr>
<tr>
<td>How many hours do you usually work per week? (open ended)</td>
<td></td>
</tr>
<tr>
<td>Do you currently work in the medical field? (yes or no)</td>
<td></td>
</tr>
</tbody>
</table>

Academic factors considered were GPA; projected grade; ACT score; course load; completed credit hours; completion of developmental courses in math, reading, and English; the student’s declared major; and time spent studying (Table 5). There are few prerequisites for BIO 137 A&PI. Those prerequisites listed in the catalogue concern the completion of those courses that prepare a student for college work in English, reading, and math or satisfactory COMPASS test scores. Low COMPASS scores and the need for remedial courses may indicate that students are not prepared to enter a difficult course such as A&P. Those that are not prepared for the course maybe less likely to succeed.

Students with an English COMPASS score under 74 or an English ACT score under 18 are required to complete at least one remedial English course. At KCTCS those courses are ENG 090 and ENG 091 Foundations of College Writing I and II. KCTCS requires students with a reading COMPASS score under 77 to take at least one remedial reading course. Depending on the student’s specific score they may be required to take
either or both RDG 020 Improved College Reading and RDG 030 Reading for a College Classroom. Students have more options for taking math courses if they do have a math COMPASS score that prevents them from taking college algebra. Some of the allied health courses do not require college algebra for instance the associates of nursing does not require algebra, although a bachelor in nursing does. College algebra (MAT 150) requires a COMPASS score of at least 36 or an ACT score of 19 or the completion of MAT 085 (Intermediate Algebra). The associates of nursing allows for the students to take MAT 110 (Applied Math) which does not require the completion of MAT 085. The variety of requirements can make the situation complicated.

Harris et al. (2004) included the number of credit hours taken and type of degree being pursued. Foster (2012) examined ACT and GPA, as well as socio-economic factors, by tracking financial aid status. Helms (2014) considered total credit to date, credit hours being taken that semester, GPA, and final course grade. Aragon and Johnson (2008) questioned participants on financial aid eligibility, hours enrolled, placement in developmental courses, and grade point average when they studied readiness for online programs. These and other sources lend validity to this section of the survey.
Table 5

*Questions that Ask About the Student’s Academic Background*

<table>
<thead>
<tr>
<th>Question</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is your projected grade in BIO 137?</td>
<td>(drop down box)</td>
</tr>
<tr>
<td>What is your best estimate of your current GPA (grade point average)?</td>
<td>(open-ended question)</td>
</tr>
<tr>
<td>Did you take the ACT?</td>
<td>(open-ended question)</td>
</tr>
<tr>
<td>If yes what is your best estimate of your commutative ACT score?</td>
<td>(open-ended question)</td>
</tr>
<tr>
<td>Please click all of the Math courses that you had or are currently taking.</td>
<td>(Math 055, 065, 085, 110, 150)</td>
</tr>
<tr>
<td>Have you taken any of the courses listed below?</td>
<td>(Reading 010, 020, 030)</td>
</tr>
<tr>
<td>Have you taken or are you currently taking any of the courses listed below?</td>
<td>(English 090, 091, 101, 102)</td>
</tr>
<tr>
<td>How many credit hours are you currently taking?</td>
<td>(open-ended question)</td>
</tr>
<tr>
<td>Approximately how many college credit hours have you completed?</td>
<td>(open-ended question)</td>
</tr>
<tr>
<td>Are you dependent of financial aid?</td>
<td>(yes or no)</td>
</tr>
<tr>
<td>How much time do you spend working or studying anatomy and physiology per week?</td>
<td></td>
</tr>
</tbody>
</table>

**Student Satisfaction Survey Questions**

Questions concerning student satisfaction can impact student performance in educational learning outcomes. All questions in this section were stated in a Likert scale of 0-4 and divided into two realms. The first focused on the reasons they chose the delivery (Table 6). The questions used in this section were derived from the tools employed by Shotwell and Apigian (2015) and Dutton et al. (2002). These studies helped to support reliability and validity in the student choice of format questions. The Likert scale for the first section was: 1 = does not apply; 2 = not important; 3 = somewhat important; 4 = important; and 5 = very important.
Table 6

*Student Choice of Delivery Format (0-4 point Likert scale)*

<table>
<thead>
<tr>
<th>Student Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opportunity for face-to-face contact with instructor</td>
</tr>
<tr>
<td>Opportunity for face-to-face contact with fellow students</td>
</tr>
<tr>
<td>Conflict between class time and work commitments</td>
</tr>
<tr>
<td>Conflict between class time and childcare commitments</td>
</tr>
<tr>
<td>Course scheduling conflict</td>
</tr>
<tr>
<td>Reduce time commuting to class</td>
</tr>
<tr>
<td>Motivation provided by regular class meetings</td>
</tr>
<tr>
<td>Flexibility in setting pace and time for studying</td>
</tr>
<tr>
<td>Better learning from hearing a lecture</td>
</tr>
<tr>
<td>Better learning from reading the lecture materials</td>
</tr>
<tr>
<td>Advice from adviser or other college official</td>
</tr>
<tr>
<td>Fewer classroom distractions</td>
</tr>
<tr>
<td>Quality of program</td>
</tr>
<tr>
<td>Advice of another student</td>
</tr>
</tbody>
</table>

The second section rated student satisfaction in terms of the delivery of the course (Table 7). The questions in this section were derived directly from the student evaluation of instruction surveys used at OCTC each semester since the fall of 2008. The Likert scale for the second section was: 1 = does not apply; 2 = strongly disagree; 3 = disagree; 4 = agree; and 5 = strongly agree. OCTC has used these questions on student evaluations of instruction since the fall of 2008. Additionally, Driscoll et al. (2012) and Helms (2014) used similar survey tools in their studies.
Table 7

*Student Satisfaction in Terms of the Delivery of the Course (0-4 point Likert scale)*

<table>
<thead>
<tr>
<th>Item</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>This course was well organized.</td>
<td></td>
</tr>
<tr>
<td>Active engagement in the course is encouraged.</td>
<td></td>
</tr>
<tr>
<td>Given the nature of this course information is presented at an appropriate rate.</td>
<td></td>
</tr>
<tr>
<td>Exams were consistent with material.</td>
<td></td>
</tr>
<tr>
<td>I receive timely comments and feedback about exams, papers, or projects.</td>
<td></td>
</tr>
<tr>
<td>My instructor was in frequent communication with students.</td>
<td></td>
</tr>
<tr>
<td>My instructor returned e-mails in a timely manner.</td>
<td></td>
</tr>
<tr>
<td>I would recommend this course to other students.</td>
<td></td>
</tr>
<tr>
<td>My experience in this course was positive.</td>
<td></td>
</tr>
</tbody>
</table>

**Persistence, Retention, and Attrition**

Persistence can be established only with further enrollment. As the respondents were anonymous, determining whether they enrolled in the next semester was impossible. Davidson, Beck, and Milligan (2009) tested a tool to predict persistence. Several of the questions were modified for use with this study. Davidson et al. considered a number of questions to predict persistence including a series referred to as “institutional commitment.” They found a high correlation between students who committed to attending the following semester and those that completed their degrees. For this study, students were asked whether they planned to take the next course in the series BIO 139 Human Anatomy and Physiology II and in what format they planned to take it (Table 8). As the tool was administered at the end of the semester, many of the students were already enrolled in the next semester, thus improving the reliability of the tool to measure persistence.
Table 8

Questions that Address Persistence

Are you planning on taking more courses in the Spring 2015 semester?
If you answered "yes" to the previous question, are you planning on taking BIO 139 Human Anatomy and Physiology II?
If you answered "yes," what format will your BIO 139 course be taught in?

As stated in Chapter I, Crawford (1999) described retention as “The maintenance of continued enrollment in classes throughout one semester” (p. 13). Attrition is the opposite of retention. Retention measures the number of students who continue with a class; attrition is a measure of the students who failed or withdrew. No method was available to measure retention, as students had already withdrawn and were no longer accessible at the end of the semester. Developing another means of recording attrition was important. Students who had failed or withdrawn in all BIO 137 sections were found in Peoplesoft after the semester grades were submitted.

Summary

The instrument and methodology described in this chapter were used to reach students over a wide geographic region. Due to the common competencies developed by KCTCS, all of the students in the sample were expected to reach the same learning outcomes. The common learning outcomes allowed for a baseline measurement that was unaffected by letter grades or other arbitrary measures. Furthermore, the survey was developed to examine numerous factors that can impact a student’s success in an A&P course. Chapters IV and V will examine the results of the study and draw conclusions from those results.
CHAPTER IV: RESULTS

Introduction

Technology has advanced to the point that lab courses can be offered online by replacing expensive lab equipment with a virtual component, or through lab kits that students purchase along with a textbook. The result is that the demand is increasing for online science labs programs. A perception exists that online science courses are less rigorous than face-to-face courses. Yet, a distinct lack can be seen rigorous analysis of the factors that hinder, or promote, success in a lab science class, such as anatomy and physiology, in the online or traditional format. Little is known about those who take online courses and there reasons. The focus of this study was to add to the limited data available concerning the success of teaching online laboratory programs, particularly A&P.

Purpose

The purpose of this quantitative study was to determine whether A&PI could be taught online without affecting academic rigor, through a comparison of the successful completion of student learning outcomes, as well as to learn more about the students who take A&P. The study sought to identify the causes or relationships that exist between online and face-to-face presentation of A&PI. It also considered retention related to the independent variables of online or face-to-face presentation.

Student learning outcomes were assessed using a 50-question examination aligned to the course competencies developed by KCTCS (see Appendix B). The intent of the study was to document differences in student learning and to correlate any additional factors that may affect student success, as well as to differentiate selected demographic
and academic factors between the two groups. Demographic factors, such as age, family responsibilities, childcare, and job commitments, are important issues that can impact student success. Further academic features can impact student retention such as grade point average (GPA); American College Testing (ACT) score; prerequisite courses in English, math, and reading; expected grade; and plans for continuing to the second semester. These factors should be considered, along with the learning outcomes in order to predict student success in an online science course. Moreover, the study investigated questions concerning the reasons students select a particular format and their satisfaction with the course. Finally, the study examined the retention rates of students in both modes of presentation. A narrative is presented that explains the results of the analysis and the results are presented in tabular and graphic format.

Methodology

A causal-comparative/quasi-experiment quantitative research design was utilized to compare the variables. Descriptive statistics of mean and standard deviation were calculated, after which t-tests, chi-square, or ANOVA were employed to identify the significant differences between the factors. An alpha level of .05 was used in the tests to determine the significance of the data, which were analyzed using Statistical Analysis System (SAS, 2014, SAS Institute, Gary, NC).

Variables

Independent variables were those that generated the dependent variables (Spatz, 2011). The independent variables of class format were defined as online, which referred to classes taught almost exclusively online using BlackBoard as a learning platform, and those that may have used BlackBoard but primarily met face-to-face for lectures and lab.
Dependent variables were impacted by independent variables. A number of dependent variables were recorded in this study. The student learning outcomes were the primary dependent variables measured by the comprehensive assessment. Retention also was a dependent variable, and attrition rates for A&PI were generated from PeopleSoft data.

Additional factors were used to distinguish between the two groups. Demographic factors, may have impacted student success and retention, to include student age and family responsibilities, including childcare, and job commitments, and academic factors such as GPA, ACT score, prerequisite courses, and expected grades. The study investigated questions concerning the reasons students chose a particular format and satisfaction with the format of the course.

**Study Sample**

During the fall of 2014 there were 143 sections of A&PI were taught in the KCTCS system (Table 9). According to KCTCS PeopleSoft, 4130 students were enrolled in BIO 137 at the beginning of the semester. Of those, 525 were enrolled in online courses, and 3537 took the traditional face-to-face presentation, for a total of 4062. Overall, 85.6% of the A&PI population took the course face-to-face and 12.7% took it online for a ratio of nearly 7:1. The remaining students took hybrid or on-demand courses that were not considered for this study due to insufficient sample size.
Table 9

*Frequency Distribution of A&PI Sections Across KCTCS*

<table>
<thead>
<tr>
<th>Presentation Format</th>
<th>Frequency of Sections Taught</th>
<th>Number of Students in Each Format</th>
<th>Percent of Total Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-Face</td>
<td>125</td>
<td>3537</td>
<td>85.6</td>
</tr>
<tr>
<td>Online</td>
<td>18</td>
<td>525</td>
<td>12.7</td>
</tr>
<tr>
<td>Other Formats</td>
<td>----</td>
<td>68</td>
<td>1.6</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td>4130</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 10 lists the number of students who participated in the survey (subsequent to removing unusable surveys) and compared those results to the percent of expected students based on the KCTCS A&PI population from Table 9. The sample size in Table 10 was determined by the number of students who answered the questions in the learning assessment portion of the survey. The number of participants varied throughout the study, as some participants did not necessarily answer all of the questions. According to the table, 66.7% of the sample took A&PI on-campus in a face-to-face format, and 33.3% took it online. The ratio between face-to-face and online was approximately 2:1. The sample represented a greater percentage of students taking the course online than the general A&PI population.
Table 10

*Frequency Distribution of Students Who Participated in the Assessment*

<table>
<thead>
<tr>
<th>Presentation Format</th>
<th>Number of Students</th>
<th>% of Survey Population</th>
<th>Expected % of Total Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-Face</td>
<td>122</td>
<td>66.7</td>
<td>85.6</td>
</tr>
<tr>
<td>Online</td>
<td>61</td>
<td>33.3</td>
<td>12.7</td>
</tr>
<tr>
<td>Other Formats</td>
<td>----</td>
<td>----</td>
<td>1.6</td>
</tr>
<tr>
<td>Total</td>
<td>183</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Note: Other formats represent students in hybrid and on-demand sections*

**Distribution**

Table 11 shows the individual representation from each campus. A total of 183 students participated in the survey; however only 157 included their home campus. Regarding the home campus question 56 online students and 101 face-to-face students were involved. Several students indicated “other” but listed the satellite campus of Jefferson Community and Technical College. All campuses do not teach both online and a face-to-face A&P courses. In the fall of 2014, online A&PI was offered by Ashland Community and Technical College, Hazard Community and Technical College, Owensboro Community and Technical College, Southeast Community and Technical College, Somerset Community College, and West Kentucky Community and Technical College. The survey participation was limited by the faculty members who distributed the link to their students and by the students willing to complete the survey.
Table 11

*Frequency Distribution of Schools for the Student Participants*

<table>
<thead>
<tr>
<th>Home School</th>
<th>Online</th>
<th>Face-to-Face</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashland Community &amp; Technical College</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Big Sandy Community &amp; Technical College</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Bluegrass Community &amp; Technical College</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Elizabethtown Community &amp; Technical College</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Gateway Community &amp; Technical College</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Hazard Community &amp; Technical College</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Henderson Community College</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Hopkinsville Community College</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Jefferson Community &amp; Technical College</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Madisonville Community College</td>
<td>5</td>
<td>40</td>
</tr>
<tr>
<td>Maysville Community &amp; Technical College</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Owensboro Community &amp; Technical College</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Somerset Community College</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Southeast Community &amp; Technical College</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>South Central Community &amp; Technical College</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>West Kentucky Community &amp; Technical College</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total Number of Students</strong></td>
<td>56</td>
<td>101</td>
</tr>
</tbody>
</table>

*Note:* Those that listed other as an option included one of the Jefferson campuses (Shelby campus) or North Carolina. Additionally, only some of the participants answered this question.

Figure 4 further compares the distribution of students throughout KCTCS with course format. The figure illustrates that distribution favored four campuses. Although participants were located across the state most of the face–to-face students were from Hazard Community and Technical College, Jefferson Community and Technical College, Madisonville Community College, and Owensboro Community and Technical College.
Most of the online students were from Hazard, Jefferson, and Owensboro although those students were more likely to also list other institutions as their home school. Online students are not required to take their classes from the local community college.

Figure 4. Geographic distribution within KCTCS schools of study participants divided into online and face-to-face groups.

A&P serves as a foundation for most allied health and nursing programs (Abdullahi & Gannon, 2012; Nguyen & Tawde, 2014; Sturges & Maurer, 2013). These programs generally appeal to significantly more women than men. The gender distribution in Table 12 illustrates the expectation that more women (90% online and 87.4% face-to-face) than men (10% online and 12.6% face-to-face) took the course. Due to this embedded gender disparity, developing a sample for with an equal mix of male and female students was impossible.
Table 12

*Gender Distribution of Participants*

<table>
<thead>
<tr>
<th>Gender</th>
<th>Online</th>
<th></th>
<th>Face-to-Face</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>54</td>
<td>90.0</td>
<td>104</td>
<td>87.4</td>
<td>158</td>
<td>88.3</td>
</tr>
<tr>
<td>Male</td>
<td>6</td>
<td>10.0</td>
<td>15</td>
<td>12.6</td>
<td>21</td>
<td>11.7</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>100.0</td>
<td>118</td>
<td>100.0</td>
<td>179</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 13 includes the anticipated major of the participants upon completion the prerequisites, including A&P. As stated previously, A&PI serves as the foundation for most allied health and all nursing programs. These programs are based on selective admissions after students have completed both A&PI and A&PII. Thus Table 13 represents the programs that students planned to enter, but were not accepted in the fall of 2014. Fifty-seven online students and 119 face-to-face students answered this question (n=176).
Table 13

Frequency Distribution of Anticipated Majors of Participants

<table>
<thead>
<tr>
<th>Anticipated Majors</th>
<th>Online</th>
<th></th>
<th>Face-to-Face</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Nursing (BSN)</td>
<td>10</td>
<td>17.5</td>
<td>22</td>
<td>18.5</td>
<td>32</td>
<td>18.2</td>
</tr>
<tr>
<td>Nursing (ASN)</td>
<td>22</td>
<td>38.6</td>
<td>35</td>
<td>29.4</td>
<td>57</td>
<td>32.3</td>
</tr>
<tr>
<td>Practical Nursing (LPN)</td>
<td>5</td>
<td>8.8</td>
<td>2</td>
<td>1.7</td>
<td>7</td>
<td>4.0</td>
</tr>
<tr>
<td>Radiography</td>
<td>2</td>
<td>3.5</td>
<td>12</td>
<td>10.1</td>
<td>14</td>
<td>8.0</td>
</tr>
<tr>
<td>Sonography (Ultrasound)</td>
<td>3</td>
<td>5.2</td>
<td>3</td>
<td>2.5</td>
<td>6</td>
<td>3.4</td>
</tr>
<tr>
<td>Surgical Technology</td>
<td>1</td>
<td>1.7</td>
<td>2</td>
<td>1.7</td>
<td>3</td>
<td>1.7</td>
</tr>
<tr>
<td>Pharmacy Technician</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.8</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>Physical Therapy Assistant</td>
<td>3</td>
<td>5.2</td>
<td>14</td>
<td>11.8</td>
<td>17</td>
<td>9.7</td>
</tr>
<tr>
<td>Occupational Therapy</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>11.8</td>
<td>3</td>
<td>1.7</td>
</tr>
<tr>
<td>Respiratory Therapy</td>
<td>1</td>
<td>1.8</td>
<td>3</td>
<td>2.5</td>
<td>4</td>
<td>2.3</td>
</tr>
<tr>
<td>Health Information Technology</td>
<td>1</td>
<td>1.8</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>Dental Hygiene</td>
<td>4</td>
<td>7.0</td>
<td>6</td>
<td>5.0</td>
<td>10</td>
<td>5.7</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>8.8</td>
<td>16</td>
<td>13.4</td>
<td>21</td>
<td>11.9</td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
<td>119</td>
<td>119</td>
<td>119</td>
<td>176</td>
<td>119</td>
</tr>
</tbody>
</table>

Note: These are selective programs; students must submit an application and be accepted in these majors. This table represents the programs into which students hope to be accepted.

