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Examination of the Relationship of Community College Opticianry Student Outcomes with Instructional Delivery Method and Student Age

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Examination of the Relationship of Community College Opticianry Student Outcomes with Instructional Delivery Methods and Student Age

by

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A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy
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Keywords: distance learning, hybrid, equivalency, technician, preparation

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Dedication

This dissertation is dedicated to my wife Elizabeth, children Laura and Brent, and faithful dog Colby for their support of my seemingly endless pursuit of higher education.
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Abstract

The purpose of this study was to determine whether student outcomes are a function of participation in different modes of delivery in an Opticianry program at the community college level. First, the intent was to determine whether differences in instructional delivery methods and background characteristics impact student performance in an Opticianry program. The three instructional delivery methods were traditional face-to-face instruction, online delivery, and a hybrid format where students take theory courses online and attend face-to-face laboratories on campus. A second objective was to determine the role of background variables such as student age, which was the age when entering the Opticianry program classified in three categories: Young Adults (18-24), Middle Age (25-33), and Older Adults (34 & >).

To meet the purpose of the study and its driving questions, a non-experimental explanatory research design relying on survey data collection strategies was used. Data collection was conducted during a six-week period using an online survey available through Survey Monkey. The survey was used to identify instructional delivery method, perception of job preparedness, and perception of program quality. A two-way ANOVA was used to analyze the relationship between independent variables (delivery method and age) and a dependent variable (GPA, national certification score, workplace preparation score, and quality of instruction score). Two hundred and eighty six graduates of the Hillsborough Community College Opticianry Program from 2006-2012 were contacted for participation.
One hundred and twelve graduates completed the survey representing a response rate of 39%. The results indicated no significant difference in the outcomes of Opticianry program graduates related to instructional delivery method or age. Based on the overall results in the study, the overall conclusion is that students in the Opticianry program should achieve similar outcomes whether they complete the program online, on campus, or in a hybrid format.

The results of the study provide support for the idea that it is possible to provide equivalent technician preparation using a variety of instructional delivery methods. The study adds to a limited body of knowledge about the impact of participation in online or hybrid courses compared to traditional courses in technical preparation. The outcomes provide support that distance education is a promising strategy for increasing access to adult learners seeking flexible opportunities for technical preparation. The results should also reduce the reluctance of institutions offering career and technical education programs, to offer complete programs via distance learning in fear that distance students will not achieve program outcomes equivalent to face-to-face students. The study has generated positive comparative evidence of student performance as a function of instructional method, and documented students’ evaluative perspectives about their occupational readiness and program quality.
Chapter 1: Introduction

According to the United States Department of Labor, Bureau of Statistics (2012), the demand for Opticians will increase 29% from 2010 to 2020. The Bureau of Statistics classifies this increase as “much better than average” when compared to other occupations. Opticianry is a skill-based occupation where technicians design, measure, fit, and adapts contact lenses, spectacle lenses and frames for their patients/customers. Opticians also need to be able to assist patients/customers with selecting frames and coordinate them with their optical prescription. In addition, opticians must be able to prepare work orders for an optical laboratory and fabricate eyewear (Opticians Association of America, 2012).

Opticianry Programs, like many two-year health science associate degree programs, are based at community colleges and typically organized under cooperative apprenticeship agreements. Cooperative apprenticeship programs established as a partnership between an industry and a cooperative community college have been found successful in other industries as an alternative to enhance the rigor and overall technician preparation. In a cooperative apprenticeship program, the employer provides practical experience under the supervision of a mentor while the college provides the related instruction. These programs, ranging in length from 2,000 to 6,240 hours, ensure up to date preparation and efficient use of resources (Cantor, 1995; Opticians Association of America, 2012). Depending on particular state requirements, students in these programs
have the option of completing an associate degree, or meet a minimum number of college credit courses, or complete a certificate program as part of their related instruction (Opticians Association of America, 2012).

The National Federation of Opticianry Schools (NFOS) lists 29 Opticianry programs in the United States and three in Canada. Overall, 26 programs offer associate degrees while the remaining programs offer diplomas or certificates. The majority of the programs are located east of the Mississippi river, primarily in states that require licensure or certification. Certification is, in fact, an issue behind the preparation and production of opticians since requirements to use the occupational title of “Optician” vary widely across the United States (United States Department of Labor, 2012). In Rhode Island for example, an individual must earn an associate degree in Opticianry prior to sitting for a state licensure exam (Rhode Island Board of Opticianry). In contrast, the state of Alabama has no educational, certification or licensure requirements to be an Optician. Currently only 23 states require a license for an Optician to practice, while the most common form of education for Opticians continues to be apprenticeship or on the job training (OJT) (United States Department of Labor, 2012). Thus, in light of the related occupational forecast and the great variability in occupational requirements, a common concern is that current educational efforts are not adequately preparing and producing new Opticians for the contemporary demands of the field (McDonald, 2005). To this end, there is evidence suggesting that customer attitudes toward optician training strongly favor higher educational requirements and credentials (Gerardi et al., 1999).

About enrollment patterns in Opticianry programs, they are similar to the rest of the community college population with an average age of 29 years, 60% female, 17%
single parents, 35% minorities, and 87% are employed on a full- or part- time basis (American Association of Community Colleges, 2009). These demographics indicate that community college students are adult learners with work schedules requiring alternative program delivery formats and supports (AACC, 2009). This trend has been reflected in a dramatic increase in the popularity of distance education since the mid 1980’s with the development of the internet, and a steady growth of post-secondary offerings as an alternative to face-to-face instruction (Allen & Seamen, 2011; Simonson et al., 2009). To wit, in 2010, approximately 31% of the student population in higher education institutions in the United States was enrolled in at least one online course compared to 9.6% in 2002 (Allen & Seamen, 2011). The popularity of distance learning is even more evident at the community college level with over 90% of public community colleges offering one or more online courses (Parsad & Lewis, 2008), and 41% offering entire degrees online (AACC, 2008).

Albeit the growing popularity of distance education, a 2010 study of online occupational education at community colleges found such programs are still limited, especially in health science, green technologies and skilled manufacturing occupational areas (Githens, Crawford & Sauer, 2010). To be sure, distance education in health science has made inroads in Nursing, Dental Hygiene, Veterinary Science and Funeral Service Education program. However, a health science program that has not appeared in distance education studies given its limited availability is Opticianry where the use of this alternative delivery method is still limited. Presently, the majority of the Opticianry programs provide face-to-face instruction, while eight programs offer distance learning options (NFOS, 2012). In this regard, previous studies have shown that online
occupational programs can be successful when supplemented with face-to-face laboratories or clinical experiences (Benson et al., 2004). Thus, to increase access to further education, colleges offering distance learning Opticianry programs are beginning to give students a choice of three instructional delivery methods; face-to-face, online and hybrid. Face-to-face students take all classes on campus where online students take all classes off-campus. Hybrid students take their lecture classes online and they attend face-to-face laboratory courses on campus.

In this context, distance education represents an opportunity to provide Opticianry education to parts of the country without degree programs and extend access to a variety of students everywhere. It also can enhance OJT and apprenticeship programs by providing related cooperative instruction with local industry.

**Problem Statement**

The need to offer alternative delivery options for community college students is well documented and accepted. In this regard, distance education is a promising strategy for increasing access to adult learners seeking flexible opportunities for technical preparation. However, many institutions and stakeholders are still concerned about the quality of distance learning in general. For example, a survey of 2,500 academic leaders conducted in 2010 found that one third believe that the learning outcomes for online education are inferior to those of face-to-face instruction (Allen & Seamen, 2011). Thus, it is not surprising that institutions offering career and technical education programs, health science programs included, are still reluctant to offer complete programs via distance learning.
Community colleges have generally accepted the idea of offering online courses, but less than half offer complete distance learning programs (Johnson et al., 2003).

In technician preparation, the reluctance is due in part to concerns that distance students will not achieve program outcomes equivalent to face-to-face students. At issue is the idea that occupational or “skill-based” programs present a greater challenge for distance education delivery due to the hands-on component associated with such programs. This problem may stem from the fact that most research to date focuses on individual course outcomes typically associated with general or academic education. In this regard, we know very little about the impact of participation in online or hybrid courses compared to traditional courses in technical preparation. Further, there is virtually no research comparing the impact of student participation in contrasting Career and Technical Education (CTE) delivery formats in general, and focusing on particular occupational programs such as Opticianry.

In Opticianry programs, this is especially problematic given lingering questions about the equivalency of laboratory and clinical instruction delivered face-to-face, online and in a hybrid format. The few studies that have examined distance education outcomes for occupational programs have mostly focused on Interactive Television (ITV) as the means of delivery (Kostrzewski, 2007; Mead, 2007; Olmsted, 2006). Thus, research on student outcomes equivalency of face-to-face, hybrid, and online programs is clearly needed to inform our comparative understanding of online and hybrid delivery formats in relation to traditional face-to-face programs.

Clearly, if done well, it has been reported that distance education programs can be as good as or even better than traditional classroom education (Russell, 2001).
In technician preparation related evidence is much more limited and further research is warranted to generate evidence regarding student performance in different delivery formats. For example, what are the student’s evaluative perspectives of the preparation they get as a function of the delivery format? How do students view the quality of traditional, online and hybrid instruction? To receive support from industry and educational administrators, and attract potential students, these issues must be examined to document the quality of Opticianry programs.

**Purpose**

The purpose of this study was to determine whether student outcomes are a function of participation in different modes of delivery in an Opticianry program at the community college level. First, the intent was to determine whether differences in instructional delivery methods and background characteristics impact student performance in an Opticianry program. The three instructional delivery methods were traditional face-to-face instruction, online delivery, and a hybrid format where students take theory courses online and attend face-to-face laboratories on campus. A second objective was to determine the role of background variables such as age, which was the age when entering the Opticianry program. Age may be important to the success of the distance-learning students as the independent nature of the distance learning may benefit from maturity (Means et al. 2010). Little is known about the impact of student age in the context of participation in Opticianry programs featuring classroom, online, and hybrid instructional methods. In turn, performance indicators for the Associate in Science Degree Opticianry program graduates including program grade point average (GPA), and scores on the National Opticianry Competency Examination (NOCE) were used to
compare student performance as a function of instructional method and/or background variables focusing primarily on student age as research on the effect of gender and ethnicity on student performance in courses using different delivery methods has been mixed (Lam, 2010).

In addition, the study seeks to determine whether differences in instructional delivery methods and background characteristics impact perceptions of job preparedness and program satisfaction. Workplace preparedness in this study was defined as the student’s perception of their ability to perform the program’s terminal competencies upon employment. In turn, program satisfaction was defined as the student’s satisfaction with the quality of instruction which includes instructional technology, equipment and faculty interaction.

Research Questions

To meet the study purpose and goals, the inquiry was guided by the following research questions:

1. Does Community College Opticianry student participation in different instructional methods and age bracket affect student performance as measured by grade point average?

2. Does Community College Opticianry student participation in different instructional methods and age bracket affect student performance as measured by national certification exam score?

3. Does Community College Opticianry student participation in different instructional methods and age bracket affect graduates’ perceptions of workplace preparedness?
4. Does Community College Opticianry student participation in different instructional methods and age bracket affect graduates’ perceptions of the program quality?

**Conceptual Framework**

The conceptual framework is rooted in the distance learning premises of the transactional distance theory. First proposed by Moore (1993), transactional distance is defined as “a psychological and communication space to be crossed, a space of potential misunderstanding between the inputs of instructor and those of the learner” (p. 22). Moore further suggested that attention to three variables allow for the reduction of the transactional distance. The first variable is instructional dialogue in which positive communication between the instructor and student must be established. The second variable is related to the nature of the program structure, while the third variable is the recognition of student ability to share responsibility for the learning process. Anderson (2004) further clarified the concept of varying interaction and its application to different instructional delivery methods with a theory of equivalency stating that the learning process is based on three types of interactions. The interactions can be student-teacher, student-student or student-material. He proposed that if one type of interaction is strong enough, learning objectives would be met even if the other two types of interactions are weak. In this case, the instructional designer and teacher need to provide enough interactions for the student to give meaning to the material. That is, the interactions need to be suitable to the delivery method, student and environment.

Both Moore and Anderson described the three basic elements of a distance learning course; structure, environment and communications. However, a theory for delivering equivalent technician preparation programs using different instructional
delivery methods requires a broader view of distance education. It must embrace the use of multiple technologies to present equivalent learning experiences sufficient to meet program objectives and it must have a focus on outcomes. Based on this rationale, the equivalency theory proposed by Simonson, Schlosser and Hanson (1999) was selected to serve as the core for the conceptual framework informing this study. Its premise is that education at a distance should be built on the concept of equivalent learning experiences. That is, “If the distance education course is effectively designed, and equivalent experiences are available, then potential learners will reach the course’s instructional objectives” (1999, p. 60). Thus, in this study, Simon, Schlosser and Hanson’s equivalency theory was used as the foundation to assess equivalency.

While Simonson, Schlosser and Hanson provided a theory for equivalency of different instructional delivery methods, it is less specific in how to measure the effectiveness of program completers. To customize the equivalency theory for technician preparation, categories for evaluating effectiveness proposed by Lockee, Moore and Burton (2002) were incorporated. Lockee, Moore and Burton suggested five categories for evaluating effectiveness; program inputs, performance outcomes, attitude outcomes, programmatic outcomes, and implementation concerns. Elements of these categories were used to determine if the three Opticianry program delivery options are effective and equivalent. The resulting framework for technician preparation used in the study is depicted in Figure 1 to illustrate how learning and, application experiences, interactions and supports, and interface with delivery context contribute to program outcomes.
Figure 1. Conceptual framework for technician preparation accounting for the role of background variables, delivery options, and nature of student experiences.

The assumption underlying the conceptual framework is that different methods of technician preparation can lead to equivalent outcomes. The study further assumed that in an effectively designed program, regardless of student age, performance outcomes and perceptions of occupational preparedness and program quality will be equivalent across instructional delivery methods. Technician preparation instruction can be provided by an institution through face-to-face, distance learning or a hybrid of online theory courses with face-to-face laboratories. If the institution offers all three options, entering students can select the method of instruction based on learning preference, geography, employment status, and other personal issues. Regardless of the instructional method
selected, each course should require interactions with the course instructor and course material, although the level of interaction will vary with the students’ ability to learn on their own.

Significance of the Study

This study contributes to the body of knowledge about the merits of online and hybrid instructional methods as viable alternative strategies to traditional classroom instruction in technician preparation in general, and in Opticianry programs in particular. Specifically, the study generated comparative evidence of student performance as a function of instructional method, and documented students’ evaluative perspectives about their occupational readiness and program quality. These vantage points for program evaluation were examined under the lens of equivalency theory serving as the conceptual framework for the study. In this regard, the study has filled an important gap in the literature as no studies have been done comparing the performance indicators of Opticianry students participating in different delivery methods.

In addition, this study has value for several groups. The optical industry is seeking access to a flexible, comprehensive training program for employees serving in roles less than an Optician. If they are providing tuition reimbursement to employees seeking a degree in Opticianry, they want assurances that their money is well spent. Thus, research documenting the extent to which distance learning can provide an equivalent education should be helpful in gauging the likely return on their investment (Smith, 2006). In turn, state Opticianry organizations can share the study with community colleges considering starting a distance education Opticianry program. To this end, the study may help the 25 Opticianry programs currently not offering a distance learning option and their
administrations considering a distance learning option. Community colleges should also benefit from the study results as they may be able to generalize some aspects of the study to other A.S. degree programs.

Limitations

This study was limited in that it focused on a single program at large community college in Florida. The study did not consider academic background prior to admission. All Opticianry students must meet college-level requirements in reading, writing and mathematics when beginning the program as determined by college placement tests. Students required to take developmental courses prior to beginning the program are considered to have a background equivalent to the other entering students. The study also did not include survey information from students who did not complete the program, which may be the focus of a future study.

Definition of Terms

The following definitions were used within the study: All definitions not accompanied by a citation were developed by the researcher.

Distance Education. Planned learning that normally occurs in a different place from teaching, requiring special techniques of course design, special instructional techniques, and special methods of communication by electronic and other technology, as well as special organizational and administrative arrangements (Moore & Kearsley, 2012).
Effectiveness. Measures of performance. The most important effectiveness measure in distance education is student’s learning, but satisfaction, faculty sustainability, and institutional reputation can also be considered. Relates to quality assurance (Moore & Kearsley, 2012).

Equivalency Theory of Distance Education. If the distance education course is effectively designed, and equivalent experiences are available, then potential learners will reach the course’s instructional objectives (Simonson, Schlosser & Hanson, 1999).

Equivalency of Program Outcomes. No statistically significant differences in measurable program outcomes.

Job Preparedness. An occupational program graduate’s ability to perform the program’s terminal competencies upon employment.

Occupational Programs. A sequence of courses designed to prepare students for an occupation that typically requires education below the baccalaureate level (Phelps & Greene, 2001).

Optician. Opticians are professionals in the field of designing, finishing, fitting and dispensing of eyeglasses and contact lenses, based on an eye doctor's prescription. The optician may also dispense colored and specialty lenses for particular needs as well as low-vision aids and artificial eyes (Opticians Association of America, 2012).

Program Delivery Method. The study identified students as belonging to one of three instructional delivery method groups. Students were coded as Face-to-Face, Online, or Hybrid. The designation was based on the number of Opticianry courses taken off-campus during the 25 course program.

- Online: Student has taken 21 or more of their courses (84%) off-campus
- Hybrid: Student has taken 7 to 20 of their courses (28%-80%) off-campus
- Face-to-Face has taken 6 courses (24%) or less off-campus.

*Program Satisfaction.* An occupational program graduate’s satisfaction with the quality of instruction, which includes instructional technology, equipment and faculty interaction.
Chapter 2: Review of Literature

A study by Carnevale, Smith and Strohl (2010) predicts that by 2018, about 66% percent of all employment will require some college education or a degree. The increase is driven by technological change and expanding occupations. In the area of Health Care Professional and Technical occupations, the need for a degree will increase 20%. Carnevale and Associates also found that the opportunities for workers without some college or a degree will become much more limited. To meet the need for technicians with higher educational levels, increased educational opportunities with flexible delivery methods are warranted. The review of literature in this chapter addresses these issues and is divided into four sections. The first section reviews delivery issues associated with skills-based occupational programs and provides related background on the Opticianry program. The second section focuses on distance education and the creation of effective distance learning courses. The process includes planning, design, technology selection and delivery. The third section reviews research related to the evaluation of the effectiveness and equivalency distance learning courses when compared to face-to-face and hybrid instructional delivery methods. The final section presents a conceptual framework for the study.

Issues Delivering Skills-Based Occupational Programs

Occupational skill-based programs present unique challenges when delivered through distance learning. A health science program has a combination of theory,
laboratory and clinical courses. Thus, because health science students require hands-on experience to become competent providers, apprenticeship was traditionally viewed as the method of learning an occupation usually involving an expert in a field passing on knowledge or training to a younger, inexperienced learner. The notion of apprenticeship has evolved over the years shifting from mere learning by observation and practice to organized learning in school settings through cognitive apprenticeship strategies.

The cognitive apprentice theory developed by Collins, Brown, and Newman (1987) suggests that learning tasks should be situated in 'zones of proximal development” as proposed by Vygotsky (1978). This means that the tasks should be authentic and just beyond a student’s ability to perform alone. Following this premise, the cognitive apprentice model (CAM) was developed to guide mentoring that occurs as part of clinical and laboratory instruction. The goal is to promote learning that involves guided practice in the Zone of Proximal Development between a mentor or coach and a less experienced learner (Collins, Brown & Newman, 1987). The five elements of CAM incorporated into mentoring are: Modeling (or thinking aloud to share a process), coaching (or scaffolding and supporting cognitive activities), reflection (to determine what worked or didn’t work, and next steps in the process), articulation (or communication with mentor about reflection), and exploration (or creating and researching new ideas) (Collins, Brown & Newman, 1987).

As student’s progress through an occupational program, clinical courses give them an opportunity to gain practical experience through direct patient contact. It is during these experiences that the student begins to put the pieces together and move toward becoming a competent provider. That is, clinical experiences become richer as the student
progresses toward graduation. In short, students need to receive applied instruction through meaningful interaction between student and teacher, student and mentor, student and student or student and material to progress to a competent practitioner who is satisfied with their learning experiences (Anderson, 2003).