Figure 5 further illustrates the distribution of the anticipated majors by percent of the total in each group. The majors are not even across the sample group. As expected, more nursing students; either BSN (bachelor’s degree in nursing) or ASN (associates of nursing), were taking A&PI. The online class attracted more BSN and LPN (licensed practical nursing) majors; whereas, the face-to-face classes attracted more PTA (physical...
therapy assistant), OTA (occupational therapy assistant), and radiography majors along with the BSN and ASN students. Students who listed “other” were inclined to list pre-professional programs such as pharmacy and medical school.

Figure 5. Percent frequency distribution of anticipated majors between the two presentation formats. The most common majors listed were BSN and ASN, although the face-to-face programs also attracted PTA, OTA and radiography students.

Data Management

The survey was presented on Qualtrics Survey Software (Qualtrics LLC, 2015) and was attempted 237 times. Only some of those attempts yielded usable data. Several individuals did not accept the conditions in the consent letter; thus, they were unable to enter the body of the survey (Appendix E). Six of the surveys indicated that the participant was taking a hybrid version of the course. Due to an insufficient number of responses, the hybrid model was not considered for this study. Other surveys could not be sorted by online or face-to-face and were not utilized.
If an individual failed to answer a particular survey question, the remainder of the information was considered if that person attempted the assessment portion. However, if a participant did not attempt the learning outcomes section of the survey, that individual was removed from the investigation. Some surveys were missing responses to part of the learning outcomes questions. If the student attempted the learning outcomes portion, the survey was included in the statistical analysis. The unanswered questions were scored as a zero.

**Research Questions**

**Research Question 1 Findings**

**RQ 1**: *To what extent is student success (measured by student learning outcomes) affected by the course delivery method (online or traditional on-campus format)?*

This question addressed both the learning outcomes and the hands-on approach to labs and included three hypotheses that were based on studies cited in the literature review.

- **H₁** There are significant differences in the total assessment scores between online A&P and the face-to-face sections.
- **H₂** There are significant differences in the sectional assessment scores between online A&P and the face-to-face sections.
- **H₃** There are significant differences in total assessment scores between the virtual lab, lab kit, and on-campus labs.

In order to evaluate RQ 1, students completed a 50-question (points) comprehensive assessment, which included 10 sections of five questions (points) each based on the course competencies and subject outline. A total of 183 participants began this section; 61 were online and 122 were face-to-face students. Several participants did
not complete the assessment; in those cases, the blank spaces were marked as 0, thus lowering their assessment score.

The first hypothesis, $H_1$, for RQ 1 focused on the total scores between the groups. Table 14 shows the results of the independent samples $t$-test comparing the results between the online and face-to-face total score and the individual sections. Significance was determined by an alpha score of less than .05. No significant difference was found between total scores for the online courses and the face-to-face courses. Relative to the total assessment, online scores were $29.28 \pm 10.93$ (58.6%). The face-to-face scores were $31.21 \pm 7.58$ (62.4%). The difference in the scores was less than 4%.

The second hypothesis, $H_2$, for RQ 1 focused on specific sections. Each result was divided into 10 sections that were determined from the course outline (Appendix A). Each section represented a significant system or overarching concept covered in API, and a separate section for diseases and each was given five points. The average scores for each section were compared using independent samples $t$-test, finding a significant difference in three sectional scores: cells, muscular system, and nervous system. The results of the $t$-tests can be found in Table 14.
Table 14

$t$-Test Results Comparing Scores on the Learning Objectives Between the Online and Face-to-Face Groups

<table>
<thead>
<tr>
<th>Learning Objectives</th>
<th>Question Numbers</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>$t$ score</th>
<th>$P$ score</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>1-5</td>
<td>61</td>
<td>3.67</td>
<td>1.15</td>
<td>122</td>
<td>3.46</td>
<td>1.15</td>
<td>-1.21</td>
<td>.229</td>
<td>No significant difference</td>
</tr>
<tr>
<td>Cells</td>
<td>6-10</td>
<td>61</td>
<td>3.14</td>
<td>1.38</td>
<td>122</td>
<td>3.55</td>
<td>1.06</td>
<td>2.00</td>
<td>.048</td>
<td>*Significant difference</td>
</tr>
<tr>
<td>Tissues</td>
<td>11-15</td>
<td>61</td>
<td>2.95</td>
<td>2.47</td>
<td>122</td>
<td>3.12</td>
<td>1.22</td>
<td>0.84</td>
<td>.403</td>
<td>No significant difference</td>
</tr>
<tr>
<td>Integumentary</td>
<td>16-20</td>
<td>61</td>
<td>2.67</td>
<td>1.41</td>
<td>122</td>
<td>2.74</td>
<td>1.30</td>
<td>0.31</td>
<td>.755</td>
<td>No significant difference</td>
</tr>
<tr>
<td>Skeletal System</td>
<td>21-25</td>
<td>61</td>
<td>2.84</td>
<td>1.48</td>
<td>122</td>
<td>2.99</td>
<td>1.31</td>
<td>0.72</td>
<td>.471</td>
<td>No significant difference</td>
</tr>
<tr>
<td>Joints</td>
<td>26-30</td>
<td>61</td>
<td>3.21</td>
<td>1.52</td>
<td>122</td>
<td>3.38</td>
<td>1.34</td>
<td>0.74</td>
<td>.459</td>
<td>No significant difference</td>
</tr>
<tr>
<td>Muscular System</td>
<td>31-25</td>
<td>61</td>
<td>2.51</td>
<td>1.34</td>
<td>122</td>
<td>2.96</td>
<td>1.33</td>
<td>2.15</td>
<td>.033</td>
<td>*Significant difference</td>
</tr>
<tr>
<td>Nervous System</td>
<td>36-40</td>
<td>61</td>
<td>2.44</td>
<td>1.51</td>
<td>122</td>
<td>2.97</td>
<td>1.31</td>
<td>2.42</td>
<td>.016</td>
<td>*Significant difference</td>
</tr>
<tr>
<td>Senses</td>
<td>41-45</td>
<td>61</td>
<td>2.49</td>
<td>1.54</td>
<td>122</td>
<td>2.44</td>
<td>1.34</td>
<td>-0.22</td>
<td>.838</td>
<td>No significant difference</td>
</tr>
<tr>
<td>Diseases &amp; Dysfunctions</td>
<td>46-50</td>
<td>61</td>
<td>3.34</td>
<td>1.84</td>
<td>122</td>
<td>3.61</td>
<td>1.84</td>
<td>0.99</td>
<td>.326</td>
<td>No significant difference</td>
</tr>
<tr>
<td>Total score</td>
<td></td>
<td>61</td>
<td>29.28</td>
<td>10.93</td>
<td>122</td>
<td>31.21</td>
<td>7.58</td>
<td>1.40</td>
<td>.164</td>
<td>No significant difference</td>
</tr>
</tbody>
</table>

Note: df for the sample was 181 $p < .05$. * Represents significant difference.
Figure 6 illustrates the slight difference in the overall assessment score. Online students scored slightly lower than the face-to-face students on the total score but were not significantly lower. As shown in Figure 6, only 1.93 points out of a possible 50 were noted between the two groups, or less than two questions in the 50-point assessment.

Figure 6. Comparison of the overall scores indicates the slight difference in overall scores between the two groups.

Figure 7 displays the scores for each section. With the exceptions of chemistry and senses, the face-to-face group scored higher than the online group in every section. Other than the columns that represent cells, muscles, and nervous, these differences were not significant. Again Figure 7 shows slight the differences in the scores for each topic.
Figure 7. Average scores in points for the individual sections of the exam. Each section was worth five points. Very little difference was found in each section.
* Represents significant difference.

The last hypothesis, H₃, for RQ 1 focused on only the lab format. In order to examine this question, the groups were categorized by lab presentation (on campus, virtual, or lab kit) rather than course presentation. Due to the addition of a variable, this comparison was made using a one-way between subjects ANOVA (analysis of variance). In order to create equal cells for the ANOVA, a random sample of 25 individuals was utilized for the on campus lab treatment. The sampling process was accomplished with the SAS Procedure SURVEY SELECT.

The results for the ANOVA can be found in Table 15. A notable difference existed in the mean scores; however, no significant difference was found between test scores at the $p < .05$ for the three conditions. The scores were nearly identical, at 31.44 and 31.34, for on campus labs and lab kits, respectively (62.88% or 62.68%). The score
for the virtual lab groups was lower at 25.83 (51.66%) although the results were not significant.

Table 15

1 x 3 ANOVA Comparing Scores on the Exam with the Lab Format

<table>
<thead>
<tr>
<th>Lab Format</th>
<th>n</th>
<th>Mean Assessment Score</th>
<th>% Assessment Score</th>
<th>SD</th>
<th>F-Value</th>
<th>P</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campus</td>
<td>25</td>
<td>31.44</td>
<td>62.88</td>
<td>9.02</td>
<td>2.81</td>
<td>0.066</td>
<td>No</td>
</tr>
<tr>
<td>Virtual</td>
<td>23</td>
<td>25.83</td>
<td>51.66</td>
<td>11.03</td>
<td>0.066</td>
<td>significant</td>
<td></td>
</tr>
<tr>
<td>Lab Kit</td>
<td>43</td>
<td>31.34</td>
<td>62.68</td>
<td>9.37</td>
<td></td>
<td>difference</td>
<td></td>
</tr>
</tbody>
</table>

Note: The campus sample was too large for an accurate ANOVA. To address this issue, a random sample of scores was taken to form the campus sample group. $p < .05$

Figure 8 illustrates the means between all three groups. The variation in the assessment scores between the virtual lab and the other lab formats was more pronounced on the Figure 8. A 5.6 point difference was noted between the on-campus and virtual labs. Although this result was not significant, it was notable. The similarities between the on-campus lab and the lab kit also are illustrated in Figure 8. Only a 0.1 point difference was found between the scores from students who attended lab on-campus and those who purchased a lab kit.
Figure 8. Comparison of the mean assessment scores between lab presentation formats. A notable difference can be seen in the virtual lab, although not significant. The lab kit and on campus lab scores were nearly identical.

**Research Question 2 Findings**

**RQ 2: What is the relationship between selected student demographics and presentation format (online or traditional on campus format)?**

Question 2 included a series of hypotheses that were based on studies cited in the literature review.

- **H₁** There are significant differences in ages between online and face-to-face groups.
- **H₂** Student age impacts successful completion of learning objectives.
- **H₃** There are significant differences in outside commitments between the two groups. Outside commitments consist of:
  - The number of students who were parents.
  - The number of children living in the student’s home.
  - The number of hours the student worked outside the home.
Likelihood of working in the medical field.

- H4 There are significant differences between the groups’ use of financial aid.

The first hypothesis, $H_1$ compared the average age of the students between the two groups. Table 16 shows the results of an independent $t$-test comparison of the mean student age, indicating that online students generally were significantly older than their face-to-face counterparts. Online students averaged slightly over 29 years and were nearly 5.5 years older than the face-to-face students, with an average age of 23.6. The online students tended to be in the classification of non-traditional students or older than 25 years, and the face-to-face students tended to be in the classification of traditional students or under 24 years of age.

Table 16

*Comparison of Mean Student Age Between the Online and Face-to-Face Classes*

<table>
<thead>
<tr>
<th>Student Age in Years</th>
<th>Online</th>
<th>Face-to-Face</th>
<th>t-score</th>
<th>P-score</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
<td>$M$</td>
<td>$SD$</td>
<td>$n$</td>
<td>$M$</td>
</tr>
<tr>
<td>58</td>
<td>29.09</td>
<td>9.00</td>
<td></td>
<td>119</td>
<td>23.57</td>
</tr>
</tbody>
</table>

df for the sample was 175 $p < .05$. * Represents significant difference.

In order to test the second hypothesis, $H_2$, the age of each participant was divided into traditional and non-traditional groups (Table 17). The age groups and the presentation format were compared using a two-way independent ANOVA based on age group and presentation format (Table 18). Non-traditional students (over the age of 25) revealed a significantly higher exam score than traditional students. The $r^2$ value indicated the extent to which the dependent variable could be explained by the
independent variable. The $r^2$ indicated that, although a statistical difference was noted it was minor and it did not result in a major interaction between the variables.

Table 17

*Descriptive Statistics of Exam Score between Traditional Age and Non-traditional Age Students in Online and Face-to-Face Formats*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Online</th>
<th>Face-to-Face</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>$M$</td>
</tr>
<tr>
<td>Traditional (under the age of 24)</td>
<td>24</td>
<td>26.7</td>
</tr>
<tr>
<td>Non-Traditional (over the age of 25)</td>
<td>34</td>
<td>30.8</td>
</tr>
</tbody>
</table>

$p < .05$

Table 18

*ANOVA Results of Exam Score between Traditional Age (< 24) and Non-traditional Age (> 25) Students in Online and Face-to-Face Formats*

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>$r^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Type (FF/Online)</td>
<td>1</td>
<td>394.42</td>
<td>394.42</td>
<td>5.25</td>
<td>0.02</td>
</tr>
<tr>
<td>Traditional vs Non-</td>
<td>1</td>
<td>574.74</td>
<td>574.74</td>
<td>7.65</td>
<td>0.04</td>
</tr>
<tr>
<td>Traditional Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interaction</td>
<td>1</td>
<td>0.24</td>
<td>0.24</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Within groups</td>
<td>173</td>
<td>12995.52</td>
<td>75.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>176</td>
<td>13791.74</td>
<td>176.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$p < .05$

Figure 9 illustrates the results of table 17. The assessment averages for both groups were incorporated into the figure. In both online and face-to-face groups, the non-traditional students scored higher than the traditional students; however, those
differences were not dramatic. The lowest score was found in the traditional online students who scored 26.7 out of 50 points. The highest score was found in the non-traditional face-to-face students who scored 34 points-7.3 points higher than the traditional aged online students but only 3.2 points higher than the non-traditional online students.

Figure 9. Comparison of age and success on the learning objectives assessment.

The third hypothesis $H_3$ concerned the effects of outside commitments. The first part involved responsibilities in the home. The survey consisted of two questions to address this factor. Students were asked whether they had children and, if so, how many they had. A chi-square determined that significantly more online students had children at home (Table 19). Almost one third (32.2%) of the face-to-face students reported having children, whereas more than half (56.57%) online students reported having children.
Table 19

Contingency Table and Chi-Square for: Do You Have Children at Home?

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face</td>
<td>n</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>32.20</td>
<td>118</td>
</tr>
<tr>
<td>Online</td>
<td>n</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>56.57</td>
<td>60</td>
</tr>
<tr>
<td>Total</td>
<td>n</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>72</td>
<td>40.45</td>
<td>179</td>
</tr>
</tbody>
</table>

Chi-Square Value 9.88
Probability .0017 *Significant Difference

The follow-up question determined whether a difference existed in the number of children in each family in each group. Table 20 lists the results of an independent samples t-test for number of children in the home and showed no significant difference between the online group and the face-to-face group; both averaged approximately 1.8 children at home. Online students had no more children at home than their face-to-face counterparts although they were significantly more likely to have children at home.

Table 20

t-Test Results on Student Commitments

<table>
<thead>
<tr>
<th>Variable</th>
<th>Online</th>
<th>Face-to-Face</th>
<th>t-score</th>
<th>P-score</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of</td>
<td>32</td>
<td>36</td>
<td>-0.06</td>
<td>.951</td>
<td>No difference</td>
</tr>
<tr>
<td>children</td>
<td>1.88</td>
<td>1.86</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hours worked</td>
<td>42</td>
<td>87</td>
<td>-5.50</td>
<td>≤.0001</td>
<td>*Significant difference</td>
</tr>
<tr>
<td></td>
<td>39.05</td>
<td>28.26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10.3</td>
<td>10.3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

df for the sample was 175 p < .05. * Represents significant difference.
The third hypothesis, H₃ also covered responsibilities outside the home. Table 20 shows the results of an independent sample t-test that examined the difference in hours worked outside the home. The t-test revealed a dramatic difference in hours worked. The online students were more likely to work full-time at 39 hours per week, whereas the face-to-face students averaged 28.3 hours, indicating that the online students work an additional 10 hours per week compared to the face-to-face students.

Figure 10 illustrates the student commitment factors relative to the combination of having children and working outside the home. The figure illustrates the mean values for both having children at home and the hours worked per week. When examining the data the online students show a dramatic difference in commitments outside of class than the face-to-face students.
Figure 10. Commitments outside of class. Two separate graphs are aligned together to compare the marked differences in outside commitments in both groups. In both graphs, the students in the online classes had more outside commitments relative to children in the home and hours worked.
As A&P students apply to allied health and nursing fields, the development of a profile on the number of students employed in the health occupation fields can help to determine whether the students find practical applications to their studies. The employment demographics in Table 21 are broken down further to determine whether the online students were more likely to work in the medical field. A chi-square test of independence was calculated to determine the frequency of employment in the medical field between students taking online and face-to-face A&PI. A significant interaction was found between the variables. Students online were more than twice as likely to work in the medical field (58.14%) than the face-to-face group (25.29%).

Table 21

Contingency Table and Chi-Square for Experience of in the Medical Field

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face</td>
<td>n</td>
<td>22</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>25.28</td>
<td>74.71</td>
</tr>
<tr>
<td>Online</td>
<td>n</td>
<td>25</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>58.14</td>
<td>41.87</td>
</tr>
<tr>
<td>Total</td>
<td>n</td>
<td>47</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>36.15</td>
<td>63.85</td>
</tr>
</tbody>
</table>

Chi-Square Value 13.46
Probability .002 *Significant Difference

The final hypothesis, H₄, focused on student finances. No difference should be seen in the need for financial aid between the two groups. In Table 22, a chi-square test of independence was calculated to compare the frequency of financial aid being received by students taking A&PI online and face-to-face. A significant difference was found between the online group and the face-to-face group. Students taking class on campus
were significantly less likely to be receiving financial aid than those online (65.55% and 81.67%, respectively).