Although the premises of cognitive apprenticeship are widely regarded as appropriate and successful for the delivery of face-to-face occupational programs, it is obvious that programs delivered through distance education require new ways of thinking about delivery and what makes a program successful. This is particularly important in the face of skepticism about the possibility of delivering occupational programs online with equivalent quality and outcomes to programs delivered face-to-face (Githens, Crawford & Sauer, 2010). Research does indicate no significant differences when distance and face-to-face versions of the same occupational courses are compared (Benson, et al., 2004). Fjermestad, Hiltz and Zang (2005) analyzed 30 comparative studies of online and hybrid occupational courses and also found no significant differences.

As online program delivery becomes more widely accepted and appreciated for technician preparation, the real measure of success for graduates of a skills-based program should be two-fold. The first measure is their ability to competently perform the skills necessary to the occupation. This can be identified through various examinations. The second measure focuses on the graduate’s perception of satisfaction with the program while attending and their level of job preparedness as they begin their career. In this regard, the Sloan Consortium (2009) has identified the following five items that will improve student satisfaction with online courses:

- Discussion and interaction with instructors and peers is satisfactory;
- Actual learning experiences match expectations;
- Satisfaction with services (advising, registration, access to materials) is at least as good as on the traditional campus;
- Orientation for how to learn online is satisfactory;
- Outcomes are useful for career, professional and academic development.

In addition to instructional quality, workplace preparedness has been identified as an essential measure of equivalent success for occupational programs regardless of their delivery method. Workplace preparedness is an occupational program graduate’s perceived or actual ability to perform the program’s terminal competencies upon employment. Workplace preparedness can be divided into three main competencies; general work habits and skills, communication skills and technical skills. A study by Higgins (2008) focusing on such skills, found related data useful in revealing both strengths and weaknesses of an occupational program.

In short, skills-based occupational programs require an applied instructional component that is expected to be available regardless of delivery method. As online delivery formats have become more widely accepted, the questions have turned to whether programs provide equivalent instructional experiences and preparation for work.

**Opticianry**

Given a projected increase in demand of 29% from 2010 to 2020 (United States Department of Labor, 2012); the preparation of Opticians to fill the need is an important issue. Opticianry education began with the invention of eyeglasses in the 12th century. Craftsmen taught their apprentices how to make the frames and lenses. People purchasing glasses tried various pairs until they found ones that worked. In the 1600’s a guild was
formed in England that controlled the education of opticians. The group was chartered by
King Charles 1st as the Worshipful Order of Spectacle Makers (Stimson, 1971). As the
understanding of optics and vision increased, Opticians began to refract or measure the
strength of the lenses necessary to correct a patient’s vision. The medical community
began to take a greater interest in refraction and eyeglasses in the mid 1800’s. Medical
doctors specializing in the eyes became known as Ophthalmologists. By 1900, the
Opticians that were refracting were beginning to encounter opposition from
Ophthalmologist who felt it was a medical procedure. This group of refracting Opticians
formed their own organization and changed their name to Optometrist. The remaining
Opticians formed the Guild of Prescription Opticians of America in 1926 (OAA, 2012).
Their goal was to improve education and monitor legislation related to Opticianry. These
dispensing opticians continued to use apprenticeship as the primary form of education
(Bruneni, 1994). In 1947 the American Board of Opticianry was formed. Its goal was to
establish collegiate courses in Opticianry and certify Opticians by examination (Stimson,
1971). The first degree granting Opticianry program was established in 1949 at Erie
County Technical College in Buffalo, NY. In 1973, the first Opticianry program in the
southeastern United States began at Hillsborough Community College in Tampa, FL.
Since 1949, programs have been established and some have closed leaving thirty degree
granting programs available in the United States today.

Apprenticeship. Despite the availability of degree granting programs,
apprenticeship still remains the primary method of Opticianry education. The Department
of Labor published revised Optician apprentice guidelines in 2007. The guideline
provides a recommended preparation path for Ophthalmic Dispensing Opticians and
Contact lens Fitters. The guideline recommends 3,000 hours of supervised experience (approximately 18 months) and 144 hours of related instruction for Ophthalmic Dispensing Opticians. The suggested source for the related instruction is the Ophthalmic Career Progression Program (OCPP). This is a home study correspondence course developed by the National Academy of Opticianry (National Academy of Opticianry, 2012). The course consists of three volumes of topics related to the fabrication and dispensing of eyewear. Students take a proctored exam at the end of each volume and comprehensive final exam. Students who pass the final exam are awarded a certificate of completion. For those Opticians whose scope of practice includes contact lens fitting, the guideline recommends an addition 3,000 hour of supervised contact lens experience with 580 hour of related instruction. The suggested source of related instruction for this portion of the apprenticeship is a home study course developed by the Contact Lens Society of America. The program consisted of two print volumes and online papers. Successful completion of each chapter in the books and online paper is verified by passing a quiz (Contact lens Society of America, 2012). The National Apprentice program guidelines recognize the need for a sufficient number of hours of clinical experience with the support of required related instruction. Both of the related instruction programs are available and provide asynchronous instruction to anyone interested in becoming an Optician.

The National Apprentice Guideline for Ophthalmic Dispensing Opticians and Contact lens Fitters however is only a suggestion. The licensed states that offer apprenticeship as a means of meeting the educational requirement for licensure have many different versions. For example, in Arizona, candidates for licensure must accrue
three years of experience with no requirements for related instruction (Arizona State Board of Dispensing Opticians, 2012). In some states, candidates are allowed to substitute the Ophthalmic Career Progression Program (OCPP), which was designed to provide related instruction, for the clinical experience. In the state of Georgia for example, candidates must work two years as a registered apprentice or complete the OCPP (Georgia State Board of Dispensing Opticians, 2012). Other states provide the opportunity to reduce the number of required hours by taking related instruction. In turn, Massachusetts’ candidates are required to work three years as a registered apprentice or reduce it to one year if they take the OCPP (Massachusetts Board of Registration for Dispensing Opticians, 2012).

In other cases, in the quest to offer alternative delivery formats, some states have tried to encourage apprentices to seek related instruction from their community colleges. For instance, Rhode Island no longer offers an apprenticeship program for prospective Opticians. It requires and Associate in Science degree in Opticianry to sit for their licensing exam. However, it will accept completion of a two-year apprenticeship from a different state as meeting the educational requirements. The State of Florida requires 6,240 hours of experience but will reduce the requirement by 86.67 hours for each college credit hour earned in recognized Opticianry program (Florida Department of Health, Board of Opticianry, 2012). Florida has three Opticianry programs at community colleges. One of the programs provides the option of taking course via distance learning. Further, Nevada requires related instruction as part of their three-year apprenticeship program. Apprentices can choose from two approved programs. One program is the OCPP Program from the National Academy of Opticianry. The other approved program
is from the College of Southern Nevada Opticianry Program and consists of six core courses. The six courses are available to all Nevada residents via distance learning (State of Nevada Board of Dispensing Opticians, 2012).

Offering yet another variation in requirements, New Jersey requires 36 months of supervised experience along with 30 credit hours of course work in ophthalmic science from a school accredited by the Commission on Opticianry Accreditation and a regional accrediting body recognized by the United States Department of Education (New Jersey Board of Examiners of Ophthalmic Dispensers and Technicians, 2012). This is an example of a cooperative arrangement between the Board of Opticianry and the three New Jersey Community College Opticianry programs in the state. The credits earned by the apprentice can be used toward an Associate’s degree.

While no studies have been done on cooperative apprenticeship programs for Opticians, studies of other occupations indicate positive benefits for the apprentice, community college and employer. Cantor (1995) found that cooperative apprenticeship programs have the ability to bring employers, community colleges, the government and in some cases unions together to pool their resources for the cost-effective education and training of workers. Employers work with the colleges to design a curriculum that meets their labor needs and provide resources to help deliver the program. Colleges increase enrollment and have the opportunity to operate state-of-the-art programs with a small amount of capital outlay. Unions benefit by increasing membership and maintaining the quality of the instruction for their field. Students benefit from employment income and reduced tuition while taking the program.
The Cantor study (1995) reviewed cooperative apprenticeship programs sponsored by the International Brotherhood of Electrical Workers Union, the International Union of Operating Engineers, the California Firefighter Joint Apprenticeship Program, and automotive manufacturer’s programs. The study looked at how these organizations structured and operated cooperative programs with 32 community colleges. In most cases, the community college provided the related instruction through college credit courses. The colleges also awarded a range from 12 to 45 credits for the on-the-job (OJT) portion of the program. Most programs were three to four years in length and participants earned an Associate in Science degree upon completion.

In this context, determining how many college credits to award for an apprenticeship program can be difficult. The American Council of Education (ACE) will assess and certify training programs to determine their suitability for college credit. ACE recommends a number of credits and individual colleges can accept or reject their recommendations (Lerman, 2009). A national study of apprenticeship and community college collaboration by Robert Lerman (2009) found that approximately one-third of all apprentices obtain their academic instruction from community or technical colleges. Yet only four State Opticianry apprenticeship programs have a formal collaboration agreement with community colleges (OAA, 2012). One of the key barriers to collaboration identified in the Lerman study is that community college courses are not offered on a regular basis or may meet at times that working people find hard to accommodate. Delivering the courses via distance learning would address these barriers. However, the study found that only 5.8% of related instruction is currently provided
thorough distance education. These findings point out a clear need for additional research on the use of distance learning delivery methods for the academic preparation of apprentices.

**Licensure.** All licensed states recognize a degree in Opticianry from an accredited institution as fulfillment of the educational requirement to sit for their exam (OAA, 2012). However, the lack of available programs continues to force aspiring Opticians to select apprenticeship as their means of preparation. Twenty two of the thirty college programs in the United States are accredited by the Commission on Opticianry Accreditation. Five of the twenty two schools offer a distance learning option (NFOS, 2009). This entry into distance learning was spurred by a 1999 initiative developed by the National Federation of Opticianry Schools. Volunteers from member schools met and developed a distance learning core curriculum. The goal was to create a uniform curriculum that would be available to all member schools and any colleges that wanted to start a new program. The approach followed the Fordist model in which development and administration have strict central control. Participating schools were required to sign a contract and use the materials as developed. The initiative has since been modified to allow individual institutions to customize the course to meet their needs. These modifications have not increased the number of schools offering a distance learning option (NFOS, 2009).

In addition, any concerns about institutions offering a lesser quality program through distance learning should be eased by statements from accrediting agencies. The Commission on Opticianry Accreditation’s position (2011) on distance education is essentially the same as the U.S. Department of Education recognized Southern
Association of Colleges and Schools (SACS); it states “Accredited programs must meet the same requirements when instruction is offered through distance delivery”. That is, the learning experience does not have to be identical, but it has to be equivalent (Simonson, Schlosser & Hanson, 1999). The test to see if the goal has been achieved is performance on various indicators such as graduate grade point average, and grade on the National Opticianry Competency Examination. The National Opticianry Competency Examination (NOCE) is spectacle related and is given by the American Board of Opticianry. The NOCE is a psychometrically developed, criterion referenced exam. After test specifications are created based on a previously performed job analysis, the exams are written by groups of certified opticians appointed by the ABO. Questions are created to test a candidate’s ability to recall knowledge and to apply that knowledge to specific dispensing functions (ABO-NCLE, 2011).

**Instructional delivery and distance learning.** Some of the challenges encountered in delivering an Opticianry program on a distance basis are shared by all health science programs. The theory courses work well with learning management systems as these systems provide the opportunity for communications, testing and content delivery using text audio and video. The more difficult area is creating an equivalent laboratory or clinical experience at a distance. The theory portion of laboratory or clinical courses can be presented with the learning management systems (Moore & Kearsley, 2012). For example, communications can include an online journal to record their laboratory and clinical experiences for the course faculty member. The variable is the mentor at the remote site who is monitoring the student’s performance and progress.
In this context, competency checklists and frequent communication with the mentor can improve the situation (Moore & Kearsley, 2012).

Despite these efforts to provide an equivalent experience, some students elect to become hybrid students. They take their theory courses online and come to campus for face-to-face laboratories and clinical. However, no studies have been done to date on the effectiveness of distance learning relative to face-to-face student performance on Opticianry indicators. The only research located in the context of an Opticianry program was a qualitative study conducted by Hubbard (2010), focusing on instructional and institutional supports available for online students in a community college. In Hubbard’s study the focus was the institutional environment with little pertaining directly to the effectiveness of the Opticianry program. In general, Hubbard confirmed the importance of having student services, faculty and technology staff committed to serving distance learning students. Another study in the context of Opticians featured a cross-sectional Delphi of Opticians involving a panel of experts in eye care (McDonald, 2005). The focus of that study was to determine the adequacy of Optician’s education and licensure for expanding their scope of practice, particularly in the area of advanced technologies such as refraction and low vision. Again, the focus of this other study did not address issues of effectiveness but on the scope of Opticianry practice in the areas of refraction, advanced contact lenses and low vision.

**Distance Education**

Distance education can be defined as education where the teacher and student are separated by time or distance (Simonson et al., 2009). The earliest form of distance learning was correspondence courses offered in the 1800’s.
As electronic communications became available, they were used to enhance or deliver distance education. In the 1920’s radio stations broadcast educational programs. The first college credit courses were offered through broadcast television in the 1950’s. Satellite broadcasts of educational courses became popular in the 1970s and 80s. In the 1990’s Fiber optics connections between sites allowed for two-way audio and video which is used for two-way interactive distance education. This synchronous Interactive Television (ITV) allows participants at the originating and remote locations to see and hear each other (Comeaux, 1995). The rapid rise in the popularity of distance education courses however can be tied to the development of the internet. The number of computer mediated courses has risen dramatically since the mid 1980’s (Simonson et al., 2009). In just five years between 2002 and 2007 enrollment in online education increased by 146% (Moore & Kearsley, 2012). Given the increasing significance of this method of education, more research is required on effectiveness and application to technical programs.

Effective Distance Learning Courses

Effective distance learning courses represent the culmination of a multi-step process. Most organizations use an Instructional Systems Design (ISD) or Analysis, Design, Development, Implementation & Evaluation (ADDIE) approach to the development of distance learning courses (Moore & Kearsley, 2012). To achieve effectiveness, course planning, design, technology selection, delivery and evaluation have been found to be essential components for ensuring high quality outcomes.

**Planning.** Planning involves ensuring proper resources are available. A strategic and holistic approach to planning and implementation is necessary to ensure a quality
program that is sustainable. Factors to be considered include instructional technology standards, accreditation process, faculty capacity, technical infrastructure, curriculum, pedagogy, and professional development (Hernandez-Gantes, 2011a; Pisel, 2008). Successful distance learning requires a commitment by the institution to provide financial and training support for the faculty and instructional designers to allow the creation of a full featured course. The institution must also purchase or lease the necessary hardware and software to deliver the courses. Another important consideration when planning distance education is how to provide the students with the same level of service received by face-to-face students. Courses and programs offered by an institution must comply with the Principles of Accreditation published by their accrediting agency. The accreditation agency for the southern United States is the Southern Association of Colleges and Schools (SACS). In a separate policy statement on distance education, SACS (2011) details requirements in the areas of curriculum and instruction, library and learning resources, student services, and facilities and finances. The policy requires that distance learning students receive the same level of services as campus-based students.

Costs associated with distance learning are an important issue for institutions. Beyond the cost of technology to deliver courses, the cost of course production needs to be considered. A common mistake made by colleges new to distance learning is to underestimate the production costs. Old Dominion University has developed a web-based Asynchronous Cost Model for online course development which could assist institutions struggling with the issue (Gordon, 2009). Staffing for distance learning is also an important administrative function that should be taken into consideration for planning purposes. The IT department will need people who can deal with the technology used to
produce and delivery distance learning. Help desk personnel are needed to assist students and faculty. Instructional designers are needed to work with faculty to create online courses. The administration will have to recruit or motivate existing faculty to adapt to teaching online. One study found the two main motivators to attract senior faculty to teach online were release time and technical support (Giannoni & Tesone, 2003). These considerations need to be incorporated into a comprehensive distance learning plan.

**Design.** Effective course design is driven by course objectives and if the course is primarily a lecture, laboratory or clinical experience. Some designers use a backward design in which course outcomes are determined first and used to develop the course objectives (Hernandez-Gantes, 2010). Moore and Kearsley (2012) recommend a team approach to designing distance learning courses. They note that it is very difficult for an individual faculty member to have the time and expertise to design an effective course. For institutions with limited resources or for courses with frequent changes, an “Author-Editor” model consisting of a subject expert and an editor with instructional design skills would constitute the minimum size team. The preferred approach is the “Course Team” model which brings together academic subject experts and technical experts including web producers, graphic designers, instructional designers, video producers and librarians. The larger team will encourage the use of more multimedia options. The team approach will take longer to develop a course and will be considerably more expensive. The subject expert for the small group may be the instructor who will deliver the course. The team approach creates a fully developed course for an unknown instructor to deliver. (Simonson et al., 2009).
Further, in a post-secondary environment, the students are adults and it is important to understand effective instructional strategies drawing from adult learning theory. A widely cited theory used to explain distance education is the adult learning theory developed by Malcolm Knowles. He used the term “Andragogy” as a label for his theory to differentiate it from the theory of youth learning known as “Pedagogy” (Knowles, 1990, p. 51). Andragogy can be defined as any intentional and professionally guided activity that aims at a change in adults. Given that the majority of community college students would be classified as adult learners, his theory provides some important insights that should be considered when developing a distance learning course.

Knowles pointed out that with the pedagogical model, the teacher determines what, when and how material will be learned, while the learner takes on a submissive role as a follower of the teacher’s instructions (Knowles, 1990). Knowles views adults differently and makes the following assumptions (Knowles, 1990, p. 57-59).

- Adults need to know why they need to learn something. The teacher should spend time explaining the need.
- Adults develop a self-concept in which they need to be viewed as being capable of self-direction. They resist and resent situations when they feel others are imposing their will upon them.
- Adults enter an educational activity with a greater volume and different quality experience than youth. Greater emphasis should be on techniques that tap the experience of learners. For example, group discussion, simulation exercises, problem solving activities, case method and other peer-helping activities. These activities have been found to enrich distance education courses.
Adult’s orientation to learning is task or problem centered. They learn new knowledge, understandings, skills, values and attitudes most effectively when they are presented in the context of application to real life situations.

Based on Knowles’ views of adults, community college occupational programs should be able effectively utilize different course delivery methods. In this regard, Diaz (2000) found that successful online students were more strongly independent learners than non-successful online students. This is consistent with Moore’s (1993) description of learner autonomy. If the transactional distance is high, the student must take greater responsibility for their learning. However, not all adults may have the same background or cognitive skills. For this reason, any study comparing delivery methods should also look for differences related to age, gender and ethnicity (Smith, 2008; Tanner, 2007).

**Technology and media selection.** An ever increasing range of technology is available to deliver instruction at a distance. The course developer can choose the most effective media (print, audio or video) and the most effective technology to deliver the selected media including recorded audio and video, interactive audio and video, and Internet technologies (Moore & Kearsley, 2012). Delivery options have progressed from satellite-based to interactive television to online multimedia. Each media and technology has its advantages and should be selected based on the learning objective and the audience.

Print is still a valuable media for distance education. Textbooks and study guides are important resources for the online student (Moore & Kearsley, 2012). Audio recordings allow for asynchronous presentation of course material in a form which may be more engaging for some students. Audio podcasting provides the
additional benefit of portability as the audio file can be downloaded onto portable audio
devices. Moreover, video has been shown to be a good medium for teaching technical
procedures found in occupational courses (Moore & Kearsley, 2012).

The majority of online courses are delivered through Web-based Learning
Management Systems (LMS). Systems like Blackboard, eCollege, and DesireToLearn
continue to improve and allow the inclusion of synchronous and asynchronous tools. The
asynchronous discussion board and e-mail features facilitate individual and group
communication. The synchronous tools may include live chat rooms or video
conferencing. The students connect to the LMS sessions through their computers. The
video tools allow the students to see the instructor and other students if they have
webcams. Some systems allow participants to share files so all can see what is being
presented in PowerPoint or word documents (Moore & Kearsley, 2012).

**Instructional staff and delivery.** Instructional delivery is more than a particular
type of technology. Recruiting, motivating, and compensating faculty are key to an
effective distance learning program. Existing faculty are reluctant to begin teaching
online without adequate support. Higher education faculty members often have limited
pedagogical preparation. They also often lack knowledge of design and development
strategies for the online medium proposed by the institution (Hernandez-Gantes, 2011b).