Table 22

Contingency Table and Chi-Square for Students Depending on Financial Aid

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face</td>
<td>n 78</td>
<td>41</td>
<td>119</td>
</tr>
<tr>
<td></td>
<td>% 65.55</td>
<td>34.41</td>
<td>66.48</td>
</tr>
<tr>
<td>Online</td>
<td>n 49</td>
<td>11</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>% 81.67</td>
<td>18.33</td>
<td>33.52</td>
</tr>
<tr>
<td>Total</td>
<td>n 127</td>
<td>52</td>
<td>179</td>
</tr>
<tr>
<td></td>
<td>% 70.95</td>
<td>29.05</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Chi-Square Value 5.03
Probability .025  *Significant Difference

$p < .05$. * Represents significant difference.

Research Question 3 Findings

RQ 3: What is the relationship between selected student academic factors and presentation format (online or traditional on campus format)?

The function of Question 3 was to consider academic background. It was divided into several hypotheses.

- **H1** There are differences in academic readiness when a student enters college between the two groups of students. College readiness was determined by placement in remedial courses in English, reading, or math based on COMPASS test scores.

- **H2** There are differences in academic measures such as college GPA, projected grade, ACT scores, current course load, and completed credit hours.
There are differences in the amount of time spent studying between the two groups of students.

The first hypothesis, $H_1$, focused on academic preparation in terms of remedial courses. Few prerequisites are required for BIO 137 A&PI. The prerequisites listed in the catalogue were concerned with the completion of those courses that prepare a student for college work in English, reading, and math or satisfactory COMPASS test scores. Students were asked whether they had taken any of the remedial courses in either English, reading, or math; and a chi-square test was used to determine whether a significant existed difference in the number of students taking remedial classes in either the online or the face-to-face courses.

Table 23 shows the chi-square analysis that was used to examine the relationship between course format and remedial English. Of the face-to-face students, 4.8% were required to take remedial English, while 8.2% of the online students needed remedial work in English. Although more online students took remedial English, the chi-square test indicated that there was no significant difference in the number of students who took remedial English and course format.
Table 23

Contingency Table and Chi-Square for Students Who Completed Remedial English

<table>
<thead>
<tr>
<th></th>
<th>No-Remedial English</th>
<th>Remedial English</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face</td>
<td>n: 116, %: 95.08</td>
<td>6, 4.92</td>
<td>122, 66.67</td>
</tr>
<tr>
<td>Online</td>
<td>n: 56, %: 91.80</td>
<td>5, 8.20</td>
<td>61, 33.33</td>
</tr>
<tr>
<td>Total</td>
<td>n: 172, %: 93.99</td>
<td>11, 6.01</td>
<td>163, 100.00</td>
</tr>
</tbody>
</table>

Chi-Square Value 0.78
Probability .38 No Significant Difference

An additional chi-square analysis was utilized to examine the relationship between course format and remedial reading (Table 24). The A&P textbook required college reading skills; therefore, this evaluation was critical to determine whether the students could comprehend the material in the textbook. The number of students who took remedial reading was nearly identical for both groups; 18.85% of the face-to-face students and 18.03% of the online students were required to take remedial reading. The chi-square analysis revealed no interaction, and the relationship between these variables was statistically insignificant.
Table 24

*Contingency Table and Chi-Square for Students Who Completed Remedial Reading*

<table>
<thead>
<tr>
<th></th>
<th>No-Remedial Reading</th>
<th>Remedial Reading</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face</td>
<td>n 99</td>
<td>23</td>
<td>122</td>
</tr>
<tr>
<td></td>
<td>% 81.15</td>
<td>18.85</td>
<td>66.70</td>
</tr>
<tr>
<td>Online</td>
<td>n 50</td>
<td>11</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>% 81.97</td>
<td>18.03</td>
<td>33.30</td>
</tr>
<tr>
<td>Total</td>
<td>n 140</td>
<td>34</td>
<td>163</td>
</tr>
<tr>
<td></td>
<td>% 81.42</td>
<td>18.53</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Chi-Square Value 0.018
Probability .89  No Significant Difference

$p < .05$

Students were asked whether they had taken at least one of the following remedial math courses: MAT 055 (Pre-Algebra), MAT 065 (Basic Algebra), or MAT 085. The results of the chi-square test can be found in Table 25. It is important to note that the type series of remedial math courses taken was dependent upon whether the intended major required college algebra. The ASN students were not required to take college algebra and did not need to take MAT 085. More online students (44.26%) than face-to-face students (30.33%) took remedial math; however; a chi-square analysis determined that no significant relationship existed between the two groups regarding remedial algebra.
Table 25

*Contingency Table and Chi-square for Students Who Completed Remedial Math*

<table>
<thead>
<tr>
<th></th>
<th>No-Remedial Math</th>
<th>Remedial Math</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>85</td>
<td>37</td>
<td>122</td>
</tr>
<tr>
<td>%</td>
<td>69.67</td>
<td>30.33</td>
<td>66.67</td>
</tr>
<tr>
<td>Online</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>34</td>
<td>27</td>
<td>61</td>
</tr>
<tr>
<td>%</td>
<td>55.74</td>
<td>44.26</td>
<td>33.33</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>119</td>
<td>64</td>
<td>183</td>
</tr>
<tr>
<td>%</td>
<td>65.03</td>
<td>34.97</td>
<td>100.00</td>
</tr>
<tr>
<td>Chi-Square Value</td>
<td>3.47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probability</td>
<td>.062</td>
<td></td>
<td>No Significant Difference</td>
</tr>
</tbody>
</table>

Figure 11 combines the results of the Tables 23-25 and the graph illustrates that, although no statistically significant difference existed, the online students were required to take more English and math than their face-to-face counterparts. Figure 11 shows that 60% more online students than face-to-face students took remedial English. Seventy percent more online students took remedial math courses, although that figure may have been dependent upon the major being pursued. The reading column indicates almost no difference in the percentage of students who took remedial reading courses.
Figure 11. A comparison of the percentage of students who were required to take remedial coursework prior to taking A&PI. Although the online students are more likely to need remedial English and math these values are not significantly different.

The second hypothesis, $H_2$, for RQ 3 involved several academic factors, including GPA, projected grade, ACT scores, current course load, and completed credit hours. All of these factors can be used to predict student success. Independent samples $t$-tests were used to distinguish whether any differences existed in these factors between the online and the face-to-face students. The results are reported in Table 26. For convenience, the independent $t$-test results are reported for both this hypothesis and the final hypothesis.

The $t$-test indicated that the accumulated GPA for both groups was nearly identical. The online students reported a mean GPA of 3.27, whereas GPA for the face-to-face students was 3.29. Additionally, the $t$-test found no significant difference between the ACT scores. Not all participants had taken or could remember their ACT scores; thus the $n$ values for both groups were lower than for the other factors. Finally, no significant difference was seen in the credit load of both groups in the fall 2014 semester.
Table 26

*t-Tests for Academic Factors*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Online</th>
<th></th>
<th></th>
<th>Face-to-Face</th>
<th></th>
<th></th>
<th>t-score</th>
<th>P score</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M</td>
<td>SD</td>
<td>n</td>
<td>M</td>
<td>SD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Projected grade</td>
<td>58</td>
<td>3.07</td>
<td>0.75</td>
<td>117</td>
<td>2.68</td>
<td>0.89</td>
<td>2.90</td>
<td>.004</td>
<td>*Significant difference</td>
</tr>
<tr>
<td>(4.0 scale)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPA (4.0 scale)</td>
<td>55</td>
<td>3.27</td>
<td>0.46</td>
<td>111</td>
<td>3.29</td>
<td>0.52</td>
<td>0.17</td>
<td>.865</td>
<td>No significant difference</td>
</tr>
<tr>
<td>ACT</td>
<td>37</td>
<td>21.86</td>
<td>4.16</td>
<td>83</td>
<td>22.37</td>
<td>3.01</td>
<td>0.76</td>
<td>.451</td>
<td>No significant difference</td>
</tr>
<tr>
<td>Course load</td>
<td>58</td>
<td>10.97</td>
<td>4.12</td>
<td>116</td>
<td>11.81</td>
<td>3.07</td>
<td>1.38</td>
<td>.171</td>
<td>No significant difference</td>
</tr>
<tr>
<td>(credit hours)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed credit hours</td>
<td>56</td>
<td>59.34</td>
<td>36.45</td>
<td>109</td>
<td>36.19</td>
<td>33.02</td>
<td>-4.03</td>
<td>≤.0001</td>
<td>*Significant difference</td>
</tr>
<tr>
<td>Time spent studying (hours)</td>
<td>56</td>
<td>13.94</td>
<td>9.44</td>
<td>113</td>
<td>11.09</td>
<td>9.44</td>
<td>-2.11</td>
<td>.036</td>
<td>*Significant difference</td>
</tr>
</tbody>
</table>

*p < .05  * Represents significant difference.
As the survey was anonymous the students’ grades could not be confirmed at the end of the semester, therefore relying on the students self-reporting the grades they expected to receive at the end of the semester. Prior to completing the t-test for the grades predicted by the students, the scores were reversed, which resulted in A = 4, B = 3, C = 2, D = 1, and F = 0. As reported in Table 26, the independent samples t-test showed a significant difference in predicted grade between the online group (3.07 ± 0.75) and the face-to-face group (2.68 ± 0.89).

Also in Table 26 the independent samples t-test revealed a significant difference in the number of completed credit hours between the online group and the face-to-face group. The online students had significantly more academic experience than the face-to-face students by almost 2:1, although a wide range of scores was noted. The online students had completed 59.34 ± 36.45 credit hours, while the face-to-face students completed 36.19 ± 33.02 credit hours. An examination the standard deviation appeared to indicate that the face-to-face group consisted of students who may have been in their first semester of college. Conversely, nearly all of the online students entered API with significant college experience.

The last hypothesis H₃ examined how much time students studied for the course. As reported in Table 26, the independent samples t-test found a significant difference in the amount of study time in hours per week that the students estimated they completed. The online students reported they studied an average of 13.94 hours per week, whereas the face-to-face students reported they studied 11.09 hours. Over the course of a 16-week semester, an additional 2.85 hours per week can result in up to 45.6 hours of study time.
Research Question 4 Findings

RQ 4: What is the relationship between selected student satisfaction factors and presentation format (online or traditional on campus format)?

Question 4 was divided in two sections because of the series of questions used in the survey were separated by two sets of Likert questions. The first involved factors affecting choice of course format, either online or face-to-face, and the second section concerned their satisfaction the selection. The following hypotheses were developed for the first section from studies cited in the literature review.

- $H_1$ There are differences in how online and face-to-face students rate flexibility and scheduling conflicts when choosing a course format.
- $H_2$ There are differences in how online and face-to-face students rate learning environment in choosing a course format.
- $H_3$ There are differences in how online and face-to-face students rate social interaction in choosing a course format.
- $H_4$ There are differences in how online and face-to-face students value advice from faculty and students in choosing a course format.

Certain aspects of a course format appeal to students for a variety of reasons, which were addressed in the same 1-5 Likert scale:

1 = does not apply  
2 = not important  
3 = somewhat important  
4 = important  
5 = very important

As all of the statements were addressed the results for the $t$-test and descriptive statistics are listed for convenience and comparison in Table 27.
Table 27
Comparison of the Results for the Student Choice of Format Questions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Online</th>
<th></th>
<th></th>
<th>Face-to-Face</th>
<th></th>
<th></th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M</td>
<td>SD</td>
<td>N</td>
<td>M</td>
<td>SD</td>
<td>t-test</td>
</tr>
<tr>
<td><strong>FLEXIBILITY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conflict between class time and work commitments</td>
<td>59</td>
<td>3.54</td>
<td>1.48</td>
<td>118</td>
<td>3.44</td>
<td>1.33</td>
<td>-0.46</td>
</tr>
<tr>
<td>Conflict between class time and childcare commitments</td>
<td>59</td>
<td>2.83</td>
<td>1.76</td>
<td>117</td>
<td>2.45</td>
<td>1.65</td>
<td>-1.40</td>
</tr>
<tr>
<td>Course scheduling conflict</td>
<td>58</td>
<td>3.16</td>
<td>1.36</td>
<td>119</td>
<td>3.42</td>
<td>1.26</td>
<td>1.28</td>
</tr>
<tr>
<td>Reduce time commuting to class</td>
<td>57</td>
<td>3.16</td>
<td>1.15</td>
<td>119</td>
<td>3.08</td>
<td>1.26</td>
<td>-0.31</td>
</tr>
<tr>
<td>Flexibility in setting pace and time for studying</td>
<td>57</td>
<td>4.04</td>
<td>1.13</td>
<td>119</td>
<td>4.14</td>
<td>0.91</td>
<td>0.99</td>
</tr>
<tr>
<td><strong>LEARNING ENVIRONMENT &amp; METHOD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Better learning from hearing a lecture</td>
<td>58</td>
<td>2.57</td>
<td>1.11</td>
<td>119</td>
<td>4.30</td>
<td>0.89</td>
<td>10.38</td>
</tr>
<tr>
<td>Better learning from reading the lecture materials</td>
<td>58</td>
<td>3.71</td>
<td>1.08</td>
<td>119</td>
<td>3.99</td>
<td>1.00</td>
<td>1.74</td>
</tr>
<tr>
<td>Motivation provided by regular class meetings</td>
<td>57</td>
<td>1.98</td>
<td>1.11</td>
<td>118</td>
<td>4.14</td>
<td>1.00</td>
<td>12.94</td>
</tr>
<tr>
<td>Fewer classroom distractions</td>
<td>58</td>
<td>3.34</td>
<td>1.53</td>
<td>118</td>
<td>3.83</td>
<td>1.19</td>
<td>2.12</td>
</tr>
</tbody>
</table>

Note df varied throughout this section. p < .05. * Represents significant difference.
Table 27 (continued)

Comparison of the Results for the Student Choice of Format Questions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Online</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M</td>
<td>SD</td>
<td>N</td>
<td>M</td>
<td>SD</td>
<td>t-test</td>
<td>p-test</td>
</tr>
<tr>
<td><strong>SOCIAL INTERACTION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opportunity for face-to-face</td>
<td>59</td>
<td>1.98</td>
<td>1.12</td>
<td>119</td>
<td>4.61</td>
<td>0.65</td>
<td>16.67</td>
<td>≤ .0001</td>
</tr>
<tr>
<td>contact with instructor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opportunity for face-to-face</td>
<td>59</td>
<td>1.93</td>
<td>1.08</td>
<td>119</td>
<td>4.01</td>
<td>1.09</td>
<td>12.03</td>
<td>≤ .0001</td>
</tr>
<tr>
<td>contact with fellow students</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ADVICE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advice from advisor or other</td>
<td>57</td>
<td>3.25</td>
<td>1.30</td>
<td>119</td>
<td>4.18</td>
<td>0.89</td>
<td>4.93</td>
<td>≤ .0001</td>
</tr>
<tr>
<td>college official</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advice of another student</td>
<td>58</td>
<td>4.57</td>
<td>0.77</td>
<td>119</td>
<td>3.66</td>
<td>1.07</td>
<td>5.48</td>
<td>≤ .0001</td>
</tr>
<tr>
<td>Quality of program</td>
<td>58</td>
<td>4.47</td>
<td>0.94</td>
<td>117</td>
<td>4.45</td>
<td>0.83</td>
<td>- 0.09</td>
<td>0.928</td>
</tr>
</tbody>
</table>

* Represents significant difference.

Note: df varied throughout this section. \( p < .05 \).

No significant difference.
The first hypothesis, $H_1$, was concerned with factors that involved flexibility and scheduling conflict. Students were asked to rank statement that addressed this concept:

- Conflict between class time and work commitments
- Conflict between class time and childcare commitments
- Course scheduling conflict
- Reduce time commuting to class
- Flexibility in setting pace and time for studying

No significant difference was found between employment or childcare time conflicts and were not seen as significant issues when choosing course format, as reported in Table 27. Both groups scored childcare conflict lower, between “not important” and “somewhat important.” Both groups scored conflict with work as “somewhat important”: 3.54 for online and 3.44 for face-to-face. The same results occurred when considering course scheduling conflicts and reducing travel time. No significant difference was noted between either factor and they were not considered as important issues when choosing course format. However, when considering only flexibility in more general terms both groups ranked it as “important.”

The second hypothesis, $H_2$, in RQ 4 considered learning environment. Students were asked to rank that addressed this concept:

- Better learning from hearing a lecture
- Better learning from reading the lecture materials
- Motivation provided by regular class meetings
- Fewer classroom distractions
The results for factors that focused on learning environment were mixed and are reported in Table 27. As expected, the face-to-face students listed improved learning through hearing the lectures as “important” and “very important” at 4.30 ± 0.89. The online students scored it significantly lower at 2.57 ± 1.11. The face-to-face students also scored very high on motivation derived from attending class (4.14 ± 1.00), and the online students scored it significantly lower (1.98 ± 1.11). Classroom motivation was one of the largest differences found between the groups. The other statements that scored dramatically different were related to social interaction. The face-to-face students found fewer classroom distractions significantly more important than those in the online course, although both groups found it important. No difference existed between the groups when examining learning through reading lecture materials. Both groups scored reading lecture materials as important.

The third hypothesis, H₃, considered social interaction, which was anticipated to appeal to face-to-face students. Students were asked to rank statements that addressed this concept:

- Opportunity for face-to-face contact with instructor
- Opportunity for face-to-face contact with fellow students

The face-to-face students scored very high in opportunity to interact with both faculty and fellow students, as reported in Table 27. These scores were significantly different than those of the online students who scored both factors very low. The face-to-face students scored faculty interaction at 4.61 ± 0.65 and interaction with other students at 4.01 ± 1.09. These scores ranked social interaction “important” and “very important.”
Online students scored the same factors at 1.98 ± 1.12 and 1.93 ± 1.08, respectively, or as “not important.” These differences were the largest between the groups.

The fourth hypothesis, $H_4$, considered the importance of advising and the individual whose opinion was more important. Students were asked to rank statements that addressed this concept:

- Advice from advisor or other college official
- Advice of another student
- Quality of program

Students were directed to a class by other students, their advisor, and the reputation of the program itself, although none of these factors were anticipated to favor either group. Both groups felt that advice from their advisor was important in choosing a course format; however, face-to-face students scored this factor significantly higher than the online students. The face-to-face students scored their advisors’ opinion at 4.18 ± 0.89, whereas the online students scored their advisors’ opinion lower at 3.2 ± 1.30. The results were reversed when about the opinion of other students (Table 27).

Online students valued the opinion of other students significantly more than the face-to-face students. The online students scored the opinion of other students at 4.57 ± 0.77 and the face-to-face students scored it lower at 3.66 ±1.07. Both groups scored the quality of the program as very important at 4.47 ± 0.94 (online) and 4.45 ± 0.83 (face-to-face).
The second part of RQ 4 focused on determining whether if the format of the class met the students’ needs. These factors were referred to as student satisfaction factors. The following hypotheses were developed from studies cited in the literature review.

- **H₅** There are differences in how online and face-to-face students perceived that the instructor interacted with them or the class as a whole. These factors were considered communication.