These principles apply to both full time and adjunct faculty. An increasing
percentage of adjunct faculty are being used to teach distance learning courses. Some of
the concerns are that adjunct faculty are not able to deliver high quality instruction which
will have an effect on subsequent courses. An added concern is that part time employees
will lack the commitment of full time faculty (Bedford, 2009). A further concern is the
lack of quality instruction provided by adjunct faculty will reduce retention (Lamer, 2009). Thus, training faculty to teach online is important as it improves their comfort level. Given the level of technology utilized, the importance of instructional support to the smooth development and delivery of online courses should not be underestimated. Wiesenmayer, Kupczynski, and Ice (2008), for example, reported that technical and pedagogical support provided to faculty is a key element of course and program planning.

**Evaluation.** A method of evaluating effectiveness must be in place to ensure the student has achieved the course objectives. An important feature of assessment is that it be done on a continuous basis and that administration and faculty receive feedback that they can act on to improve the process (Kim, 2008). Student satisfaction and retention are often used as indicators of program and course quality and some studies have reported online courses with 10% to 20% retention rate below that of traditional classroom courses (Herbert, 2006). In general, evaluation reports have suggested that some of the reasons why adults drop out of online learning programs include: Poor design, failure to understand the new medium, lack of consideration for variety of learning styles, lack of support systems, and ignoring the self-selecting content need of learners (Herbert, 2006). Other reports have also revealed lack of computer skills, lack of ability to use the internet, lack of motivation and lack of engagement all contribute to failure to complete online courses (Herbert, 2006).

**Evaluation of Effectiveness and Equivalency**

An assumption of equivalent program effectiveness is that if programs and courses were to be evaluated by comparing results on the same indicators across instructional delivery methods, student satisfaction and workplace preparation would be
relatively equivalent. Some commonly used indicators are course or program grade point average and scores on national achievement or licensure examinations. For example, a study by Olmstead (2006) was designed to determine if face-to-face classroom participants in a dental hygiene program at a Wisconsin community college performed differently than distance learners taking the same courses through Interactive Television (ITV). The indicators used to measure differences were the student’s program grade point average (GPA) and score on the National Board of Dental Hygiene Examination (NBDHE). The sample consisted of 114 face-to-face or host site graduates and 71 distance learner or remote site graduates from 10 graduating cohorts. T-test analyses were used to examine differences between the sample means. The researcher found no statistically significant differences for 9 of the 10 cohort scores on the NBDHE. T-test analyses of graduate GPAs found no significant differences in all 10 cohorts.

In another study, Diana Kostrzewski (2007) explored the extent to which a nursing program, delivered via Interactive Television (ITV), achieved stated program goals and objectives. In this case, the study looked at graduate cohort performance on the National Council Licensure Examination for Registered Nurse (NCLEX-RN) and GPA for differences between ITV host site and remote site learners. The study sample consisted of 38 host site and 26 remote site students. Using mean scores and T-test comparisons, the remote site student GPAs were found to be significantly lower. The first time pass rate on the NCLEX-RN examination was only slightly lower for the remote site graduates. The study also looked at demographic information including gender, age, marital status, number of children at home, driving time to the ITV site, employment status and hours worked per week and passing the NCLEX-RN the first time. The study
found that single, females, younger students (age 20-25), those with shorter driving times, those with no children, those who were employed and those who worked more hours per week passed at a higher rate the first time. The study also found equivalent satisfaction between cohorts on all survey items except feeling comfortable participating in course discussions with students at their own ITV site and feeling isolated. The satisfaction level on these two items was lower at the remote site.

These two studies of health science programs at community colleges lend support to this proposed study’s use of GPA and national test scores as effective indicators for determining the equivalency of face-to-face and distance learning instructional delivery methods. The second study reinforces the value of including demographics in the comparison.

**Equivalency of Technician Preparation Conceptual Framework**

A literature review was conducted to identify a conceptual framework to support the concept of equivalent technician preparation using different instructional delivery methods. This is in response to the concern for those calling for distance education to provide off-campus students the same quality education as face-to-face students. The identified framework takes its roots from the transactional distance theory proposed by Michael Moore (1993). Moore states that transactional distance is “a psychological and communication space to be crossed, a space of potential misunderstanding between the inputs of instructor and those of the learner” (p. 22). He further suggests that attention to three variables allows for the reduction of the transactional distance. The first variable is instructional dialogue in which positive communication between the instructor and student must be established. The second variable is program structure. This includes the
following six elements of course design; presentation of instructional materials, support of learner motivation, stimulate analysis and criticism, give advice and counsel, arrange practice, application, testing and evaluation, and arrange for student creation of knowledge. Moore’s third variable is learner autonomy. The instructor must recognize the ability of students to share responsibility for the learning process. If a distance-learning course has little dialogue or structure, the student will have to assume a higher level of autonomy. The key to an effective course is providing a level of structure and dialogue to balance the level of autonomy a student is capable of.

Terry Anderson (2003) built on Moore’s premises and developed a theorem which he labeled as an equivalency theory. He proposes that deep meaningful learning is supported as long as one of three forms of interaction is at a high level. The three forms of interaction are student-teacher, student-student and student-content. Even if interaction is minimal in the other two areas of interaction, the high level of interaction in any one area will lead to equivalent effectiveness. This understanding gives course designers and faculty the flexibility to create equivalent, but not identical experiences for lecture, laboratory, clinical, online and hybrid course combinations. For example, Learning Management Systems (LMS) like Blackboard provide a flexible structure for delivering online content and the instructor or instructional designer can determine which options to include in a course (Moore & Kearsley, 2012). Asynchronous and synchronous communication, video and audio are available for use in online and web enhanced courses. For each course the designer should consider Moore’s guideline.

A slightly different equivalency theory of distance education was proposed by Simonson, Schlosser and Hanson in 1999. Its premise is that education at a distance
should be built on the concept of equivalent learning experiences. Their version states “If the distance education course is effectively designed, and equivalent experiences are available, then potential learners will reach the course’s instructional objectives” (p. 60). For the purpose of this study, Simon, Schlosser and Hanson’s equivalency theory builds upon Moore and Anderson’s studies to form a foundation to assess equivalency. The five key elements of the theory include considerations for equivalence, learning experience, applications, role of students, and outcomes.

**Equivalence.** Equivalence is the first element and it requires the experiences of the distance learner and local learner to be of equal value even though they may be very different. For example, local or face-to-face students may listen to the instructor present a lecture on identifying parts of the eye. The students would then dissect a cow’s eye to reinforce the location of the parts. The students have an opportunity to ask questions at any point during the class session. The distance student may watch streaming video of the same lecture and then dissect a virtual model of an eye to reinforce the location of the parts. The student has the opportunity to e-mail the instructor through the Learning Management System or post a question to a discussion board for classmates to answer. If both groups have similar levels of satisfaction and perform the same on an assessment, the assumption is that the experience was of equal value.

**Learning experience.** The second element is defined as anything that happens to the student to promote learning. This includes observations, impressions, interactions and performance of competencies. This is where Moore’s second variable program structure should be addressed by the instructional designer and the course instructor. The course design elements of presentation of instructional materials, support of learner motivation,
stimulation of analysis and criticism, giving advice and counsel, arranging practice, application, testing and evaluation, and arranging for student creation of knowledge should be structured to provide an equivalent experience. For example, a face-to-face student in a laboratory may watch the instructor perform a facial measurement and then perform it under their supervision. The distance student may watch a streaming video of facial measurement procedures or read a textbook and then perform the task under the supervision of a mentor at a work site.

**Appropriate applications.** Appropriate Applications imply that the learning experiences are suitable to the needs of the learner. The example given by Simon, Schlosser and Hanson to explain the element is making sure students have access to the technology used to deliver the learning experience. This element will also include Moore’s first variable instructional dialogue which is positive communication between the instructor and student. Greater dialogue between the instructor and student results in a smaller the transactional distance. However, a single method of communication may not be appropriate for all students. For example, a study by Kramarae (2007) found that female students must juggle schoolwork with an average of six other major responsibilities. Finding a common time for synchronous online group communication can be difficult. Both synchronous and asynchronous communication should be available to provide maximum flexibility.

**Students.** The institution should identify students by the course or program, not the instructional delivery method. In this study the program uses the same assessment methods and expects the same learning outcomes regardless of the instructional delivery method. The institution and instructor should provide equivalent support for all students.
regardless of their physical location. The level of support required ties to Moore’s third variable learner autonomy referring to the student’s ability to manage the learning process on their own. The less dialogue between the instructor and the student, the greater the amount of learner autonomy required by the student to be successful. Anderson (2003) found that if student-student or student-content interaction is at a high level, students should be successful with minimal student-teacher interaction. The ability of a student to succeed in a more autonomous environment may increase with age (Lam, 2010). A study by Gunawardena, Linder-VanBerschot, LaPoint and Rao (2010) found that online self-efficacy, or the students confidence in using the technology needed to participate in the course, was a significant predictor of student satisfaction. The ability to learn from online discussions and the ability to transfer learning to the workplace were also significant predictors of student satisfaction with online courses. Instructors must be able to adjust their level of support to all students regardless of delivery method if the students are to receive an equivalent learning experience.

Outcomes. This is the final element of Simon, Schlosser and Hanson’s equivalency theory. The two types of outcomes are teacher determined and learner determined. Teacher determined outcomes would be the course or program outcomes. In this study the teacher determined outcomes were measured using GPA and national certification exam scores. Learner determined outcomes are related to what the learner hopes to accomplish which includes satisfaction with the program and job preparedness. Simon, Schlosser and Hanson (1999) also suggested that the more equivalent the learning experience of off-campus students are to those of on-campus students, the more equivalent the outcomes of the educational experiences for all learners.
Figure 2 illustrates the interface of the different components of the theoretical framework. This study’s assumption was that if the equivalency theory is correct for individual courses, then it should be applicable to entire programs using different delivery methods. In turn, the equivalency of different delivery methods should be demonstrated under the assumption that the nature of student experiences in the program, regardless of program delivery format, is also equivalent. In addition, equivalence of delivery methods should be demonstrated by comparing graduate levels of program satisfaction, preparedness, and outcomes. The study also looked for differences related to age and the study prediction was that no differences would be found when comparing indicators or age.

Figure 2. Conceptual framework for technician preparation accounting for the role of background variables, delivery options, and nature of student experiences.
In this study the learning experiences occur primarily in the theory courses while the application experiences mostly occur during the student’s laboratory and clinical courses. The theory courses provide a knowledge base for the skills required to complete laboratory and clinical competencies. Subjects are often linked within the curriculum. For example, the Contact Lens Theory I course supports the Contact Lens Laboratory I course.
Chapter 3: Method

The purpose of this study was to determine whether student outcomes are a function of participation in different modes of delivery in an Opticianry program at a community college. Specifically, the intent of the study was to determine the relationship of community college Opticianry student outcomes with instructional delivery methods and student age. The instructional delivery methods were traditional face-to-face instruction, online delivery, and a hybrid format where students take theory courses online and attend face-to-face laboratories on campus. Student age was the age at the time students entered the Opticianry program and classified in three categories: Young Adults (18-24), Middle Age (25-33), and Older Adults (34 & >). First, the goal of the study was to identify whether participation in different instructional delivery methods and student age had an impact on academic performance. The academic outcomes were program grade point average (GPA) and national certification exam scores. The second goal of the study was to determine whether instructional delivery methods and age of the student made a difference in graduate perceptions of workplace preparedness and program satisfaction. Workplace preparedness in this study means the student’s ability to perform the program’s terminal competencies upon employment. In turn, program satisfaction was defined as the student’s satisfaction with the quality of instruction including instructional technology, equipment and faculty interaction.
Research Questions

To meet the study purpose and goals, the inquiry was guided by the following research questions:

1. Does Community College Opticianry student participation in different instructional methods and age bracket affect student performance as measured by grade point average?

2. Does Community College Opticianry student participation in different instructional methods and age bracket affect student performance as measured by national certification exam score?

3. Does Community College Opticianry student participation in different instructional methods and age bracket affect graduates’ perceptions of workplace preparedness?

4. Does Community College Opticianry student participation in different instructional methods and age bracket affect graduates’ perceptions of the program quality?

Research Design

To meet the purpose of the study and its driving questions, a non-experimental explanatory research design relying on survey data collection strategies was used. An explanatory design was used to explain differences in Associate in Science Degree Opticianry student outcomes related to delivery method and age of the student. In this study the independent variable of instructional delivery method was not manipulated as it represents student’s self-selected participation based on their particular preference. The data used to answer the first question came from college records. Data used to answer the
second question came from a report from the certification agency. Data used to answer questions three and four came from a survey of the seven most recent cohorts to graduate from the Opticianry program. Some researchers refer to this type of study design as survey research which is defined as research that provides a quantitative or numeric description of trends, attitudes or opinions of a population by studying a sample of the population (Creswell, 2009).

**Target Population and Sample**

The target population was students who completed an Opticianry program at a large community college in Florida in the past six years. Each cohort typically graduates 30 to 50 students. The plan was to study a sample from six cohorts or a total population of 272 graduates. A review of alumni records maintained by the Opticianry program revealed that of the 272 graduates, 65% were Caucasian, 23% Hispanic, 6% Asian, 5% Black, and 1% American Indian. The 272 graduates in the population are 72% female and 28% male. The sample consisted of students from all six cohorts who responded to an invitation to participate in the study.

To determine sample size an a Priori Power Estimation was conducted. The estimate is based on a two way 3 x 3 factorial ANOVA design with a medium effect size (.25), alpha = .05, and power of .80. Using Cohen’s Power Table (Stevens, 2008), 52 participants were needed per group. Cohen’s adjusted sample size formula revealed a need for a total of 162 participants. To achieve the desired number of participants, a response rate of 60% was needed. If the power is lowered to 61%, 34 participants were needed per group for an adjusted total of 108 participants. This would reduce the response rate to 38%.
Given the survey responses rates published in other studies, a power goal of 60% to 80% was considered attainable. A survey in a similar study of nurses by Kostrzewski (2007) produced a response rate of 42%, while a survey of online learner outcomes by Hawkins (2009) yielded a response rate of 56%. In the event that the response rate was lower than the goal, an additional cohort of graduates would be added.

In the target program, ethnicity was identified by the students as White, Black, Hispanic, Asian or American Indian when they applied for admission. In this regard, the small percentages of Non-Caucasian ethnicities made it unlikely that a statistically significant percentage of these groups would make up the sample and thus not considered as part of the sampling plan.

Variables

There are two independent and four dependent variables, which were selected based on their relevance and availability of data in the study.

Independent variables. The first independent variable was instructional delivery method. The Florida Distance Learning Task Force (2009) defines an online course as “where at least 80 percent of the direct instruction of the course is delivered utilizing some form of technology when the student and faculty member are separated by time, space or both”. The task force further defined hybrid courses as “where at least 50 percent and not more than 79 percent of the direct instruction of the course is delivered utilizing some form of technology when the student and faculty member are separated by time, space or both”. For the purposes of this study, these percentages were used as a guide in determining a student’s delivery method classification. The program consists of 25 Opticianry courses and five general education courses. Only the Opticianry courses
were used in the study. Instructional Delivery method is categorical so graduates were
coded Face-to-face, Online, or Hybrid using the following operational definition:

- Online: Student has taken 21 course (84%) or more of their courses off-campus
- Hybrid: Student has taken 7 to 20 (28%-80%) of their courses off-campus
- Face-to-Face has taken 6 courses (24%) or less off-campus.

The second independent variable was age. The operational definition of age was
based on the graduate’s age when they entered the program. Student age were be
classified into three groups identified as Young Adults, Middle Age, and Older Adults.
Younger Adults included all graduates who were less than 25 years old when they began
the program. The Middle Age group included all graduates who were 25 to 33 years old
when starting the program. The Older Adults age group will consist of all students who
were 34 years old or older when they began the program. Student age was selected
because studies have indicated age may be important to the success of the distance-
learning students. That is, the independent nature of the distance learning may benefit
from maturity suggesting that older students are more likely to be focused and motivated
to successfully complete an occupational program (Means et al, 2010).

Four additional background variables traditionally found in studies like this were
considered but rejected for inclusion in the study. Two of the rejected independent
variables are background characteristics including ethnicity and gender. The studies
related to college level course delivery methods investigated during the review of
literature found no significant differences due to these two background characteristics.
Further, the study’s population was 72% female and 28% male. This again made it
unlikely that a statistically significant percentage of males would be present in the
delivery method sample groups. A third independent variable that was rejected was cohort membership. The seven cohorts span from 2006 to 2012. However, the program curriculum, faculty and delivery technology has remained the same during the seven year period. The faculty members have taught the same courses using the same delivery methods to all seven cohorts and thus this variable was not included in the study. Finally, prior achievement as measured by high school GPA upon entering the program was not considered either. Although prior achievement is a variable found important to account for background differences, in the Opticianry program students must meet a minimum GPA requirement for admissions and renders this variable largely equivalent.

**Dependent variables.** There were four dependent variables in the study. The first dependent variable was Grade Point Average (GPA). The graduate grade point average used included 57 program specific credits. The fifteen additional general education credits required to earn the Associate’s degree were not included. These courses may have been taken at other institutions prior to beginning the Opticianry program. A total of twenty five Opticianry courses were used to calculate the grade point average. The GPA was determined from college records.

The second dependent variable was the student’s score on the National Opticianry Competency Examination (NOCE). The NOCE exam is a certification requirement created by the American Board of Opticianry (ABO) and used to determine if an individual has the knowledge to be certified as an Optician. The exam includes 100 multiple choice questions to determine knowledge in three areas: Analyzing and interpreting prescriptions, fitting and dispensing spectacles and other ophthalmic devices, and using ophthalmic tools, instruments and equipment.
The National Opticianry Competency Examination (NOCE) scores are on a scale of 0-100. The NOCE score was obtained from the American Board of Opticianry.

The third dependent variable was graduate’s perception of workplace preparedness. This variable was defined based on related research pointing to three complementary sub-constructs including general work habits and skills, communication skills & technical skills.

Finally the fourth dependent variable was graduate’s perception of satisfaction with the program quality. Graduate’s perception of satisfaction with program quality was defined as the student’s satisfaction with instructional technology, equipment and faculty interaction aligned with the conceptual framework on equivalency of teaching and learning experiences.

**Data Sources and Instrumentation**

Data for the independent variable of age along with dependent variable of GPA was gathered from student records at the community college the subjects attended. A list of study participants was sent to the American Board of Opticianry with a request for their scores on the National Opticianry Competency Examination (NOCE).

**Student records.** The college offering the Opticianry program of interest maintains electronic student records using the Datatel software system. Cumulative grade point average is available for all students. The Institutional Review Board application to the community college included a request to access participant information in the Datatel system. As an employee of the college, the researcher was familiar with the operation of the system and had access to related data upon approval of an IRB request for this purpose.
National Optician competency examination scores. The National Opticianry Competency Examination (NOCE) is related to the design, fabrication and dispensing of eyeglasses and is given by the American Board of Opticianry (ABO). The exam is psychometrically developed and criterion referenced. After test specifications are created based on a previously performed job analysis, the exam is written by groups of expert certified opticians appointed by the American Board of Opticianry (ABO). The exam writers are assisted by Professional Examination Service (PES) in ensuring the validity and reliability of the exam. Reliability statistics are calculated and reported after each exam administration. Reliability is determined using the KR 20 test value which provides evidence relating to the internal consistency of the examinations. Internal consistency refers to the degree of homogeneity among test items, and theoretically may range from 0 to 1.00. A reliability coefficient of .80 or higher is usually recommended for certification examinations of the type and length of the NOCE (Gall, Gall & Borg, 2007). The NOCE exam had consistently high reliability coefficients, well above .80, from 2004 through 2010. KR 20 values ranged from .88 to .92. The exam questions are reviewed by testing service specialists for proper testing principles, rules of grammar, and style. Questions are created to test a candidate's ability to recall knowledge and to apply that knowledge to specific dispensing functions (ABO-NCLE, 2011).

Survey Instrument

Data used to determine participation in an instructional delivery method, level of program satisfaction and level of workplace preparedness, came from an Opticianry Graduate Survey (Appendix A) which contained three sections.
Section 1: Instructional delivery method. The first section of the survey was used to identify participation in an instructional delivery method group. It contained a list of all program courses. The student identified for each course if it was taken On-Campus or Off-Campus (Questions 5-29 on the Optician Graduate Survey). This classification was used in the analysis of all research questions.

Section 2: Program satisfaction. The second section contained questions regarding the student’s perception of Opticianry program satisfaction (Questions 30-54 on the Opticianry Graduate Survey). The score range on the 4-point Likert scale questions was 0-92 points. The questions were modified from a survey developed by Chandler Mead and the Faculty Evaluation and Development Task Force (FEAD) of Northwestern Oklahoma State University (Mead, 2007). Mead used the survey in his study Using Equivalency Theory in Explaining the Learning Experience between Originating and Remote Site Students Taking an Interactive Television Course. In this study, the eighteen items were used to measure graduate’s satisfaction with the program.