- **H₆** There are differences in how online and face-to-face students kept pace with the material. These factors were considered content.

- **H₇** There are differences in how online and face-to-face students rated the course overall.

The series of questions were developed from the OCTC Student Evaluation of Instruction that students received at the end of the term. The Likert scale for the second section was:

1 = does not apply
2 = strongly disagree
3 = disagree
4 = agree
5 = strongly agree

As all of the statements concerning student satisfaction were addressed collectively, the results for the *t*-test and descriptive statistics are listed for convenience and comparison in Table 28.
### Table 28

**Comparison of the Results for the Student Satisfaction with Format Questions**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Online</th>
<th>Face-to-Face</th>
<th>t-score</th>
<th>P-score</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COMMUNICATION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I receive timely comments and feedback about exams, papers, or projects.</td>
<td>58 4.43 0.88</td>
<td>119 4.38 0.71</td>
<td>-0.43</td>
<td>.669</td>
<td>No significant difference</td>
</tr>
<tr>
<td>My instructor was in frequent communication with students.</td>
<td>58 4.52 0.84</td>
<td>119 4.23 0.84</td>
<td>-2.14</td>
<td>.034</td>
<td>*Significant difference</td>
</tr>
<tr>
<td>My instructor returned e-mails in a timely manner.</td>
<td>58 4.64 0.74</td>
<td>119 4.01 1.22</td>
<td>-3.62</td>
<td>.0004</td>
<td>*Significant difference</td>
</tr>
<tr>
<td><strong>CONTENT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This course was well organized.</td>
<td>58 4.57 0.77</td>
<td>119 4.29 0.75</td>
<td>-2.26</td>
<td>.025</td>
<td>*Significant difference</td>
</tr>
<tr>
<td>Active engagement in the course was encouraged.</td>
<td>58 4.69 0.68</td>
<td>119 4.41 0.81</td>
<td>-2.49</td>
<td>.014</td>
<td>*Significant difference</td>
</tr>
<tr>
<td>Given the nature of this course information is presented at an appropriate rate.</td>
<td>58 4.34 0.93</td>
<td>119 4.06 0.81</td>
<td>-2.11</td>
<td>.037</td>
<td>*Significant difference</td>
</tr>
<tr>
<td>Exams were consistent with material.</td>
<td>58 4.47 0.84</td>
<td>119 4.23 0.81</td>
<td>-1.82</td>
<td>.071</td>
<td>No significant difference</td>
</tr>
</tbody>
</table>

*Note.* df was 175.  *p* < .05.  *Represent* significant difference.
Table 28 (continued)

*Comparison of the Results for the Student Satisfaction with Format Questions*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Online</th>
<th>Face-to-Face</th>
<th>$t$-score</th>
<th>$P$-score</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OVERALL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would recommend this course to other students</td>
<td>58, M = 4.53, SD = 0.86</td>
<td>119, M = 4.09, SD = 1.01</td>
<td>-2.87</td>
<td>.005</td>
<td>*Significant difference</td>
</tr>
<tr>
<td>My experience in this course was positive</td>
<td>58, M = 4.50, SD = 0.92</td>
<td>119, M = 4.13, SD = 0.96</td>
<td>-2.46</td>
<td>.015</td>
<td>*Significant difference</td>
</tr>
</tbody>
</table>

*Note. df was 175.  $p < .05$.  
* Represents significant difference*
The fifth hypothesis H₅, in this RQ4 was concerned with communication. The statements that addressed communication between the faculty member and the student were:

- I receive timely comments and feedback about exams, papers, or projects.
- My instructor was in frequent communication with students.
- My instructor returned e-mails in a timely manner.

All of the statements were ranked “agree” and “strongly agree” and are reported in Table 28. The first statement addressed feedback on assessments and the length of time the students waited for that feedback. No significant difference was found in the scores between the online and face-to-face students relative to feedback; however, the online students scored slightly higher. On the other two questions a significant difference existed in the way in which the students ranked the statements. Online students reported more frequent communication with their instructors than those in the face-to-face class. The online students scored instructor communication at 4.52 ± 0.84, and the face-to-face students scored it lower at 4.23 ± 0.84. The online students also scored the rate the instructors returned e-mails higher at 4.64 ± 0.74, and the face-to-face students scored it lower at 4.01 ± 1.22.

The sixth hypothesis H₆, involved the student’s ability to keep pace with the content in the course, which can concern the extent of the pace of the class and whether students could keep pace with the course schedule. In an online
course, this may include locating the material on BlackBoard. The statements that addressed content were:

- This course was well organized
- Active engagement in the course was encouraged
- Given the nature of this course, information was presented at an appropriate rate
- Exams were consistent with material

These statements also were ranked between “agree” and “strongly agree.” Both groups ranked the exam statement high, and no difference existed between the groups. The results can be found in Table 28. The online students ranked the other statements higher than the face-to-face students. Online courses reported more active engagement than the face-to-face classes (4.69 ± 0.68 and 4.23 ± 0.84, respectively). The online students also reported a more appropriate rate of course presentation (4.34 ± 0.93 and 4.06 ± 0.81, respectively). The online students scored course organization higher at 4.57 ± 0.77, while the face-to-face students scored it at 4.29 ± 0.74 (Table 28).

The final hypothesis, H7, concerned an overall ranking for the course. The statements that addressed the overall ranking were:

- I would recommend this course to other students
- My experience in this course was positive

The online students ranked all of the student satisfaction factors higher than the face-to-face students. They ranked the factors lower on only two occasions. As a result, the final two factors also were ranked higher. Both statements scored
higher for the online students, and the results can be found on Table 28. The online students reported a more positive experience than the face-to-face students (4.50 ± 0.92 and 4.13 ± 0.96, respectively). The online students also scored higher on recommending the course to other students at 4.53 ± 0.86, while the face-to-face students scored it at 4.09 ± 1.01 (Table 28). The online students scored higher on all statements that concerned student satisfaction.

Research Question 5 Findings

RQ 5: What is the relationship between student retention and modes of presentation (online or traditional on campus format)?

Attrition and persistence can be major problems in any academic setting. The following hypotheses were developed from studies cited in the literature review.

- **H₁** There are differences in persistence, as measured by the intent of returning to take APII in spring of 2015 between the two formats.
- **H₂** There are differences in persistence, as measured by the intent of returning to take APII in the same format.
- **H₃** There are differences in attrition rate between online and face-to-face courses.

RQ 5 was difficult to measure through the use of the survey, as it could not be administered prior to the end of the term, at which point those students who were unsuccessful had already left. Students who succeed in API generally plan to take APII. This assumption was confirmed by asking students about plans to take the second semester of A&P. The results were dramatically in favor of students proceeding to A&PII in the spring and remaining in the same format.
The few who indicated they would not continue to A&PII in the spring stated that they were transferring or returning in the summer. The results made further statistical analysis unnecessary. As the participants were anonymous, tracking for persistence of individual students through PeopleSoft© was impossible. Thus measurements for H₁ and H₂ were inconclusive.

The survey was not a viable measure of retention, to answer H₃, as it could not be released until the end of the semester, which was long after failing students had already dropped the course. An improved measure of retention was developed by examining the total number of successful students in all sections subsequent to the close of the semester. Those results were distilled from the KCTCS PeopleSoft © management system. For this measure success was defined as passing the course and earning four credit hours in biology. Students who either failed or withdrew were considered unsuccessful.

Data were gathered concerning the total number of students registered in each section of API taught through KCTCS in the fall of 2014. Significantly more sections of face-to-face courses (125 sections) were offered than online courses (18 sections) (Table 9). In order to balance the samples to perform a t-test, an equal number (18) of sections of the face-to-face courses were randomly selected. The sampling process was accomplished by using the SAS Procedure SURVEY SELECT.

The number of students who withdrew and who failed for each section was counted. Table 29 summarizes the descriptive statistics of the two groups after sampling. The class size for both online and face-to-face samples varied
dramatically around the mean. The mean class size for a face-to-face section of A&P was 25.97 students, with a range of 12-41. The online courses tended to be larger at 29.72 students, with a larger range of 7-57.

Attrition was calculated for each section by adding the total of failed students to those who withdrew and dividing by the total number of students who began the semester (Johnson, 2012). An independent samples t-test was utilized to estimate the effect of program format on percent of class attrition, and the results can be found in Table 30. The mean attrition rates were nearly identical for both groups, and the t-test revealed no significant differences in the values. The online attrition mean was 0.335 (33.5%) ± 0.171, and the face-to-face attrition mean was 0.334 (33.4%) ± 0.176. Essentially no difference was noted between the two values. Table 29 indicates that there is a wide range for attrition between the individual sections. The highest attrition values were over 60% (66.7% for online and 62.3% for face-to-face) and lower values are in the single digits (3.7% for online and 5.0% for face-to-face).

Table 31 was developed in order to organize and summarize the results for the research question and the hypothesis. Each research question is listed along with the hypotheses that were developed from it. The results of the statistical analysis are listed in a column. The column indicates if a statistical difference was determined from the analysis. The far right column summaries what the statistical results mean in terms of the hypothesis.
Table 29

Descriptive Statistics for Attrition

<table>
<thead>
<tr>
<th>Format</th>
<th>Variable</th>
<th>$n$</th>
<th>$M$</th>
<th>$SD$</th>
<th>Median</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online</td>
<td>Total Class Size</td>
<td>18</td>
<td>29.72</td>
<td>13.42</td>
<td>28.00</td>
<td>7.00</td>
<td>57.00</td>
</tr>
<tr>
<td></td>
<td>Number of Fails</td>
<td>5.94</td>
<td>5.01</td>
<td>4.50</td>
<td>4.00</td>
<td>1.00</td>
<td>18.00</td>
</tr>
<tr>
<td></td>
<td>Number of Withdraws</td>
<td>4.39</td>
<td>5.11</td>
<td>3.00</td>
<td>0</td>
<td>0</td>
<td>21.00</td>
</tr>
<tr>
<td></td>
<td>Total Attrition</td>
<td>10.33</td>
<td>8.23</td>
<td>8.00</td>
<td>1.00</td>
<td>1.00</td>
<td>27.00</td>
</tr>
<tr>
<td></td>
<td>% Student Attrition</td>
<td>0.334</td>
<td>0.18</td>
<td>0.378</td>
<td>0.037</td>
<td>0.667</td>
<td></td>
</tr>
<tr>
<td>Face-to-face</td>
<td>Total Class Size</td>
<td>18</td>
<td>25.94</td>
<td>9.14</td>
<td>22.50</td>
<td>12.00</td>
<td>41.00</td>
</tr>
<tr>
<td></td>
<td>Number of Fails</td>
<td>3.83</td>
<td>2.96</td>
<td>3.50</td>
<td>0</td>
<td>0</td>
<td>10.00</td>
</tr>
<tr>
<td></td>
<td>Number of Withdraws</td>
<td>5.28</td>
<td>4.40</td>
<td>4.00</td>
<td>0</td>
<td>0</td>
<td>15.00</td>
</tr>
<tr>
<td></td>
<td>Total Attrition</td>
<td>9.11</td>
<td>6.31</td>
<td>8.00</td>
<td>1.00</td>
<td>1.00</td>
<td>23.00</td>
</tr>
<tr>
<td></td>
<td>% Student Attrition</td>
<td>0.335</td>
<td>0.17</td>
<td>0.335</td>
<td>0.050</td>
<td>0.623</td>
<td></td>
</tr>
</tbody>
</table>

Note: The face-to-face sample was too large for an accurate ANOVA. To address this issue a random sample of scores was taken to form the face-to-face sample group.

Table 30

Comparison of the Results for Student Attrition

<table>
<thead>
<tr>
<th>Variable</th>
<th>Online</th>
<th>Face-to-Face</th>
<th>$t$-score</th>
<th>$P$ score</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Student Attrition</td>
<td>18 0.3346 0.171</td>
<td>18 0.3338 0.176</td>
<td>0.01</td>
<td>0.9889</td>
<td>No significant difference</td>
</tr>
</tbody>
</table>

alpha < .05
Table 31

**Summary of the Findings Set Forth for Each of the Research Questions**

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Significant Difference</th>
<th>Was the hypothesis accepted?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RQ 1: To what extent is student success (measured by student learning outcomes) affected by the course delivery method (online or traditional on campus format)?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• H₁ There are significant differences in the total assessment scores between online A&amp;P and the face-to-face sections.</td>
<td>No significant difference</td>
<td>Not accepted: There are no differences in total assessment scores.</td>
</tr>
<tr>
<td>• H₂ There are significant differences in the sectional assessment scores between online A&amp;P and the face-to-face sections.</td>
<td>Significant difference on only three factors (cell, muscle, and nervous)</td>
<td>Accepted: There are differences in some sections.</td>
</tr>
<tr>
<td>• H₃ There are significant differences in total assessment scores between the virtual lab, lab kit, and on campus labs.</td>
<td>No significant difference</td>
<td>Not accepted: Although virtual labs scored noticeably lower.</td>
</tr>
<tr>
<td><strong>RQ 2: What is the relationship between selected student demographics and presentation format (online or traditional on campus format)?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• H₁ There are significant differences in ages between online and face-to-face groups.</td>
<td>Significant difference</td>
<td>Accepted: Online students tend to be older.</td>
</tr>
</tbody>
</table>
Table 31 (continued)

Summary of the Findings Set Forth for Each of the Research Questions

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Significant Difference</th>
<th>Was the hypothesis accepted?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• H₂ Student age impacts successful completion of learning objectives.</td>
<td>Significant difference</td>
<td>Accepted: Older students tend to score higher.</td>
</tr>
<tr>
<td>• H₃ There are significant differences in outside commitments between the two groups.</td>
<td></td>
<td>Accepted: Online students have more outside commitments.</td>
</tr>
<tr>
<td>o The number of students who were parents.</td>
<td>Significant difference</td>
<td>Accepted: Online students are more likely to be parents.</td>
</tr>
<tr>
<td>o The number of children living in the student’s home.</td>
<td>No significant difference</td>
<td>Not accepted: There is no difference in the number of children.</td>
</tr>
<tr>
<td>o The number of hours working outside the home.</td>
<td>Significant difference</td>
<td>Accepted: Online students work almost twice as many hours.</td>
</tr>
<tr>
<td>o The number of students working in the medical field.</td>
<td>Significant difference</td>
<td>Accepted: Online students are much more likely to work in the medical field.</td>
</tr>
<tr>
<td>• H₄ There are significant differences between the groups’ use of financial aid.</td>
<td>Significant difference</td>
<td>Accepted: Online students are much more likely to utilize financial aid.</td>
</tr>
</tbody>
</table>
Table 31 (continued)

*Summary of the Findings Set Forth for Each of the Research Questions*

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Significant Difference</th>
<th>Was the hypothesis accepted?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RQ 3</strong>: What is the relationship between selected student academic factors and presentation format (online or traditional on campus format)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• H₁ There are differences in academic readiness when a student enters college between the two groups of students. College readiness was determined by placement in remedial courses in English, reading, or math based on COMPASS test scores.</td>
<td>No significant difference</td>
<td>Not accepted: There is no difference in the college readiness between the two groups.</td>
</tr>
<tr>
<td>• H₂ There are differences in academic measures such as college GPA, projected grade, ACT scores, current course load, and completed credit hours.</td>
<td>Varied</td>
<td>Accepted: There are differences in some academic measures.</td>
</tr>
<tr>
<td>o GPA, ACT scores, and semester course load</td>
<td>No significant difference</td>
<td>There is no difference between the GPA, ACT scores, and semester course load between the two groups.</td>
</tr>
<tr>
<td>o projected grade and completed credit hours</td>
<td>Significant difference</td>
<td>Online students project a higher course grade, and they have more college experience in terms of completed credit hours.</td>
</tr>
</tbody>
</table>
Table 31 (continued)

**Summary of the Findings Set Forth for Each of the Research Questions**

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Significant Difference</th>
<th>Was the hypothesis accepted?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• H₃ There are differences in the amount of time spent studying between the two groups of students.</td>
<td>Significant difference</td>
<td>Accepted: Online students spend more time studying than face-to-face students.</td>
</tr>
</tbody>
</table>

**RQ 4: What is the relationship between selected student satisfaction factors and presentation format (online or traditional on campus format)?**

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Significant Difference</th>
<th>Was the hypothesis accepted?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• H₁ There are differences in how online and face-to-face students rate flexibility and scheduling conflicts when choosing a course format.</td>
<td>No significant difference</td>
<td>Not accepted: There is no difference in how the groups rank flexibility.</td>
</tr>
<tr>
<td>• H₂ There are differences in how online and face-to-face students rate learning environment in choosing a course format.</td>
<td>Significant difference</td>
<td>Accepted: Face-to-face students value listening to a lecture and attending classes.</td>
</tr>
<tr>
<td>• H₃ There are differences in how online and face-to-face students rate social interaction in choosing a course format.</td>
<td>Significant difference</td>
<td>Accepted: Face-to-face students value social interaction in choosing a course format</td>
</tr>
<tr>
<td>• H₄ There are differences in how online and face-to-face students value advice from faculty and students in choosing a course format.</td>
<td>Significant difference</td>
<td>Accepted: Campus students value their advisors’ opinion and online students value the opinion of other students.</td>
</tr>
</tbody>
</table>
Table 31 (continued)

Summary of the Findings Set Forth for Each of the Research Questions

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Significant Difference</th>
<th>Was the hypothesis accepted?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• H₅ There are differences in how online and face-to-face students perceived that the instructor interacted with them or the class as a whole. These factors were considered communication.</td>
<td>Significant difference</td>
<td>Accepted: Online students scored communication with the instructor higher than face-to-face students.</td>
</tr>
<tr>
<td>• H₆ There are differences in how online and face-to-face students kept pace with the material. These factors were considered content.</td>
<td>Significant difference</td>
<td>Accepted: Online students scored higher the managing content.</td>
</tr>
<tr>
<td>• H₇ There are differences in how online and face-to-face students rated the course overall.</td>
<td>Significant difference</td>
<td>Accepted: Online students scored the overall satisfaction with the course higher than the face-to-face students.</td>
</tr>
</tbody>
</table>

RQ 5: What is the relationship between student retention and modes of presentation (online or traditional on campus format)?

• H₁ There are differences in persistence, as measured by the intent of returning to take APII in spring of 2015 between the two formats. No useable results
Table 31 (continued)

*Summary of the Findings Set Forth for Each of the Research Questions*

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Significant Difference</th>
<th>Was the hypothesis accepted?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• H2 There are differences in persistence, as measured by the intent of returning to take APII in the same format.</td>
<td>No useable results</td>
<td></td>
</tr>
<tr>
<td>• H3 There are differences in attrition rate between online and face-to-face courses.</td>
<td>No significant difference</td>
<td>Not accepted: Mean attrition rates were nearly identical for both groups.</td>
</tr>
</tbody>
</table>
Summary

The distribution of the survey was limited, as it relied on the A&P instructors from KCTCS to e-mail the link to their classes. Participants were not rewarded which was an additional limitation; therefore the students were not motivated to complete it. Despite these limitations, the survey was completed by 183 A&P students at the end of the fall 2014 semester.