Section 3: Workplace preparedness. The final section contained questions regarding workplace preparedness. This section was broken into three sub-sections: The questions in the first two sub-sections are related to general work habits and communication skills. The score range on the 4-point Likert scale questions was 0-48 points for the general work habits section and 0-32 points for the communications section. The items in this portion of the survey have been modified from a survey developed by Higgins (2007) for her study of graduate and employer perceptions regarding job preparedness skills of design technology.
The questions in the third sub-section of workplace preparedness are related to technical skills. The score range on the 4-point Likert scale questions was 0-76 points. The questions were selected from the Commission on Opticianry Accreditation’s Essentials of an Accredited Educational Program for Opticianry (COA, 2011). The questions are part of a suggested graduate survey that was prepared by subject experts. They represent the accrediting agency’s expected Opticianry program graduate competencies. The score range on the 4-point Likert scale questions for the combined sections was 0-156 points.

**Pilot study.** A pilot study was conducted with current Opticianry students prior to administering the survey to the study sample. The pilot group consisted of 10 students. Content validity was established through a focus group consisting of three Opticianry Program faculty members. These subject matter experts reviewed the survey for content and readability. Another focus group consisting of five current Opticianry students reviewed the survey questions to identify confusing wording. Ten current students volunteered to take the pilot survey. Their scores on the 62 Likert scale questions were entered into an SPSS software data form and a Cronbach’s Alpha analysis was performed to test for reliability. The resulting Cronbach’s Alpha test result was .918. On a scale of 0-1.0, this represents a very high degree of reliability.

**Data Collection Procedures**

All graduates of the Hillsborough Community College Opticianry Program from 2007-2012 received an e-mail invitation and informed consent letter from the investigator. The e-mail addresses came from an Alumni data base maintained by the Opticianry Program Manager. For students who agreed to participate, the investigator
accessed data from student records at Hillsborough Community College. The records were used to gather demographic and program grade point average (GPA) for seven cohorts of Opticianry students. A request was made to the Hillsborough Community College Institutional Review Board for permission to access the data. A list of graduates who elect to participate in the study was sent to the American Board of Opticianry to obtain their scores on the National Opticianry Competency Examination.

Data related to instructional delivery method, program satisfaction and workplace preparedness were obtained using the Opticianry Graduate Survey. The survey was available through Survey Monkey and the corresponding link was sent to graduates via e-mail. A sample of the survey can be seen in Appendix A or accessed using the following link: https://www.surveymonkey.com/s/KGLRXWQ. The participants were asked to self-identify instructional delivery method. They also were asked their perception of their level of workplace preparedness and satisfaction with the Opticianry program. The students were sent an e-mail asking them to participate in the survey with a link to the online survey. Graduates who did not respond within two weeks received a follow up e-mail.

Data Analysis

The unit of analysis for the study was the student and the main analysis tool was factorial Analysis of Variance (ANOVA). Factorial ANOVA was used to examine the effects of two or more independent variables on a dependent variable (Stevens, 2007). A two-way ANOVA allowed the researcher to analyze the relationship between independent variables (delivery method and age) and a dependent variable (GPA, certification score, workplace preparation score, quality of instruction score).
A 3x3 factorial ANOVA was needed because delivery method has three levels and student age was grouped into three levels.

Calculations for this study were done using SPSS statistical software. The analysis of all research questions had one continuous criterion or dependent variable and two predictor or independent variables. The two-way ANOVA determined the main effect of instructional delivery method, the main effect of student age and the interaction effect between them. The two-way ANOVA SPSS summary table provided the sum of squares, degrees of freedom, mean square, F value, significance level or p value, and partial eta squared or effect size in all three areas. An effect was considered significant if the F value is greater than the critical F value or the corresponding p-value is less than an alpha of .05. Cohen’s (1988) guideline for effect size was used with 0.01 = small, 0.06 = medium, and 0.13 = large. Medium and large effect sizes may be predictive of significance in a study with a larger sample size.

The analysis of research question three, which measured graduate perceptions of workplace preparedness, contains three sub-sections. The sub-sections of general work habits and skills, communication skills, and technical skills were entered separately into the two-way ANOVA SPSS program. To control for Type I error, the alpha level for each sub-section was set at .017 (.05 / 3).

For surveys with missing data, an average score based on the answered items was used. If no statistical differences were detected, the assumption was that student age did not impact perceived workplace readiness or perceived quality of the program. It was also assumed that students using different instructional delivery methods reported equivalent workplace readiness and quality of program scores.
If differences had existed among the group means, post hoc multiple comparison tests would have been used to determine which means differ.

**Limitations**

This study was limited in several ways. This study was limited to program graduates. The study did not consider academic preparedness measures like high school GPA, SAT and College Placement test scores which have been shown to be helpful in predicting completion. It also ignores environmental variables such as socio-economic status (SES), marital status, number of children, number of hours worked per week and financial resources. Based on the review of literature it was found that these issues are more relevant to studies of retention that to studies of graduate outcomes.

**Ethics**

All participants in the study were no longer students in the HCC Opticianry program and participation was strictly voluntary. Further, IRB guidelines were followed when asking students to participate and the survey was online and confidential.
Chapter 4: Results

The results of the study are presented in this chapter beginning with a recap of survey participation and reliability analysis. The results associated with each research question are reported based on the corresponding analysis of variance and complemented with data on means and standard deviations for comparative review.

Survey Participation and Reliability

Data collection was conducted during a six-week period using an online survey available through Survey Monkey. Two hundred and seventy two graduates of the Hillsborough Community College Opticianry Program from 2007-2012 were contacted for participation. The graduates who elected to participate were asked to complete the online survey within four weeks. After two weeks a reminder was sent via e-mail to the graduates. At the end of four weeks the response rate was not as high as desired and a second e-mail was sent to the graduates announcing that the survey completion date had been extended two weeks. Further, to ensure sufficient responses, the 2006 graduate cohort was added to the study and e-mail invitations were sent to that group. This increased the target number of graduates to 286. Overall, 119 graduates completed the survey. However, seven of the surveys were incomplete and were not used for the statistical analysis. As a result, the 112 usable surveys represent a response rate of 39%.

Table 1 displays the distribution of study participants according to delivery method and age bracket. The goal was to have a minimum response rate of 38% or 108
participants. Therefore the response rate was acceptable. The sample (n=112) was representative of the typical enrollments by delivery method and age based on the data reported in Table 1. Participation by delivery method and age groupings was representative of what is normally seen in the program.

Table 1

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Groups</th>
<th>Description</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery Method</td>
<td>1</td>
<td>Online</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Hybrid</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Campus</td>
<td>35</td>
</tr>
<tr>
<td>Age</td>
<td>1</td>
<td>18-24</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>25-33</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>34 &amp; &gt;</td>
<td>55</td>
</tr>
</tbody>
</table>

Regarding the Opticianry Graduate Survey (Appendix A), it contained 62 Likert scale questions addressing two main sections, job preparedness and program quality. To verify the reliability of the survey, the answers from the 112 respondents were entered into an SPSS data form for analysis. The Cronbach’s Alpha score for the overall survey was .971, which indicated high reliability mirroring the results for the pilot survey (.918). Similarly, when analyzed by section, the 23 items related to the graduate’s perception of program quality yielded a Cronbach’s Alpha Score of .947. In turn, the analysis of the 39 items related to the graduate’s perception of job preparedness produced a Cronbach’s Alpha score of .961. In addition, each of the three sub-sections comprising the section on job preparedness was found reliable with Cronbach’s Alpha scores of .884 for General Work Habits and Skills, .896 for Communication Skills and .993 for Technical Skills.

Further, two-way analysis of variance (ANOVA) was used for the analysis of survey data using SPSS software, and using a p value of .05 to determine statistical
significance. The partial eta squared value was reported for effect size with 0.01 = small, 0.06 = medium, and 0.13 = large. Medium and large effect sizes may be predictive of significance in a study with a larger sample size. Also, due to the unbalanced number of subjects in each cell, a Type III Sum-of-Squares or Full Regression approach suggested in such cases was used to analyze effects (Stevens, 2008).

**Do Instructional Methods and Age Affect Grade Point Average?**

The first research questions was concerned with whether community college Opticianry student participation in different instructional methods and age bracket affect student performance as measured by grade point average. Two-way ANOVA analysis was used to examine the main effect of instructional delivery method, the main effect of student age and the interaction effect between them. As illustrated in Table 2, the results showed no significant differences ($p > .05$) suggesting that students in the Opticianry program perform relatively equal regardless of participation in different delivery formats or their age bracket. The effect size was small for delivery method and age with a medium interaction effect.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>$p$ value ($\text{Sig.}&lt;.05$)</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery</td>
<td>2, 103</td>
<td>0.02</td>
<td>.98</td>
<td>.00</td>
</tr>
<tr>
<td>Age</td>
<td>2, 103</td>
<td>1.45</td>
<td>.24</td>
<td>.03</td>
</tr>
<tr>
<td>Delivery*Age</td>
<td>4, 103</td>
<td>1.83</td>
<td>.13</td>
<td>.07</td>
</tr>
</tbody>
</table>

Further inspection of descriptive statistics reported in Table 3 confirmed the analysis of variance for the results associated with age groups. Although, there are observed differences for age groups between and within delivery methods, the differences
in mean GPA were minimal. Students in the 25-33 years old bracket in the Hybrid method showed the highest mean GPA (3.75) while the younger group participating in that same delivery method showed the lowest mean GPA (3.15). Again, the small difference between the highest and lowest mean GPA is an indicator of similar performance across delivery method regardless of age group.