The results from the survey are discussed further in Chapter V, although some interesting points should be emphasized. RQ 1 addressed the primary focus of the study to assess student learning outcomes. No significant differences were noted in the scores between the two groups on the assessment portion of the survey; however the online students scored slightly lower than the face-to-face students in most sections. The discrepancy is significant in only a few areas. When the results were analyzed by changing the groupings to reflect the manner in which the lab was taught, the minor difference was absent between the face-to-face group and the groups using a lab kit. Rather the lower scores focused on the students who used virtual labs.

RQ 2 results indicated that non-traditional students over the age of 25 scored slightly higher than traditional students under the age of 25. It also showed that the online students worked significantly more hours outside the home. This is particularly interesting when combined with the results of RQ 3 that indicated the online students spent more time studying for A&P than the face-to-face students.

The results from RQ 4 revealed that flexibility, which has been the hallmark for distance education while important for online students, was not highly important. The face-to-face students also valued flexibility. The need for personal interaction with
instructors and other students clearly divided the online and face-to-face students. An additional point mentioned by the different groups from the first part of RQ 4 was the importance placed on the advice of advisors and other students.

The results for the section on student satisfaction indicated that the online groups scored higher on all factors. They valued communication with their instructors, and the results revealed that the instructors were communicating with the class and returning emails more effectively than the face-to-face instructors. Relative to the overall satisfaction statements, the online groups scored significantly higher and were more likely to recommend the course to other students.

The final question looked involved persistence and attrition. No valid means was possible to measure persistence on the survey. The best measure involved a comparison of the roster of the A&PII courses with those of the students who passed the A&PI course. As the participants were anonymous, that was not feasible. Rather the survey queried whether the students were returning to A&PII, although the results indicated that most planned to return if they had reached the end of A&PI. Those results conveyed an unclear vision of overall persistence. Measuring attrition on the survey was also impossible, as it required development of data from the PeopleSoft © management system. There was no significant difference between the attrition rates in the two groups; they were nearly identical. The results are discussed further described in the upcoming chapter.
CHAPTER V: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

The challenge for colleges is to meet the demand for online curricula while maintaining high academic expectations for students. Various issues become apparent when developing and delivering an online laboratory course, which has resulted in a bias concerning the efficacy of teaching labs online (Gallagher et al., 2005; Murray et al., 2012; Stewart et al., 2010). Faculty are resistant to accept online science courses due to a bias about the quality between labs taught in a lab setting and simulated labs or lab kits (Corter et al., 2004; Lee & Choi, 2011; Ma & Nickerson, 2006; Simsek, 2013). On a larger scale this bias can be observed in the reluctance of schools and programs to accept online lab science courses for transfer. This bias exists despite the lack of a thorough analysis of the factors that hinder or promote success in a lab science class, such as A&P, in either the online or traditional format. This study was designed to fill this void in the research, and to answer the question about the effectiveness of teaching A&P online when compared to traditional courses.

Summary of Study

Purpose of the Study

The purpose of this quantitative study was to determine whether A&PI could be taught online without affecting academic rigor, through a comparison of the successful completion of student learning outcomes, as well as to learn more about the students who take A&P. The study sought to identify the causes or relationships that exist between online and face-to-face presentation of A&PI. It also considered retention related to the independent variables of online or face-to-face presentation.
The intent of the study was to document differences in student learning and to correlate any additional factors that may affect student success, as well as to differentiate selected demographic and academic factors between the two groups. Demographic factors such as age, family responsibilities, childcare, and job commitments are important issues that can impact student success. Further academic features can impact student retention such as GPA; ACT score; prerequisite courses in English, math, and reading; expected grade; and plans for continuing to the second semester. These factors should be considered along with the learning outcomes in order to predict student success in an online science course. The study also delved into the reasons that students choose a particular class format and whether they were satisfied with the experience. Finally, the study examined student attrition by comparing the rate that students withdrew or failed in either class format.

**Summary of Demographics**

The sample for this study was derived from the population of students taking BIO 137 A&PI through KCTCS in November and December of the fall 2014 semester. KCTCS is comprised of 16 colleges located on more than 70 campuses throughout Kentucky. In the fall of 2014, 143 sections of A&PI were taught in the KCTCS system with 4130 students. A total of 183 students, 2:1 face-to-face to online, voluntarily took the assessment and the survey; all results were anonymous.

**Review of Methodology**

A causal-comparative/quasi-experiment quantitative research design was utilized because the subjects could not be randomly assigned to study groups (Fowler, 2014). Assigning students to a group is unethical when the treatment group is a particular course
(Barbeau et al., 2013). A pre-test was not considered because it would not have had significant value, as students entering A&P have very little experience with the topic.

The study sought to identify the causes or relationships that exist between the two factors of online and face-to-face presentation of A&PI. It was critical to develop an assessment that was consistent and without have any inherent bias. Brookhart (1993, 2013) found that there was a wide range in grading practices among instructors. The inherent variation in grading results in grades being an unreliable form of comparison, although the end of term grades are intended to express a level of achievement. Thus, using another objective instrument that would hold up to scrutiny was critical. Utilizing the competencies established by KCTCS allowed for the development of such a tool (Appendix A).

As previously stated, the primary focus was to measure student learning outcomes. Assessing learning outcomes allowed this study to fill a major gap in the research discussed by Kirtman (2009), who found that much of the research that attempted to compare online and traditional classes did not focus on academic achievement or learning outcomes. Ma and Nichols (2006) suggested that the different camps between virtual and hands-on lab experiences were the result of measuring different educational objectives. Therefore, it was important to work with an assessment of learning outcomes that was central to the topic rather than the format.

Developing an instrument based on student learning outcomes or competencies that are standardized across KCTCS removed instructor bias from the study. Student learning outcomes-based assessment has become the norm in terms of accountability, accreditation, and performance indicators (Keshavarz, 2011; Kuh et al., 2014). Student
learning outcomes can help instructors to better facilitate student learning and can provide schools, departments, and the instructors with valid feedback (Kennedy, 2009). They allow for consistency when applied to courses that are delivered by numerous instructors. Student learning outcomes were assessed using a 50-question examination aligned to the course competencies developed by KCTCS (see Appendix B).

In order to develop a complete picture to compare the course formats, additional demographic, academic, and student satisfaction factors were examined. The instrument used for the remainder of the study was created based on the evidence in the literature. The additional survey questions allowed the study to examine demographic issues such as age, family responsibilities, work commitments, and financial needs. Academic concerns also were explored by considering the need for remedial courses, semester course load, college GPA, ACT, and academic history. The literature examined various reasons for the increase in demand for online courses. Using a Likert scale and the literature as a basis, the students were asked to rank the factors that impacted their choice of course format. An additional Likert scale was used to rank student satisfaction with the course.

The study also considered retention as it related to the independent variables of online or face-to-face presentation. Attrition data could not be gathered through the Qualtrics survey. Upon submission of grades, PeopleSoft © management system was utilized to obtain information from all sections of KCTCS BIO 137. Attrition was measured for each section by adding the number of students who failed to those who withdrew and dividing by the total number of students who began the semester.
Interpretation of Findings

The interpretation of findings represents the conclusions drawn from the data developed in Chapter IV. A discussion of the findings is organized by research question, and the hypotheses are summarized after the discussion of the results.

Discussion of Research Question 1

RQ 1: To what extent is student success (measured by student learning outcomes) affected by the course delivery method (online or traditional on-campus format)?

- $H_1$ There are significant differences in the total assessment scores between online A&P and the face-to-face sections.
- $H_2$ There are significant differences in the sectional assessment scores between online A&P and the face-to-face sections.
- $H_3$ There are significant differences in total assessment scores between the virtual lab, lab kit, and on campus labs.

$H_1$ examined the total assessment scores between the course format sections. Although no significant difference was found between the scores, the online students scored slightly lower (58.56%) than the face-to-face students (62.42%). The difference in scores represented less than two questions. As both groups of students took an exam for which they did not prepare, low test scores were expected, if not predicted. The exam, however, focused on learning outcomes the students should have absorbed; they should have been able to recall knowledge included on the test without excessive preparation. $H_1$ was not accepted since there was no significant difference between the scores.
H₂ examined the sectional assessment scores between the sections. The online students scored significantly lower in the sections devoted to cells, muscular system, and nervous system, sections that focused on membrane permeability. Online students scored slightly but not significantly higher in chemistry and senses and slightly lower although not significant in the remaining subjects. A specific cause was not apparent for these results, although it is important to note that each section represented only 5 questions. The differential scores could possibly change with additional questions. H₂ was accepted since there was a significant difference between three sections.

H₃ looked at the total assessment scores between the virtual lab, lab kit, and on campus labs. Notably, the discrepancy between scores of face-to-face and online students changed when the online students were divided into those who complete virtual labs and those who received lab kits. The scores of students who received a Hands on Labs © kit were only one tenth of a point lower (31.34) than face-to-face students (31.44) on the assessment. The online students who interacted with a virtual lab scored lower than the face-to-face and kit students by five and one half points. H₃ was not accepted since the difference was not statistically significant although it was notable.

These findings are in opposition to current research in the field. Maldarelli et al. (2009) and Bird (2010) stated that students need a hands-on approach to laboratory science only found in a formal laboratory setting. These results do not agree with conclusions by either Maldarelli et al. or Bird as the students who worked from home scored as well as those on campus. Stuckey-Mickell and Stuckey-Danner (2007) found that students using Virtual Physiology Lab from McGraw-Hill did not score as high as those who worked hands on with kits developed by faculty. It was suggested that the
campus labs and the labs from the kits were easily manipulated to fit into the course pedagogy, thus they having greater impact on student learning.

The first research question (RQ1) formed the foundation of the study by both the learning outcomes and the hands-on approach to labs. The question included three hypotheses that were based on the literature review. The first hypothesis, (H₁) there are significant differences between the scores of online A&P classes and those of face-to-face sections—was not accepted. The study found no significant differences between the values. The second hypothesis, (H₂) there are significant differences between online and face-to-face A&P students in the sectional assessment scores—was accepted after noting significant differences in several sections. The final hypothesis of the first research question (H₃), the lab format impacts the total assessment scores between online A&P and face-to-face sections—was not accepted, as the differences in scores were not significant. However, the virtual labs scored lower than the students with lab kits or on campus labs.

Discussion of Research Question 2

RQ 2: What is the relationship between selected student demographics and presentation format (online or traditional on-campus format)?

- H₁ There are significant differences in ages between online and face-to-face groups.
- H₂ Student age impacts successful completion of learning objectives.
- H₃ There are significant differences in outside commitments between the two groups. Outside commitments consist of:
  - The number of students who were parents.
• The number of children living in the student’s home.
• The number of hours the student worked outside the home.
• Likelihood of working in the medical field

- $H_4$ There are significant differences between the groups’ use of financial aid.

RQ 2 focused on the family and societal pressures faced by students. Family responsibilities that result from marriage, number of children, outside employment, and income were examined as these factors can impact the student’s need for flexibility and time available to study (Aragon & Johnson, 2008; Cochran et al., 2014).

$H_1$ examined the students’ age between the groups to determine whether the individuals could be considered traditional or non-traditional college students. In this study a five and one half year difference existed between the mean ages of the online and the face-to-face students. The average age of the face-to-face students was 23.6 years; thus, they were classified as traditional college students under the age of 24. The online students on the other hand were 29.1 years old and classified as non-traditional. The online students were older, but the face-to-face students were older than the typical incoming freshman between the ages of 18-20 years. Allied health fields tend to appeal to older returning students (Shelton, 2012). A&P also requires college level coursework so students may have taken several semesters of remedial courses. $H_1$ was accepted since there was a significant difference in the ages of the students in the groups.

The results of this study support Colorado and Eberle (2010), Dutton et al. (2002), and Radford (2012). These studies found that online students tend were older with more life experience, which could have been reflected in improved academic performance. Other studies such as Driscoll et al. (2012) and Yu et al. (2008) reported either no
difference in the ages between online students and face-to-face students or that the online students were younger.

H2 compared the mean student age and mean assessment score with the presentation format for the course to determine whether increased life experience related to increased academic performance. The non-traditional students scored slightly higher than the traditional students in both presentations; however, the difference was not dramatic. The non-traditional students in the face-to-face courses scored three points higher than non-traditional online students. The online traditional students scored the lowest of the four groups. These results were supported by Colorado and Eberle (2010) but contradicted Driscoll et al. (2012) and Yu et al. (2008), who hypothesized that the younger students would be more comfortable with the technology needed to advance in an online course and would perform better in the course. H2 was accepted since there was a significant difference in the assessment score and student age. This study concluded that increased life experience has a greater impact on the successful completion of learning objectives.

H3 was divided into four sections which focused on responsibilities within the home. Students who were older were may be more likely to have families and outside employment. These outside pressures can limit the students’ time to study. According to Bean and Metzner (1985), these environmental factors can negatively impact student retention. In this study, significantly more of the online students reported having at least one child in the home when compared to the face-to-face students. Gault et al. (2014) and Horn et al. (2006) found that, overall, 26% of undergraduates in general and 35% of community college students in particular were raising children. The 32.2% of the face-
to-face students raising children fell within this range. However, the 56.6% of online students who were parents indicated that specific populations within the community college were more likely to be parents. Both groups averaged approximately 1.8 children at home, which was in line with the U.S. total fertility rate in 2014 of 1.9 children per woman (United Nations, 2015). Thus, the online students were much more likely to be juggling school and parenting responsibilities but were unlikely to have larger families than the online students who are raising children.

$H_3$ was also concerned with employment outside the home. This study found that online A&PI students worked an additional 10 hours per week compared to the face-to-face students. AACC (2014) reported that nearly 62% of full-time community college students work outside the home. Harris et al. (2004) predicted that students lost 0.20 points for every hour per week they worked, but a relationship was not found relative to the grades and the number of children.

$H_3$ not only focused on the hours a student worked it also focused on the type of employment the student was engaged in. Work commitment may have made it more difficult to devote time to a class, in the case of A&P, the type of employment may support the student’s education. Those working in healthcare fields may have utilized the experience to reinforce the lessons in A&P. Online students were more than twice as likely to work in the medical field as the face-to-face group. Peters (2001) and Colorado and Eberle (2010) described the online students as having more experience in life through personal encounters and the working environment, resulting in enhanced study if they worked in the field about which they were studying. The results of this study supported their conclusions. Additionally, Lee and Choi (2011) considered relevant experience and
skills important in maintaining retention. H₃ was accepted, since the online students have significantly more outside commitments than the face-to-face students.

H₄ focused on the need for financial aid. According to Lee and Choi (2011), financial support from family and friends was an important consideration, in that it can reflect overall emotional support. Aragon and Johnson (2008) and Foster (2012) examined socioeconomic factors by tracking financial aid status. This survey was insufficient to determine student financial needs; however, by asking whether students were utilizing financial aid, two conclusions were drawn. The first was that those students who were receiving financial aid had a lower tuition burden; second, they had submitted financial documents and were determined to have a financial need. Online students were significantly more likely to be receiving financial aid than face-to-face students. Although online students were more likely to work they were still in need of financial support. Face-to-face students tended to be younger, indicating that many may have had parental support for tuition or their parents’ wages were considered when applying for financial aid. According to Tinto (1999) and Tinto and Pusser (2006), financial and social support encourages academic and social integration, and thus, retention. H₄ was accepted because there was a significant difference in the need for financial aid between the two groups of students. This study revealed that although they worked outside the home, older students taking A&PI online needed financial support.

The second research question (RQ 2) focused on social pressures and demographic information and the way in which they differed between students online and face-to-face. The question included four hypotheses developed from the literature review. The first hypothesis, (H₁) there were significant differences in ages between
online and face-to-face groups—was accepted. The second hypothesis, \( H_2 \), student age impacts successful completion of learning objectives—also was accepted. A significant age difference was noted between the two groups, and the older students scored higher on the assessment. The non-traditional students scored the highest, and the low score was attributed to the traditional students taking A&PI online.

The third hypothesis \( H_3 \), there are significant differences in outside commitments between the two groups—was accepted. As was expected, the online students had more outside commitments in terms of family and work. The online students were more likely to have children and worked more hours outside the home. Interestingly they also tended to have more experience in the medical field, which may have supported their A&P studies. The fourth hypothesis \( H_4 \), there are significant differences between the groups’ use of financial aid—also was accepted. The online students were significantly more likely to need financial aid, which may have indicated that they did not have family financial support for their education.

**Discussion of Research Question 3**

**RQ 3:** *What is the relationship between selected student academic factors and presentation format (online or traditional on-campus format)?*

- \( H_1 \) There are differences in academic readiness when a student enters college between the two groups of students. College readiness was determined by placement in remedial courses in English, reading, or math based on COMPASS test scores.

- \( H_2 \) There are differences in academic measures such as college GPA, projected grade, ACT scores, current course load, and completed credit hours.
• H3 There are differences in the amount of time spent studying between the two
groups of students.

RQ 3 focused on the students’ academic factors and background. Academic
readiness and skills in terms of college preparation, current credit hours, ACT, and
college GPA can affect retention and success (Bailey, 2009; Bailey & Cho, 2010; Harris
et al., 2004; Lee & Choi, 2011).

H1 focused on academic readiness by looking at how many remedial courses in
English, reading, or math the student took prior to taking A&PI. KCTCS uses COMPASS
scores to determine college readiness. In some cases, the student’s ACT score may be
high enough to be exempted from taking the COMPASS test. Students who test into
remedial courses frequently are prevented from taking other courses until the remedial
requirements are fulfilled; A&P is one such course. Several sources indicated that
retention was low in the remedial courses (Attewell et al., 2006; Bailey, 2009; Bailey &
Cho, 2010; Crisp & Delgado, 2014). This study did not find any significant difference
between the online and the face-to-face students’ academic readiness. Although no
significant difference was seen between the groups, noticeably more online students
needed remedial coursework in English and math. Older students who have been away
from school may have needed some refresher work in both subjects.

Bailey (2009) and Bailey and Cho (2010) found that approximately 60% of
students entering community college needed remedial work in English, reading, or math.
AACC (2014) reported that 68% of community college students took at least one
remedial English, reading, or math course. More than 50% of the graduating high school
students in Kentucky needed to take a remedial course when entering college. In this
study far fewer than 50% of the students reported that they completed remedial coursework. The lower numbers may have been the result of students failing to complete remedial work and therefore, denied enrollment in A&P. H₁ was not accepted because there was not significant difference in the number of students who took remedial coursework.

H₂ focused on other academic measures. Online students were expected to take fewer credit hours because they worked more hours, but this study found that to be a false assumption. The average course loads were slightly under a full-time community college course load of 12 credit hours for both groups. A dramatic difference existed in the academic history or completed course loads between the two groups. The online students had completed almost twice as many credit hours than their face-to-face counterparts. The age difference between the groups may have been a factor, as older students may have accumulated more credits overtime. Harris et al. (2004) considered a large course load to be a negative factor in A&P success, but they did not consider accumulated credit hours. Foster (2012) examined accumulated credit and found a positive correlation between completed credit hours and grades in non-major biology.

Both groups reported nearly identical GPAs and ACT scores, but a difference was seen in projected course grade; the online students predicted higher semester grades. Lee and Choi (2011) and Harris et al. (2004) examined GPA, ACT score, projected grade, current course load, and completed credit hours. Harris et al. focused on projected course grade as an indicator for success. Maurer et al. (2012) found that as many as 50% of A&P students failed to earn a C. In this study, only a few students indicated grades lower than a C. This was a caveat because it was late in the semester and many students with
low grades would have dropped the class. Additionally, the survey was voluntary and students who were more driven to higher scores were expected to have participated. Letter grades reflect the type and number of assessments; thus, comparing letter grades across class sections can be slightly arbitrary. It is notable that the letter grade prediction did not reflect the assessment results. In RQ 1 no significant differences were noted in the learning outcome assessment, although the online students scored slightly lower. H2 was accepted because there were significant differences in the completed credit hours and projected grade, even though there were no differences in the other academic factors.

H3 concentrated on the time students spent studying for the course. One of the critical components to success in a content driven course such as A&PI is the study time. The students were asked to approximate the time that spent studying for class. To avoid confusion with the online students who may have spent time study the online module, study was defined to include the time actually spent in class. The online students spent an additional four and one half hours per week studying for A&PI than the face-to-face students. This is a significant amount of additional study time, which translates to 72 hours over the course of the semester. The results were unexpected, as RQ 2 found that the online students worked significantly more hours and were more likely to have children at home. Therefore, the assumption was made that they may have had less time to devote to studying. The difference may have reflected the active learning content of the online courses and may have accounted for the reason the online students predicted a higher grade for the course. H3 was accepted since there was a significant difference in the amount of time the students spent studying for the course.
The third research question (RQ 3) focused on academic background and preparation and the way in which it may differ between students online and face-to-face. The question included three hypotheses that were developed from studies cited in the literature review. When examining the academic factors, some interesting results were noted. The first hypothesis, \((H_1)\), there are differences in academic readiness when a student enters college between the two groups of students — was not accepted. Academic readiness was determined through the completion of remedial classes; although some differences were seen that were not significant. The second hypothesis, \((H_2)\), there are differences in academic measures such as college GPA, projected grade, ACT scores, current course load, and completed credit hours — was accepted. For most of the factors no significant difference existed between the two groups; however, the online students projected higher grades and had completed more course credit hours. The third hypothesis, \((H_3)\), there are differences in the amount of time spent studying between the two groups of students — was accepted. The online students studied significantly more hours per week than the face-to-face students, which was unexpected because they also tended to work more hours and have more family responsibilities.

**Discussion of Research Question 4**

**RQ 4:** *What is the relationship between selected student satisfaction factors and presentation format (online or traditional on-campus format)?*

- \(H_1\) There are differences in how online and face-to-face students rate flexibility and scheduling conflicts when choosing a course format.
- \(H_2\) There are differences in how online and face-to-face students rate learning environment in choosing a course format.
• $H_3$ There are differences in how online and face-to-face students rate social interaction in choosing a course format.

• $H_4$ There are differences in how online and face-to-face students value advice from faculty and students in choosing a course format.

• $H_5$ There are differences in how online and face-to-face students perceived that the instructor interacted with them or the class as a whole. These factors were considered communication.

• $H_6$ There are differences in how online and face-to-face students kept pace with the material. These factors were considered content.

• $H_6$ There are differences in how online and face-to-face students rated the course overall.

RQ 4 was divided into two sections because the series of questions used in the survey were separated by two sets of Likert questions. The first section focused on those factors that affected the student’s choice of course format, either online or face-to-face; and the second section concerned their satisfaction with the selection. The first set of hypotheses and the Likert questions were developed from the Dutton et al. (2002) study. The second section of RQ 4 concerned student satisfaction with the course selection. This section utilized the questions from the OCTC Student Evaluations of Instruction that students complete for each class at the end of the term.

$H_1$ focused on flexibility and scheduling conflicts when choosing a course format. Although flexibility was ranked as important to A&PI online students, it did not rank as very important and was equally significant to the on campus students. Both groups ranked general flexibility as important. Most notably, the face-to-face students ranked
flexibility slightly higher, but not significantly so, than the online students. Dutton et al. (2002) found that flexibility was more important for online students than for their face-to-face counterparts. Jaggars (2014) questioned students as to their reasons for choosing an online class and found that flexibility and convenience were the primary reasons. This finding makes intuitive sense, as students can attend an online class at any time in any location that has internet access; however, it was not critically important in this study.

Additional questions concerning work and childcare conflicts were used to determine the importance of flexibility. Although the online students were more likely to have children and to work, neither were major reasons for picking their course format. Childcare ranked low for both groups, which was interesting because many community college students are parents. In this study, 32.2% of the on campus students and 56.6% of the online students were parents; therefore, the low rank for childcare was surprising. Conflicts with job schedules were important to both groups, but not significantly more important to either one. As might have been expected, on-campus students were concerned with conflict with other classes, but online students also noted the same statement as important. It is possible that students were pushed into online courses due to course scheduling issues. H1 was not accepted since there was no significant difference between the groups. Both groups scored flexibility as important but not critically important.

H2 examined the importance of learning environment. Dutton et al. (2002) found that learning environment statements favored the on campus students. This study found similar results. The online students ranked several of the learning environment statements very low. Unlike the on-campus students, they did not feel the need to attend
a lecture to learn the material and were not motivated by attending class. The online students felt they learned more by reading a textbook; interestingly, the on-campus students ranked the statement equally as high. The on-campus students stated that working on campus resulted in fewer distractions, although both ranked the statement as important. The problem with analyzing this statement was in determining the students’ interpretation of the term “classroom distractions.” On-campus students may have considered home life to be a distraction, whereas online students may have considered other students as a distraction. H2 was accepted because there was a significant difference in the students’ choice based on learning environment.

H3 focused on student-to-student and student-to-faculty interaction. As expected, the online students were uninterested in social contact in the educational settings; they scored these factors dramatically low. They were uninterested in personal interaction with students and faculty as well. Conversely, the on-campus students valued face-to-face interaction with the instructor and ranked that statement higher than all others. On-campus students needed the face-to-face interaction and social support of a campus community. Dutton et al. (2002) found similar results. Online students were less interested in face-to-face contact. The on-campus students choose their course format in order to experience the interaction. In the case of the online students that dichotomy was found to be dramatic with the possibility that face-to-face interaction may have driven them from on campus courses. The Tinto (1999) and Tinto and Pusser (2006) models focused on social interaction as a major factor for improving retention, which can be a problem if students are uninterested in social interaction. H3 was accepted since there was a dramatic difference between the groups need for social interaction.
H₄ considered the individual to whom the students listened when asking about course selection advice. The quality of the program was important to both groups, which was expected. In keeping with their lack of interest in face-to-face interaction with faculty, online students were less interested in following the advice of their advisor than listening to the advice of students who had been through the program. The on-campus students scored their advisors’ opinion higher. Dutton et al. (2002) found similar results when they asked the same question. Allen and Seaman (2012) noted hesitancy on the part of advisors to recommend online programs, possible because those interested in online courses were asking students with online experience for advice. As a result, the online students made their final decisions based on student reviews of the course, which could impact the manner in which schools address student advising. A specific set of advisors for online courses may be able to address these students’ concerns. H₄ was accepted since there was a significant difference in the way the online student seek advice.

Student satisfaction is a popular indicator of the learning experience. “This operationalization relies upon the argument that when students report their satisfaction with a course, they are assessing the quality of their learning experience” (Driscoll et al., 2012, p. 315). The student responses to the second set of Likert questions (H₅-H₇) reflected communication, pedagogy, and overall satisfaction with the results. These statements also reflected the ability of the instructor to make use of the medium. Emerson and MacKay (2011) found that student satisfaction and performance were not differentiated between online and face-to-face courses. This study found several differences in communication, satisfaction with content delivery, and overall score.
Some of the student satisfaction variables may have favored an online environment. The nature of an online course requires that students interact with the material; thus, it must be built along an active learning foundation. Additionally, on-campus instructors address all of the students during class time, whereas online instructors must rely on email in order to give students directions and assistance. The result is that online instructors may pay greater attention to returning email. Also, an online medium may allow for faster feedback, as Blackboard and other learning platforms such as McGraw-Hill’s Connect and Pearson’s CourseConnect can grade assessments immediately. Due to possible favoritism toward the medium, these statements should not be considered a judgment on the instructor’s ability. Rather, the responses were used to gauge the way in which the students were engaged with the medium and whether they were satisfied with their choice of course format.

H5 was concerned with communication between students and faculty. Communication is critical in any successful student-teacher relationship, but it may be more important in an online classroom. Both groups rated their courses high on communication in general and returning emails specifically; however, the online students rated both factors significantly higher. In an online class, returning and initiating emails is critical to creating a sense of belonging and support. An on campus instructor can ask and answer questions during a specified time period, but online students work at all hours and, thus, ask questions at all hours. They need an answer to their questions in a reasonable amount of time or they can feel abandoned. According to Davidson and Wilson (2013), campus relationships are critical to maintaining student persistence, particularly within non-traditional populations. Within an online framework those
relationships can be created and established through email and other media. The results from this study indicated that the students focused on this line of communication in order to feel connected to the course. Since there was a significant difference in the values for communication $H_5$ was accepted.

$H_6$ addressed pedagogy. In a content rich course such as A&P, students may find it difficult to maintain the pace in which the material is presented or in the amount of material on which the instructor tests. RQ 1 demonstrated no significant difference between the students’ ability to accomplish the learning outcomes, which did not indicate that the students felt they could keep pace or were well prepared for assessments. The statement, “This course was well organized” scored high for both groups; however, the online students rated it higher. In online courses, organization refers to the students’ ability to navigate through the content. Online courses are not affected by the surroundings as dramatically as on campus courses. Thus, an online course can be formatted well in advanced and modified prior to the beginning of the semester.

Both groups scored high in appropriate presentation rate and active engagement. The online students reported a more appropriate rate of course presentation, they had more control over the pace. Online students can advance through a course at a rate appropriate for their learning abilities. Online students also ranked active engagement higher than face-to-face students, which was not surprising, because the nature of online education dictates active learning. The lab component in both courses also indicates that active learning is an intrinsic component in the course. $H_6$ was accepted because the online students rated the pedagogy section higher than the face-to-face students.
H7 concentrated on an overall satisfaction with the course format. Overall both groups were satisfied with the experience, although the online group rated it slightly higher. Also of note the online students indicated they would tell others about the course. This finding was of interest, as online students focused on the experience of other students when choosing a course. H7 was accepted since the online students rated overall satisfaction significantly higher than face-to-face students.

The fourth research question (RQ4) addressed the factors that influenced choice of course format and student satisfaction with that choice. It was divided into two sections, as the series of questions used in the survey were separated by two sets of Likert questions. The questions included seven hypotheses that were developed from studies cited in the literature review and from the student evaluations of instruction utilized by OCTC. The first hypothesis, (H1), there are differences in how online and face-to-face students rate flexibility and scheduling conflicts when choosing a course format—was not accepted. Flexibility was important to both groups, but no more important to the online group and not highly important to either group. Online students indicated that flexibility was not necessary for work or childcare, but rather, due to conflict with other courses. The second hypothesis, (H2), there are differences in how online and face-to-face students rate learning environment in choosing a course format—was accepted. Not surprising online students felt no need to attend a physical class in order to be motivated, nor did they need physical lectures to learn material. The third hypothesis (H3), there are differences in how online and face-to-face students rate social interaction in choosing a course format—was accepted. The online students scored these statements very low, and the face-to-face students scored them extremely high. The fourth hypothesis (H4),
there are differences in how online and face-to-face students value advice from faculty 
and students in choosing a course format—was accepted. The online students were more 
likely to listen to the advice of other students as opposed to their advisors. These 
questions indicated dramatic differences in the reasons students chose a course format for 
A&PI, but they did not indicate the student satisfaction with these choices.

The last three hypotheses dealt with student satisfaction with the choice of course 
presentation. The fifth hypothesis (H₅) there are differences in how online and face-to- 
face students perceived that the instructor interacted with them or the class as a whole— 
was accepted. These factors were considered to be communication. No difference was 
noted in timely feedback on assessments, as both groups scored high. The online 
students were more satisfied with email responses and overall communication. The sixth 
hypothesis (H₆), there are differences in how online and face-to-face students kept pace 
with the material—was accepted. These factors were considered content, because these 
statements dealt with the pace, assessments, and active learning. The online students 
scored significantly higher on all factors except for the exams being consistent with 
material. The final and seventh hypothesis (H₇), there are differences in how online and 
face-to-face students rated the course overall—also was accepted. The online students 
scored higher on the overall factors including recommending the course to other students. 
As online students took the advice of other students when choosing a course, this was 
particularly important.
Discussion of Research Question 5

RQ 5: What is the relationship between student retention and modes of presentation (online or traditional on-campus format)?

- \(H_1\) There are differences in persistence, as measured by the intent of returning to take APII in spring of 2015 between the two formats.
- \(H_2\) There are differences in persistence, as measured by the intent of returning to take APII in the same format.
- \(H_3\) There are differences in attrition rate between online and face-to-face courses.

Persistence refers to a student’s tendency to return for classes in the following semester. Upon successful completion of A&PI, students take A&PII the next semester. The sample population for this study did not include students who had already dropped the course. The students who voluntarily took the survey were those who planned to return in the spring semester for A&PII. Thus, determining persistence by means of this survey yielded a biased result. The persistence for both groups was nearly 100%.

Because the students had grown comfortable in the medium, no indication was seen that they had plans to switch to another presentation format. Developing a conclusion was impossible concerning persistence using the survey. These results were expected; as a result, the goal was to examine persistence in terms of attrition. Persistence is a factor of attrition as failure to successfully complete A&PI not only means that students cannot take APII, but it also means that they cannot progress in their declared major and may drop out. Thus it was impossible to develop a statistically meaningful conclusion for \(H_1\) or \(H_2\).
H₃ concerned the attrition rates in the A&PI courses. The average online and face-to-face attrition rate was essentially the same and high. One third of the students who began A&PI fail to complete it, thus lowering persistence into APII and into the selected majors. Angelino et al. (2007); Boston et al. (2014); Capra (2011); and Hart (2012) found that the attrition or drop/fail rate of online courses was higher than corresponding face-to-face courses. Urtel (2008) found that students enrolled in online sections had a statistically significant higher D-F-drop rate than their peers who took the face-to-face section. This study contradicted those results, as the online and face-to-face attrition was nearly identical despite a wide range of retention values for A&PI sections. In some courses, this score was as high as two thirds, although it also was as low as 3.7% (online) and 5% (face-to-face). The overall cause for this high attrition rate was not explored in this study, although several conclusions can be made. Attrition in A&P is the result of a number of problems but, interestingly, that the presentation format does not impact retention. H₃ was not accepted because there was no difference in the attrition scores.

Bean’s model focused on increased external pressures faced by non-traditional students, which have been demonstrated by this study (Bean, 1980; Bean & Metzner, 1985). RQ 2 and RQ 3 indicated that the A&P students dealt with a significant external pressure. If those external pressures for non-traditional students increased, as suggested by the Bean model, online attrition would be expected to be higher since RQ 2 indicated that more non-traditional students were enrolled in the online course.

According to Tinto (1975, 1997, 1999, 2001), one key to student retention is to integrate students into the campus community. With the advancements in technology,
incorporating online students into a campus community has become easier. RQ 4 concluded that lack of communication was not an issue with online A&P classes. Students felt that online teachers responded to email and maintained an open line of communication. This open line of communication can erase feelings of isolation addressed by Willging and Johnson (2009) and can function to integrate the students into the larger campus community. A&P is a demanding program; thus, the concerns raised by Willging and Johnson about course difficulty are a concern for the online students.

The fifth research question (RQ 5) addressed persistence and retention in A&PI. The first hypothesis ($H_1$), there will be a difference in persistence, as measured by the intent of returning to take APII in spring of 2015 between the two formats and the second hypothesis ($H_2$), there will be a difference in persistence, as measured by the intent of returning to take APII in the same format could not be accurately tested with the means available. All students who took the survey planned to continue to APII in the same format. The third hypothesis, ($H_3$), there will be a difference in attrition rate between online and face-to-face courses—was not accepted. The attrition in both courses was nearly identical, although a wide range was noted in values. Approximately one third of the students who began the semester did not complete the course. Attrition can impact more than just one course or one student. It was no surprise that attrition was detrimental to student success. A student who drops from a class may begin a downward spiral and drop from multiple classes.

**Summary of the Findings**

This study addressed several biases and uncovered some intriguing results. In general it appeared to be more in depth and investigated more factors than previous
studies of this nature. The primary focus of the study was to investigate the impact of class delivery format on student learning outcomes, as queried in RQ 1. An answer to this is important in order to address the bias that can occur in transfer. This study found no significant difference in the successful completion of learning outcomes between the online and face-to-face API courses. The online students scored slightly lower than the face-to-face students. The scores changed when online students were divided into those who completed the lab component virtually or through the use of a lab kit. No difference was seen in the scores between the online lab kit students and the face-to-face students, although the virtual students scored more than five and a half points lower. Lab kits appear to be more effective leaning tool than virtual labs.

The low assessment score for both groups clearly indicated room for improvement. A lower score was expected, as the students took an exam for which they did not prepare; however, the exam focused on learning outcomes that the students should have embedded and been able to access without excessive study. The results of the learning objective assessment clearly revealed that they do not retain adequate information. Colleges assume that students come to class with the necessary study skills; the reality may be different. Students should learn to study in the same way they learn math skills; they must be taught. Supplying students with a variety of study tools may impact this discrepancy.

One of the largest implications from the findings involved advising and the promotion of quality programs. Advisors tended not to suggest online courses. A problem may have resulted if advisors make these recommendations without sufficient understanding of the best mode of presentation for an individual. Online courses may not
be ideal for all students and begs the question, how can advisors predict the students who will be more successful? RQ 2-4 sought to answer this question. Online students generally were older, and had more commitments, but they also were driven to study more.

The study found that the online students were older and older students tended to score higher regardless of the course format. No difference was found in academic readiness between the two groups. Both groups were likely to need remedial math, which is not uncommon in community college students. The online students were slightly more likely to take math or English than the face-to-face counterparts but the difference was not significant. The online students were not only older, but they were more likely to have children and to work outside the home. The online students were more likely to need financial aid despite working more hours. They also were more likely to have had experience in a medical field, which gave them a stronger background in the allied health fields and A&P. In addition, they were more likely to have a significant number of completed college courses, although no difference was seen in course load, college GPA, or ACT score. Surprisingly, although the online students had more family responsibilities in terms of jobs and children, they also spent much more time studying A&P. This difference may have reflected the active learning content of the online courses and may have accounted for the reason the online students predicted a higher grade for the course.

The online students were expected to focus on flexibility. Although they rated it high, they did not score it extremely high and flexibility was equally important to the face-to-face students. Online students indicated that the flexibility was unnecessary for
work or childcare, but rather, for conflict with other courses. They scored social interaction extremely low and did not need to meet with the teacher or other students. That result also was reflected in their responses to other factors that involved interaction. They were not motivated by attending class, did not need lectures to understand material, and were more likely to listen to the advice of other students as opposed to their advisors. They also had a stronger internal motivation, as seen in the additional hours they studied. The online students did not require physical interaction with faculty or other students, but they valued communication. They also listened to other students when deciding the courses to take. Online students may have been more comfortable listening to the opinions of student mentors when choosing a course direction.

No difference was found in the average attrition rate between online or face-to-face courses, although a wide range existed between individual sections. The general attrition rate for A&PI was extremely high bringing a number of factors into play. Students who fail to successfully complete A&PI will not proceed to A&PII and will not be able to pursue the major of their choice. This downward spiral may result in dropping out of other courses or out of school. The difficulty of the course cannot be changed; however, the incorporation of study strategies into the overall presentation could be advantageous. Additionally, instructors should focus on maintaining open lines of communication, which may require quick responses to email and specific and immediate feedback on assessments.
Directions for Future Studies

As this study sought to answer the research questions previously posed the pathway for other studies were outlined.

- Future studies should consider A&PII, microbiology, general biology, and other science lab courses. The framework for the assessment can be used to examine other online science courses.
- A future study could examine the retention of anatomy and physiology basic knowledge upon a student being admitted to an allied health program. An assessment can be developed that involves the course competencies for both semesters of A&P and grouped according to course format. The long term retention of information is critical but was not addressed in this study.
- Several studies have compared virtual labs with on campus labs but have not explored the difference between online lab kits and virtual labs. When lab format was considered, students using a virtual lab scored notably lower on the learning outcome. Virtual labs may not be meeting the needs of the students, but the reason was unclear.
- A future study should examine the impact that experience in the medical field has on learning outcomes. This study found that the online students are older with more family responsibilities, but it also noted that they have more experience in the medical field. It did not indicate if this experience impacted their success.
- Additional research could examine the issues with retention in A&PI. Of interest would be a study to examine the reasons for attrition in sections with
high dropout rates to compare them to demographic and academic factors in sections with high retention. This study was unable to pursue the causes of attrition, as a requirement was in place that the subjects remain anonymous.

**Summary**

The study revealed that hands-on labs may be more effective than virtual labs, although further study is suggested. It is possible that virtual labs do not fit the pedagogy as well as campus or lab kits. The efficacy of virtual labs requires further examination. A critical point was that there was no significant difference between the student learning outcomes between the course formats. Thus the bias that has been documented to exist toward online laboratory courses has no foundation. Even so online programs may not be ideal for all students.

The challenge for advisors is to identify those students who work best in particular course formats. Online students had more family responsibilities than face-to-face students, but they overlapped in several ways. The online students were older, but the face-to-face students were older than the typical incoming freshman. Students in both groups had jobs, but online students work more hours. Students in both groups may have been parents, but online students were more likely to have children. The dichotomy resulted in difficulty to identifying characteristics of successful online students.

Internal motivation was an important characteristic for successful online students. They were uninterested in external motivation or social interaction on campus. Students attending community college may not have left their old social network behind. They had a support network of local family and friends and may not have looked to their classmates to replace that network. Thus, when students indicated they did not need the
social interaction with classmates, may have been it because they already had a network in place.

The academic support supplied by the programs was important to online students. Although they did not value physical interaction, they valued open communication. Both the online and face-to-face instructors should consider the importance of responding to student email. An additional means to support these students may be to develop a virtual support network. They depended upon the advice of other students, and virtual programs can harness that ability by creating social media networks.

Distance education is not a new concept. Virtual classes have been popular for several decades, yet a bias still exists relative to online science lab classes. This study investigated a number of factors, but the major issue to be addressed is the bias toward online science labs that prevents articulation within programs and between schools. This study confirmed that online science lab courses can be effective learning platforms.
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APPENDIX A

KCTCS Course Description and Competencies for A&PI

BIO 137 Human Anatomy and Physiology I 4 Credits

Description:
The interrelationship and structure and function of each body system in two semesters. The first semester will include basic chemistry, cell structure, cell physiology, metabolism, tissues, and integumentary, skeletal, muscular, and nervous systems.

Pre-requisites: Reading, English, and Mathematics assessment exam scores above the KCTCS developmental placement level or successful completion of the prescribed developmental course(s) or consent of instructor.

Implementation: Fall 2005

Competencies:
Upon completion of this course, the student can:

1. Explain basic principles of inorganic and organic chemistry as they apply to physiological processes.
2. Describe basic cell structure and physiology.
3. Describe the structure and function of major tissue types.
4. Recognize the complementarity of structure and function.
5. Describe basic metabolic processes of organ systems.
6. Explain the interrelationships between organ systems and physiological processes.
7. Explain the major homeostatic mechanisms utilized in each body system in response to internal and external environmental changes.
8. Explain physiological and anatomical mechanisms of common dysfunctions.

Outline:
I. Chemistry of Life
   A. Inorganic molecules important in physiological processes
   B. Basic atomic structure
   C. Ion formation
   D. Chemical bonding
1. Ionic
2. Covalent
3. Hydrogen

E. pH and buffering
   1. Sodium bicarbonate/carbonic acid
   2. Sodium monohydrogen/dihydrogen phosphates
   3. Proteins
   4. Hemoglobin

F. Organic functional groups

G. Organic compounds
   1. Carbohydrates
   2. Lipids
   3. Proteins
   4. Nucleic Acids
   5. ATP

H. Hydrolysis and dehydration synthesis

I. Solutions

II. Anatomical terminology
   A. Directional terminology
   B. Body systems
   C. Body planes and sections
   D. Body cavities
   E. Body regions

III. Eukaryotic Cell Structure and Function
   A. Cellular organelles and their functions
   B. Cell membrane structure
   C. Transport
   D. Enzymes
   E. Cell division
      1. Mitosis
      2. Meiosis
IV. Metabolism
   A. The function of ATP
   B. Oxidation/reduction reactions
   C. ATP formation
      1. Glycolysis
      2. Kreb's cycle
      3. Electron transport chain
   D. Role of glycerol, fatty acids, and amino acids in the metabolic mill
   E. Protein Synthesis

V. Animal Tissues
   A. Epithelial
   B. Muscle
   C. Connective
   D. Nerve

VI. Integumentary System
   A. Functions
   B. Layers of the skin
   C. Accessory structures
   D. Membranes

VII. Skeletal System
   A. Functions
   B. Macroscopic anatomy of bones
   C. Microscopic anatomy of bone tissue
   D. Intramembranous bone formation
   E. Endochondral bone formation
   F. Growth and repair
   G. Articulations
      1. Classes of joints
      2. Synovial joint structure
   H. Identification of major bones and markings
VIII. Muscular system
   A. Functions
   B. Characteristics of muscles
   C. Microscopic structure of muscle tissue
      1. Muscle fibers
      2. Myofibrils
   D. Physiology of muscle contraction
   E. Energy sources for muscle contraction
   F. Types of muscle contractions
   G. Movements
   H. Identification

IX. Nervous system
   A. Functions
   B. Divisions of the nervous system
   C. Anatomy of nerve tissue
      1. Neurons
      2. Neuroglial cells
   D. Physiology of the nerve impulses
   E. Synapses and neurotransmitters
   F. Spinal cord
      1. Gray and white matter
      2. Ascending and descending tracts
      3. Spinal nerves
   G. Spinal reflexes
   H. Brain
      1. Cerebral cortex
      2. Brain stem
      3. Cerebellum
      4. Cranial nerves
   I. Autonomic nervous system
      1. Sympathetic
2. Parasympathetic

J. Sensory receptors and organs
   1. Skin and muscles
   2. Ear
   3. Eye
   4. Nose
   5. Tongue

Dates of Actions:
Approved: July 1975
APPENDIX B

Assessment Questions Based on Learning Outcomes

The questions are broken into topics with corresponding competencies. Qualtrics does not always number questions in order. The following table lists the numbers listed in the designer’s page of Qualtrics.

<table>
<thead>
<tr>
<th>Number</th>
<th>Qualtrics Question Number</th>
<th>Correct Answer</th>
<th>Learning Outcome Question</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Explain basic principles of inorganic and organic chemistry as they apply to physiological processes.</td>
</tr>
<tr>
<td>1</td>
<td>Q32</td>
<td>B</td>
<td>Organic compounds always contain <em>?</em> atoms.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>A. water</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B. carbon</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C. nitrogen</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D. oxygen</td>
</tr>
<tr>
<td>2</td>
<td>Q33</td>
<td>D</td>
<td>Which of the following contains carbohydrate?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A. Protein</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B. Fat</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C. Nucleic acid</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D. Starch</td>
</tr>
<tr>
<td>3</td>
<td>Q34</td>
<td>B</td>
<td>The subunit molecules for proteins are <em>?</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A. atoms.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B. amino acids.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>C. enzymes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D. polymers.</td>
</tr>
<tr>
<td>4</td>
<td>Q35</td>
<td>B</td>
<td>Which of the following molecules is the primary energy carrier in cells?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A. DNA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B. ATP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C. RNA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D. GNA</td>
</tr>
<tr>
<td>5</td>
<td>Q36</td>
<td>A</td>
<td>Organic compounds that are always insoluble in water are called <em>?</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A. lipids</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B. sugars.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C. nucleotides.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D. proteins</td>
</tr>
</tbody>
</table>
**CELLS**

Describe basic cell structure and physiology.

6  Q37  C  Mitochondria function to _?_.
    A. produce protein.
    B. store food.
    C. produce ATP.
    D. digest food

7  Q38  A  _?_ are small hair-like extensions that produce movement across the surface of cells.
    A. Cilia
    B. Flagella
    C. Microvilli
    D. Basal bodies

8  Q39  A  Plasma membranes are _?_, which means that some chemicals move easily through plasma membrane while other chemicals do not.
    A. selectively permeable
    B. concentration graded
    C. electrically graded
    D. selectively soluble

9  Q40  C  The random movement of simple substances from an area of higher concentration to an area of lower concentration is called _?_.
    A. osmosis.
    B. filtration.
    C. diffusion.
    D. pumping.

10 Q41  D  Which of the following does NOT influence the rate of diffusion of a chemical across a plasma membrane?
    A. concentration gradient of the chemical across the membrane
    B. mass of the diffusing chemical
    C. distance that the chemical has to diffuse
    D. amount of ATP available

**TISSUES**

Describe the structure and function of major tissue types.

11 Q42  B  Which type of tissue covers surfaces and lines cavities?
    A. connective
    B. epithelium
    C. muscle
    D. connective and muscle
12 Q43 C Which type of tissue binds and supports body parts?
   A. epithelium
   B. nervous
   C. connective
   D. muscular

13 Q44 C Which of the following is NOT a characteristic of epithelial tissue?
   A. It readily divides to produce new cells.
   B. It has a basement membrane to connect to underlying tissue.
   C. It has many blood vessels to support its nutrient needs.
   D. It always has a free surface.

14 Q45 A Which type of muscle tissue is found in the walls of hollow internal organs?
   A. smooth
   B. cardiac
   C. skeletal
   D. Both smooth and skeletal are correct.

15 Q46 D What is the cell found in fibrous connective tissue?
   A. osteocytes
   B. chondrocytes
   C. erythrocytes
   D. fibroblasts

---

**INTEGUMENTARY (Skin)**
- Recognize the complementarity of structure and function.
- Describe basic metabolic processes of organ systems.
- Explain the interrelationships between organ systems and physiological processes.
- Explain the major homeostatic mechanisms utilized in each body system in response to internal and external environmental changes.

16 Q47 B Keratin is _?_
   A. a pigment.
   B. a waterproof protein.
   C. located in the hypodermis.
   D. described by all of these characteristics.
17. Q48. D. Melanin _?_.
   A. is a pigment.
   B. protects the skin from ultraviolet radiation.
   C. is located in the epidermis.
   D. is described by all of these characteristics.

18. Q49. D. Which of the following is a function of the skin?
   A. protection
   B. sensory reception
   C. synthesis of vitamin D
   D. all of these are functions

19. Q50. C. The skin consists of _?_ regions.
   A. 1
   B. 2
   C. 3
   D. 4

20. Q52. B. Which layer of the epidermis is closest to the surface?
   A. stratum lucidum
   B. stratum corneum
   C. stratum basale
   D. dermis

---

**SKELETAL SYSTEM**
- Recognize the complementarity of structure and function.
- Describe basic metabolic processes of organ systems.
- Explain the interrelationships between organ systems and physiological processes.
- Explain the major homeostatic mechanisms utilized in each body system in response to internal and external environmental changes.

21. Q53. A. Which of the following bones forms most of the roof of the cranium?
   A. parietal
   B. frontal
   C. mandible
   D. temporal

22. Q51. D. Which of the following are the bone-eating (reabsorbing) cells?
   A. osteoprogenitor cell
   B. osteocytes
   C. osteoblasts
   D. osteoclasts
23  Q54  B  What structure is the site of bone growth in length?
   A. primary ossification center
   B. epiphyseal plates
   C. periosteum
   D. None of the choices are correct.

24  Q55  C  Which ribs do NOT attach anteriorly to the sternum?
   A. true ribs
   B. false ribs
   C. floating ribs
   D. All ribs attach to the sternum

25  Q54  D  Red bone marrow _?_
   A. produces blood cells.
   B. is located in spongy bone.
   C. is located in the epiphyseal plate.
   D. produces blood cells and is located in spongy bone.

---

**JOINTS**

Recognize the complementarity of structure and function.

26  Q55  B  What material is found within the joint cavity of a synovial joint?
   A. fibrous connective tissue
   B. synovial fluid
   C. fibrocartilage
   D. ligaments

27  Q56  C  The wrist is an example of a _?_ joint.
   A. ball-and-socket
   B. hinge
   C. gliding
   D. pivot

28  Q57  C  Bursae are _?_
   A. tendons.
   B. types of joints.
   C. fluid-filled sacs.
   D. cartilage pads.
What type of synovial joint movement will move a body part laterally, away from the body?

A. adduction  
B. extension  
C. dorsiflexion  
D. abduction

What type of synovial joint movement is the movement of a body part around its own axis?

A. flexion  
B. supination  
C. pronation  
D. rotation

MUSCULAR SYSTEM

- Recognize the complementarity of structure and function.
- Describe basic metabolic processes of organ systems.
- Explain the interrelationships between organ systems and physiological processes.
- Explain the major homeostatic mechanisms utilized in each body system in response to internal and external environmental changes.

The ? will adduct the scapulae and help extend the neck.

A. trapezius  
B. temporalis  
C. sternocleidomastoid  
D. deltoid

The special name for the plasma membrane of a muscle fiber is the ?

A. sarcolemma.  
B. sarcoplasm.  
C. T tubules.  
D. sarcoplasmic reticulum.

The sliding filament theory of muscle contraction describes ?

A. how a sarcomere shortens.  
B. the disappearance of the A band.  
C. the movement of the myosin in relation to the actin.  
D. All of the choices are correct.
34 Q63 A What does calcium do during muscle contraction?
A. binds to troponin
B. binds to the cross-bridges
C. supplies energy
D. hydrolyzes ATP

35 Q64 D Athletes sometimes complain of oxygen debt, a condition that results when insufficient oxygen is available to completely break down pyruvic acid. As a result, the pyruvic acid is converted to __?
A. a strong base.
B. stearic acid.
C. hydrochloric acid.
D. lactic acid

NERVOUS SYSTEM
- Recognize the complementarity of structure and function.
- Describe basic metabolic processes of organ systems.
- Explain the interrelationships between organ systems and physiological processes.
- Explain the major homeostatic mechanisms utilized in each body system in response to internal and external environmental changes.

36 Q65 D The right and left halves of the cerebrum (the cerebral hemispheres) are connected to each other mainly by a bundle of neuron axons called the __?
A. thalamus.
B. insula.
C. corpus cavernosum.
D. corpus callosum.

37 Q66 B The entire nervous system is divided into two main regions: The __?
A. brain and the spinal cord
B. CNS and the PNS
C. neurons and the glial cells
D. motor neurons and the sensory neurons

38 Q67 B The "fight or flight" response is the term used to describe activation of the __?
A. parasympathetic division
B. sympathetic division
C. somatic nervous system
D. CNS
39  Q69  C  The movement of $K^+$ out of the cell makes the inside of the cell less positive (more negative) and acts to restore the original resting voltage of the neuron - a process called _?_.  
A. depolarization.  
B. hyperpolarization.  
C. repolarization.  
D. overshoot

40  Q70  C  A(n) _?_ neuron transmits signals to muscles or glands from the CNS.  
A. interneuron  
B. sensory  
C. motor  
D. ganglion

### SENSES

- Recognize the complementarity of structure and function.  
- Explain the interrelationships between organ systems and physiological processes.

41  Q71  E  Other sensations that influence taste are _?_.  
A. Smell  
B. Pain  
C. Temperature  
D. Texture  
E. All options are correct

42  Q72  C  The transparent anterior portion of the outer eye coat which allows light rays to enter the interior of the eye is the _?_.  
A. sclera  
B. eyeball  
C. cornea  
D. extrinsic

43  Q73  C  Which of the following is **NOT** a feature of the retina?  
A. ganglion cells  
B. photoreceptors  
C. optic chiasma  
D. optic disc
44 Q74 D The optic disc marks the _?_.
   A. region in the retina where the ganglion cells are located.
   B. most optically sensitive point of the retina.
   C. latest recording techniques on CDs.
   D. exit of the optic nerve.
   E. junction between the iris and the ciliary body.

45 Q75 E The receptors for _?_ and _?_ are classified as chemoreceptors
   A. sight; smell
   B. proprioception; pain
   C. smell; hearing
   D. pain; pressure
   E. taste; smell

**DISEASES/DYSFUNCTIONS**

* Explain physiological and anatomical mechanisms of common dysfunctions.

46 Q76 B The epidermis and part of the dermis are damaged from a _?_
   A. first-degree burn.
   B. second-degree burn.
   C. third-degree burn.
   D. fourth-degree burn.

47 Q77 C A condition in which bones lose bone mass and therefore become weak is _?_
   A. osteomyelitis.
   B. osteogenesis.
   C. osteoporosis.
   D. osteomalacia.

48 Q78 C What type of joint disease is described by the autoimmune inflammation of the synovial membrane?
   A. osteoarthritis
   B. osteoporosis
   C. rheumatoid arthritis
   D. gout
A genetic disease of progressive muscle weakening and degeneration due to the lack of a protein is
A. fibromyalgia.
B. myasthenia gravis.
C. muscular dystrophy.
D. osteoarthritis.

A person who has loss of sensation and movement of the lower limbs but not the upper limbs (usually due to a break in the lower portion of the spinal cord) is a _?_
A. Spinal invalid
B. Quadriplegic
C. Paraplegic
D. Brachioplegic
APPENDIX C

Qualtrics Survey Questions

The Qualtrics numbers are not sequential. Qualtrics numbers questions based on the order that they are entered. The questions below were used to answer Research Questions 2-5.

Q84 I agree to participate in the study as outlined on the previous page.
☐ Yes (1)
☐ No (2)
If Yes Is Selected, Then Skip To The first part of this survey asks for...If No Is Selected, Then Skip To Q81. Thank you very much and good luck.

The first part of this survey asks for demographic information. This data will help us understand BIO 137 students and it will allow us to develop programs to better serve the student population.

Q2 In which mode of BIO 137 are you currently enrolled?
☐ Traditional face-to-face on campus class (1)
☐ Hybrid (2)
☐ Fully online course (3)

Q4 Which school is your home school? ☐ Jefferson (9)
☐ Ashland (1)
☐ Big Sandy (2)
☐ Bluegrass (3)
☐ Elizabethtown (4)
☐ Gateway (5)
☐ Hazard (6)
☐ Henderson (7)
☐ Hopkinsville (8)
☐ Madisonville (10)
☐ Maysville (11)
☐ Owensboro (12)
☐ Somerset (13)
☐ Southeast (14)
☐ South Central (15)
☐ West Kentucky (16)
☐ Other (17)
Q6 If you picked "other" please list the name of the school below:

Q5 Please list the section number for your BIO 137 course.

Q7 Please list the name of your instructor
Q8 How is the lab component for your class presented?
- Lab is presented on campus (1)
- Lab is presented using virtual programs such as APR (Anatomy & Physiology Revealed) (2)
- Lab is presented using an eScience kit (3)
- Lab is presented using a Lab Paq kit from Hands on Lab (4)
- Other (5)

Answer If How is the lab component for your class presented? Other Is Selected

Q9 If you picked "other" please describe how the lab component is addressed in your BIO 137 section.

Q10 What is your projected grade in BIO 137?
- A (1)
- B (2)
- C (3)
- D (4)
- E (5)

Q11 What is your best estimate of your current GPA (grade point average)?

Q14 Did you take the ACT?
- Yes (1)
- No (2)

Answer If Did you take the ACT test? Yes Is Selected

Q12 If yes what is your best estimate of your commutative ACT score?

Q87 Please click all of the Math courses that you have or are currently taking.
- MAT 055 (1)
- MAT 065 (2)
- MAT 085 (3)
- MAT 105 (4)
- MAT 110 (5)
- MAT 126 (6)
- MAT 150 College Algebra (7)
- Statistics (8)
- I have not taken a math course yet, but I tested into College Algebra (9)
- I have not taken a math course yet. I test into one of the remedial math courses (10)
- Other (11)

Answer If Please click all of the Math courses that you have or are currently taking.
Other Is Selected
Q89 Have you taken any of the courses listed below:
- Reading 010 (1)
- Reading 020 (2)
- Reading 030 (3)
- I am currently taking Reading 020 (4)
- I am currently taking Reading 030 (5)
- I have not taken a reading course because I did not test into one (6)
- I tested into a reading course but I have not taken it yet. (7)

Q90 Have you taken or are you currently taking any of the courses listed below:
- English 090 (1)
- English 091 (2)
- English 101 (3)
- English 102 (4)
- I have not taken an English class yet but I tested into English 101 (5)
- I have not taken an English class yet but I did not test into English 101 (6)
- Other (7)

Answer If Have you taken or are you currently taking any of the courses listed below: Other Is Selected
Q91 If you answered other please fill in the blank below describing which English class you have taken

Q13 How many credit hours are you currently taking?

Q15 Approximately how many college credit hours have you completed?

Q16 Are you dependent of financial aid?
- Yes (1)
- No (2)
Q17 I am planning on entering:

- Dental hygiene (15)
- Health Information Technology (14)
- Medical Lab Technician (12)
- Nursing (BSN) (1)
- Nursing (RN) (2)
- Occupational Therapy Assistant (10)
- Pharmacy Technician (7)
- Physician Assistant (13)

Answer If I am planning on entering: Other Is Selected

Q18 If you picked "other" please list the program you are planning to enter.

Q92 Are you planning on taking more courses in the Spring 2015 semester?

- Yes (1)
- No (2)

Answer If Are you planning on taking more courses in the Spring 2015 semester? No Is Selected

Q94 If you answered 'no' to the previous question can you describe why you are not taking additional classes?

Answer If Are you planning on taking more courses in the Spring 2015 semester? Yes Is Selected

Q95 If you answered "yes" to the previous question are you planning on taking BIO 139 Human Anatomy and Physiology II?

- Yes (1)
- No (2)

Answer If If you answered "yes" to the previous question are you planning on taking BIO 139 Human Anatomy and Physiology II? No Is Selected

Q96 If you answered "no" to the previous question why are not going to take BIO 139?

139 Human Anatomy and Physiology II? Yes Is Selected

Q97 If you answered "yes" what format will you BIO 139 course be taught in?

- Traditional face-to-face on campus class (1)
- Hybrid (2)
- Online (3)
Q19 How much time do you spend working or studying anatomy and physiology per week? Include how much time you are in class.

Q1 What is your age?

Q20 What is your gender?
- Male (1)
- Female (2)
- Other (3)

Q21 Do you have any children?
- Yes (1)
- No (2)

Answer If Do you have any children? Yes Is Selected
Q28 How many children do you have living at home?

Q22 Did you be work outside the home this semester?
- Yes (1)
- No (2)

Answer If Did you be work outside the home this semester? Yes Is Selected
Q23 If you picked "yes" how many hours do you usually work per week

Answer If Did you be work outside the home this semester? Yes Is Selected
Q24 If you picked "yes", do you currently work in the medical field?
- Yes (1)
- No (2)

Q25 How far away is your local campus from your home?
Q26 In choosing the section in which you are enrolled (lecture vs. online vs hybrid), please rate the importance of the following factors.

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<thead>
<tr>
<th>Factor</th>
<th>Does not apply (1)</th>
<th>Not important (2)</th>
<th>Somewhat important (3)</th>
<th>Important (4)</th>
<th>Very important (5)</th>
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<tr>
<td>Opportunity for face-to-face contact with instructor (1)</td>
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<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Opportunity for face-to-face contact with fellow students (2)</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<td>Conflict between class time and work commitments (3)</td>
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<td>Conflict between class time and childcare commitments (4)</td>
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<td>Course scheduling conflict (5)</td>
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<td>○</td>
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<tr>
<td>Reduce time commuting to class (6)</td>
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<td>○</td>
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<tr>
<td>Motivation provided by regular class meetings (7)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Flexibility in setting pace and time for studying (8)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Better learning from hearing a lecture (9)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Better learning from reading the lecture materials (10)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Advice from adviser or other college official (11)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Fewer classroom distractions (12)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Quality of program (13)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Advice of another student (14)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
Q27 Please complete the following in reference to your experience during the semester.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Does not apply (1)</th>
<th>Strongly disagree (2)</th>
<th>Disagree (3)</th>
<th>Agree (4)</th>
<th>Strongly agree (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>This course was well organized (1)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Active engagement in the course is encouraged (2)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Given the nature of this course information is presented at an appropriate rate. (3)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Exams were consistent with material (4)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I receive timely comments and feedback about exams, papers, or projects. (5)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>My instructor was in frequent communication with students. (6)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>My instructor returned e-mails in a timely manner. (7)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I would recommend this course to other students. (8)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>My experience in this course was positive. (9)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
Q30 Are you the first person in your family to attend college?

☐ Yes (1)
☐ No (2)

Q31 What is the highest degree attained by your parents?

<table>
<thead>
<tr>
<th></th>
<th>Mother (1)</th>
<th>Father (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not a high school graduate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GED/ high school graduate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certificate or diploma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some college but not a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>completed degree (4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associate degree (5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bachelor’s degree (6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Master’s degree (7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doctorate (PhD or EdD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(8)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q82 The next part of the survey involves student learning outcomes. The questions cover some of the more important concepts from the semester. This will not affect your grade in any manner. Do not use any outside material to help answer the following questions. Please just do your best. The final from your course will probably cover many of these issues so think of this as practice. Questions for this section can be found in Appendix B.

Q81 Thank you very much and good luck as you continue your education.
APPENDIX D

IRB Approval from WKU & HSRB Approval from KCTCS

IRB Approval for Survey from WKU

DATE: October 10, 2014

TO: Geralyn Caplan
FROM: Western Kentucky University (WKU) IRB

PROJECT TITLE: [85045.1] A COMPARATIVE ANALYSIS OF STUDENT ACHIEVEMENT & RETENTION IN TRADITIONAL AND ON-LINE FIRST SEMESTER ANATOMY & PHYSIOLOGY COURSES

REFERENCE #: IRB 15-011

SUBMISSION TYPE: New Project

ACTION: APPROVED

APPROVAL DATE: October 10, 2014

REVIEW TYPE: Exempt from Full Board Review

Thank you for your submission of New Project materials for this project. The Western Kentucky University (WKU) IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Exempt Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by an implied consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

This project has been determined to be a Minimal Risk project.

Please note that all research records must be retained for a minimum of three years after the completion of the project.

If you have any questions, please contact Paul Mooney at (270) 745-2120 or irb@wku.edu. Please include your project title and reference number in all correspondence with this committee.
WESTERN KENTUCKY UNIVERSITY

Institutional Review Board
Continuing Review Report

Name of Project: A COMPARATIVE ANALYSIS OF STUDENT ACHIEVEMENT & RETENTION IN TRADITIONAL AND ON-LINE FIRST SEMESTER ANATOMY & PHYSIOLOGY COURSES
Name of Researcher: Geralyn M. Caplan
Department: Educational Leadership

How many total subjects have participated in the study since its inception? #0
How many subjects have participated in the project since the last review? #0

Is your data collection with human subjects complete? ☐ Yes ☑ No

1. Has there been any change in the level of risks to human subjects? (If “Yes”, please explain changes on a separate sheet). ☐ Yes ☑ No
2. Have informed consent procedures changed so as to put subjects above minimal risk? (If “Yes”, please describe on a separate sheet). ☐ Yes ☑ No
3. Have any subjects withdrawn from the research due to adverse events or any unanticipated risks/problems? (If “Yes”, please describe on a separate sheet). ☐ Yes ☑ No
4. Have there been any changes to the source(s) of subjects and the Selection criteria? (If “Yes”, please describe on a separate sheet). ☐ Yes ☑ No
5. Have there been any changes to your research design that were not specified in your application, including the frequency, duration and location of each procedure. (If “Yes”, please describe on a separate sheet). ☑ Yes ☐ No
6. Has there been any change to the way in which confidentiality of the Data is maintained? (If “Yes”, please describe on a separate sheet). ☐ Yes ☑ No
7. Is there desire to extend the time line of the project? ☐ Yes ☑ No
On what date do you anticipate data collection with human subjects to be completed? __Dec 14, 2014__

Additional questions have been made and minor changes to the letters to the participants and the informed consent forms have also been made.
HSRB Approval from KCTCS for Both the Survey and to Collect Retention Data

11/5/2014

Geralyn N. Caplan,
Owensboro Community & Technical College
4300 New Hartford Rd.
Owensboro, KY 42303

RE: A Comparative Analysis of Student Achievement & Retention in Traditional and Online First Semester Anatomy & Physiology Courses

Dear Ms. Caplan:

After careful consideration of your application to the KCTCS Human Subjects Review Board, I have determined that you are eligible for exemption from federal regulations regarding the protection of human subjects based on your research using a procedure that meets the exempt review criteria section 7 [2].

Thank you for your cooperation in meeting the federal requirements for conducting research that involve human subjects. We appreciate your notification to this board and we will keep your information on file.

Sincerely,

[Signature]

[Name]

Chair, KCTCS Human Subjects Review Board

cc: Christina Whitfield, Ph.D.
System Director of Research and Policy Analysis
APPENDIX E

Consent Document

Informed Consent Document

Project Title: A COMPARATIVE ANALYSIS OF STUDENT ACHIEVEMENT & RETENTION IN TRADITIONAL AND ON-LINE FIRST SEMESTER ANATOMY & PHYSIOLOGY COURSES

Investigator: Geralyn M. Caplan, Educational Leadership, 812-867-1459

Students must be 18 year old or older to participate.

The survey must be completed by December 14th 2014.

You are being asked to participate in a project conducted through Western Kentucky University. The university requires that you give consent to participate in the project.

A basic explanation of the project is written below. Please read this explanation. You can contact the researcher Geralyn Caplan at geralyn.caplan@kctcs.edu if you have any additional questions.

1. Nature and Purpose of the Project

The purpose of this project is to determine what impact the mode of presentation (on-line, hybrid, or traditional on campus format) has on the success of students in the first semester anatomy and physiology course and what factors demographic factors play on student success.

2. Explanation of the Procedures

Participants are invited to participate via e-mail invitation through their instructors. The students will be asked to complete the two parts of the survey. The first part includes demographic factors and the second part is the competency portion and it will serve as a 'practice exam'. The questions on the second part were developed to specifically align with the BIO 137 course competencies.

3. Discomfort and Risks

Participants may feel discomfort if they do not know the answers to the competency questions. These questions do not impact a student’s grades so there is no risk associated with answering them wrong. Additionally the survey is anonymous so that data cannot be matched to a specific student. The data will be processed and become part of the dissertation and later publication. Instructors will not have access to individual results.
4. Benefits

The practice exam section will give participants insight into areas that they may need to review before their finals. The study will give us a greater insight into how students learn in different classroom formats. That information can then be used to develop better courses.

5. Confidentiality

The identity of the participant will be protected. Participants are not asked for identifying information such as names and e-mails. We will be interested in some factors such as attending school and section which will be shielded to protect the identity of the participants.

6. Refusal/Withdrawal

Refusal to participate in this study will have no effect on any future services you may be entitled to from KC TCS or WKU. Anyone who agrees to participate in this study is free to withdraw from the study at any time with no penalty.

I request that students only take this demographic and competency sections once. Please do not start and stop since the results cannot be saved. There is no time limit if a student needs to step away. Thank you for your time.

If you agree to participate and would like a copy of this form please contact Geralyn Caplan at geralyn.caplan@kctcs.edu. If you then decide to participate in the project, please select “yes” to the question on the first page of the survey.

Geralyn Caplan
Doctoral candidate in Educational Leadership, WKU
Professor of Biology, OTC

THE DATED APPROVAL ON THIS CONSENT FORM INDICATES THAT THIS PROJECT HAS BEEN REVIEWED AND APPROVED BY THE WESTERN KENTUCKY UNIVERSITY INSTITUTIONAL REVIEW BOARD

Paul Mooney, Human Protections Administrator
TELEPHONE: (270) 745-2129

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APPENDIX F

Cover Letter to Faculty

Thank you for your time. I am working on a conclusive study to determine the efficacy of on-line Anatomy and Physiology education.

I need you to forward the next email which contains the survey link to your BIO 137 classes. At this point I am only interested in studying the dichotomy between the different presentations of BIO 137. So please send the link to your face to face, online, and hybrid classes.

This study will be part of a broader research project that looks at the demographic information concerning students taking anatomy and physiology. The information that is developed will used for my dissertation and may be presented at a conference at a later date. If you are interested I can forward the results of this study when it is completed.

Your students will be asked a series of questions concerning demographic issues and a second set of questions were developed with the KCTCS competencies in mind. Your students will be able to consider this section a practice final. The opening statement on the link will make sure that they understand that participation is voluntary and that they are free to decline to answer any question at their discretion. It should take no more than 30-45 minutes to complete. All responses will be completely anonymous.

If the results of the study are published no personal information will be included. My dissertation committee of Dr. Barbara Burch, Dr. Kristin Wilson, and Dr. Rob Wyatt, and the Institutional Review Board (IRB) of WKU have the authority to review all records. You can also contact the Institutional Review Board (IRB) at WKU. IRB is composed of faculty and staff members of WKU. The IRB functions to protect the rights
of participants in university sponsored studies. You may address any questions or concerns with a member of the IRB in secret. The IRB has reviewed and approved this study.

There are no foreseeable risks to responding to this study. There is no compensation for participating in the interview; although the students may find it helpful to complete the competency portion of the survey before taking finals. By completing the survey they will have agreed to participate in the study and to allow the results of the study to be published.

This survey must be released by November 15th and completed by December 14th 2014. Students must be 18 year old or older to participate. I would like to thank you for your participation in this study. I greatly appreciate your time and consideration.

Sincerely,

Geralyn Caplan

Doctoral candidate in Educational Leadership, WKU

Professor of Biology, OCTC
APPENDIX G

Letter Forwarded to Students

Please forward the following link and letter to the students in your BIO 137 course.

**Link to Qualtrics here**

Thank you for your time. I know everyone is busy this time of year but I really need you input. I am working on a conclusive study to determine the efficacy of Anatomy and Physiology education. At this point I am only interested in BIO 137. I am asking for students to go to the Qualtics link above and complete the 2 part survey.

- The first part covers **demographic information**. We are interested in the impact various factors may have an on student success in the first semester on Anatomy and Physiology.
- The second part is the **competency based** section and is referred to as a practice exam. This section will allow us to understand how well students are meeting learning outcomes. This does not impact student class grades, however, it can give students an idea of what they need to work on for their final exam. Even if you have already completed your final please take this survey.

This study will be part of a broader research project that looks at the demographic information concerning students taking anatomy and physiology, their success at reaching learning outcomes, and retention in BIO 137. The information that is developed will be used for my dissertation and may be presented at a conference at a later date. I will also share the conclusions with your instructor so that they can apply the results to future courses.

The opening statement on the link is the informed consent link. Please read it and click ‘I agree.’ All participation is voluntary and students are free to decline to answer any question at their discretion. It should take no more than 30-45 minutes to complete. All responses will be completely anonymous.

If the results of the study are published no personal information will be included. My dissertation committee of Dr. Barbara Burch, Dr. Kristin Wilson, and Dr. Rob Wyatt, and the Institutional Review Board (IRB) of WKU have the authority to review all records. You can also
contact the Institutional Review Board (IRB) at WKU. IRB is composed of faculty and staff members of WKU. The IRB functions to protect the rights of participants in university sponsored studies. You may address any questions or concerns with a member of the IRB in secret. The IRB has reviewed and approved this study.

There are no foreseeable risks to responding to this study. There is no compensation for participating in the interview; although the students may find it helpful to complete the competency portion of the survey before taking finals. By completing the survey they will have agreed to participate in the study and to allow the results of the study to be published.

I would like to thank you for your participation in this study. I greatly appreciate your time and consideration.

This survey must be completed by December 14th 2014 and students must be 18 year old or older to participate.

Sincerely,

Geralyn Caplan
Doctoral candidate in Educational Leadership, WKU
Professor of Biology, OCTC