Table 3

Grade Point Average (GPA): Descriptive Statistics

<table>
<thead>
<tr>
<th>Delivery Method</th>
<th>Age</th>
<th>Mean GPA</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online (1)</td>
<td>18-24 (1)</td>
<td>3.50</td>
<td>.19</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>3.41</td>
<td>.37</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>3.49</td>
<td>.30</td>
</tr>
<tr>
<td></td>
<td><strong>Total Online Mean</strong></td>
<td><strong>3.47</strong></td>
<td><strong>.31</strong></td>
</tr>
<tr>
<td>Hybrid (2)</td>
<td>18-24 (1)</td>
<td>3.15</td>
<td>.52</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>3.75</td>
<td>.32</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>3.58</td>
<td>.29</td>
</tr>
<tr>
<td></td>
<td><strong>Total Hybrid Mean</strong></td>
<td><strong>3.56</strong></td>
<td><strong>.37</strong></td>
</tr>
<tr>
<td>Campus-Based (3)</td>
<td>18-24 (1)</td>
<td>3.49</td>
<td>.41</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>3.40</td>
<td>.50</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>3.54</td>
<td>.39</td>
</tr>
<tr>
<td></td>
<td><strong>Total Campus Mean</strong></td>
<td><strong>3.50</strong></td>
<td><strong>.40</strong></td>
</tr>
</tbody>
</table>

The graph in figure 3 illustrates the mean GPA by age across delivery methods. The mean GPA by age varied little for online and campus-based students. The younger students in the hybrid delivery method had the lowest GPA while the middle age group had the highest. Overall, although not significant, there appears to be a greater variation resulting from participation in the hybrid delivery method.

An examination of the estimated marginal means, reported in Table 4 for each delivery method and age group, provides additional evidence of equivalent performance regardless of age and delivery method. Marginal means are the overall means used for estimating the effect for each independent variable, averaging across the other
independent variable. When groups contain an unequal number of subjects, estimated or unweighted marginal means are recommended for examining the main effects.

![Figure 3: Mean GPA for age group across delivery methods.](image)

**Table 4**

*GPA Estimated Marginal Means*

<table>
<thead>
<tr>
<th>Delivery</th>
<th>Mean</th>
<th>Standard Error</th>
<th>Age</th>
<th>Mean</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online (1)</td>
<td>3.47</td>
<td>.06</td>
<td>18-24 (1)</td>
<td>3.38</td>
<td>.08</td>
</tr>
<tr>
<td>Hybrid (2)</td>
<td>3.49</td>
<td>.08</td>
<td>25-33 (2)</td>
<td>3.51</td>
<td>.08</td>
</tr>
<tr>
<td>Campus (3)</td>
<td>3.48</td>
<td>.07</td>
<td>34 &amp; &gt;</td>
<td>3.54</td>
<td>.05</td>
</tr>
</tbody>
</table>

In this case, as noted in Table 4, the mean GPA for each age group clustered at about a mean of 3.5 with minimal departure from each other. Based on the results, it is concluded that participation in different program delivery method and age group did not affect Grade Point Average.
Do Instructional Methods and Age Affect Certification Scores?

The second research question sought to determine whether community college Opticianry student participation in different instructional methods and age bracket affect student performance as measured by national certification exam score. Again a two-way ANOVA was used to examine the main effect of instructional delivery method, the main effect of student age and the interaction effect between them. As suggested by the results of the analysis reported in Table 5, there were no significant differences leading to the conclusion that students in the Opticianry program perform about the same on the National Certification Exam regardless of participation in different delivery formats or their age bracket. The effect size was small for delivery method and age with a medium interaction effect.

Table 5

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>p value (Sig.&lt;.05)</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery</td>
<td>2, 103</td>
<td>.04</td>
<td>.97</td>
<td>.00</td>
</tr>
<tr>
<td>Age</td>
<td>2, 103</td>
<td>.96</td>
<td>.39</td>
<td>.02</td>
</tr>
<tr>
<td>Delivery*Age</td>
<td>4, 103</td>
<td>1.56</td>
<td>.19</td>
<td>.06</td>
</tr>
</tbody>
</table>

A confirmatory inspection of mean scores on the American Board of Opticianry National Certification Examination reported in Table 6 revealed that the overall campus mean score was 82.23. Not surprisingly, the same groups with the highest and lowest mean scores were the same groups with the highest and lowest mean GPAs reported previously. That is, the middle age group in the hybrid method had the highest mean score (85.88), while the lowest mean score (77.25) was reported for the youngest group in the same delivery method. However, the lowest and highest mean scores were not too
far apart from the overall campus mean to be statistically different. Further, there was no
discernible pattern of observable differences across delivery method. That is, the oldest
group of graduates earned the highest scores on the online method whereas the middle
age group scored the highest for the hybrid graduates. In turn, the youngest age group on
the campus-based method earned the highest scores. Further, total mean score for the
three delivery method varied by less than two points.

Table 6

NOCE National Certification Exam Score: Descriptive Statistics

<table>
<thead>
<tr>
<th>Delivery Method</th>
<th>Age</th>
<th>Mean ABO Score</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online (1)</td>
<td>18-24 (1)</td>
<td>80.75</td>
<td>5.23</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>81.06</td>
<td>7.11</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>83.88</td>
<td>6.58</td>
</tr>
<tr>
<td><strong>Total Online Mean</strong></td>
<td></td>
<td><strong>82.45</strong></td>
<td><strong>6.61</strong></td>
</tr>
<tr>
<td>Hybrid (2)</td>
<td>18-24 (1)</td>
<td>77.25</td>
<td>6.13</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>85.88</td>
<td>4.97</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>83.69</td>
<td>6.85</td>
</tr>
<tr>
<td><strong>Total Hybrid Mean</strong></td>
<td></td>
<td><strong>83.69</strong></td>
<td><strong>6.85</strong></td>
</tr>
<tr>
<td>Campus-Based (3)</td>
<td>18-24 (1)</td>
<td>83.29</td>
<td>6.95</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>82.75</td>
<td>6.70</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>80.79</td>
<td>10.75</td>
</tr>
<tr>
<td><strong>Total Campus Mean</strong></td>
<td></td>
<td><strong>82.23</strong></td>
<td><strong>8.51</strong></td>
</tr>
</tbody>
</table>

The graph in figure 4 illustrates the mean NOCE scores by age across delivery
methods. The greatest variance among age brackets was the hybrid graduates. The
youngest hybrid students had the lowest scores while the middle age hybrid students had
the highest scores. Again, although the interaction is not significant, there appears to be a
greater variation resulting from participation in the hybrid delivery method with lower
scores for the younger group compared to other two age groups. This is the same pattern
as seen with grade point average.
The complementary analysis of the estimated marginal means for each delivery method and age group reported in Table 7 provided additional confirmation of observed results. The mean NOCE score for each delivery method showed a minimal (less than one point) difference. If anything, the mean certification score suggested a slight difference favoring the middle age group, with the youngest group at the lower end. Again, even though the difference by age group was about 2.8 points, it was not large enough to produce statistical significance. Therefore, in light of the overall results, it was concluded that participation in different program delivery method and age group did not affect performance as measured by national certification scores.

Figure 4: Mean NOCE scores for age group across delivery methods.
Table 7

NOCE National Certification Exam Score: Estimated Marginal Means

<table>
<thead>
<tr>
<th>Delivery</th>
<th>Mean</th>
<th>Standard Error</th>
<th>Age</th>
<th>Mean</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online (1)</td>
<td>81.90</td>
<td>1.16</td>
<td>18-24</td>
<td>80.43</td>
<td>1.60</td>
</tr>
<tr>
<td>Hybrid (2)</td>
<td>82.27</td>
<td>1.61</td>
<td>25-33</td>
<td>83.23</td>
<td>1.61</td>
</tr>
<tr>
<td>Campus (3)</td>
<td>82.28</td>
<td>1.50</td>
<td>34 &amp; &gt;</td>
<td>82.78</td>
<td>1.01</td>
</tr>
</tbody>
</table>

Do Instructional Methods and Age Affect Preparation Perceptions?

The third research questions addresses whether community college Opticianry student participation in different instructional methods and age bracket affect graduates’ perceptions of workplace preparedness. This section is broken into three sub-sections:

The questions in the first two sub-sections were related to general work habits and communication skills. The questions in the third sub-section of workplace preparedness were related to technical skills. For each of the three sub-sections and the total a two-way ANOVA analysis was used to examine the main effect of instructional delivery method, the main effect of student age and the interaction effect between them. The sub-sections of general work habits and skills, communication skills, and technical skills were entered separately into the two-way ANOVA SPSS program. To control for Type I error, the alpha level for each sub-section was set at .017 (.05 / 3).

**General work skills.** As illustrated in Table 8, the results for the General Work Skills (GWS) section of the survey showed no significant differences indicating that students in the Opticianry program reported relatively equal perceptions of general work skills preparation regardless of participation in different delivery formats or their age bracket. The effect size was small for delivery method, age, and interaction.
Further inspection of the descriptive statistics reported in Table 9 show the highest mean score on the GWS survey questions for the youngest group of both online and campus-based graduates. Hybrid graduates had the highest scores in the middle age group. It is interesting to note that the scores across age brackets for campus-based students (within two points) and online students (within four points) were very similar. In contrast the score for oldest age group in the Hybrid method was nine points lower than the middle age group.

A complementary analysis of the estimated marginal means for each delivery method and age group reported in Table 10 provided additional confirmation of observed results. The campus-based graduate’s mean rating for general work habits and skills preparation was the highest of the three delivery methods. The age group recording the highest score was the middle age group. This was influenced by the relatively higher middle age group score for Hybrid delivery and the relatively consistent scores across age groups for the other delivery methods. The total mean differed by about five points for delivery method and only about three points for age group. This was not enough to produce statistical difference. Therefore, it is concluded that participation in different program delivery method and age group did not affect perception of general work skills preparation.
Table 9

*General Work Skills Preparation Survey Scores: Descriptive Statistics*

<table>
<thead>
<tr>
<th>Delivery Method</th>
<th>Age</th>
<th>Mean GWS</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online (1)</td>
<td>18-24 (1)</td>
<td>94.75</td>
<td>4.90</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>92.69</td>
<td>9.53</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>90.60</td>
<td>11.09</td>
</tr>
<tr>
<td><strong>Total Online Mean</strong></td>
<td></td>
<td><strong>91.96</strong></td>
<td><strong>9.79</strong></td>
</tr>
<tr>
<td>Hybrid (2)</td>
<td>18-24 (1)</td>
<td>89.00</td>
<td>9.42</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>94.75</td>
<td>5.01</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>85.81</td>
<td>10.94</td>
</tr>
<tr>
<td><strong>Total Hybrid Mean</strong></td>
<td></td>
<td><strong>88.82</strong></td>
<td><strong>9.93</strong></td>
</tr>
<tr>
<td>Campus-Based (3)</td>
<td>18-24 (1)</td>
<td>95.71</td>
<td>5.07</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>94.25</td>
<td>9.03</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>95.64</td>
<td>5.79</td>
</tr>
<tr>
<td><strong>Total Campus Mean</strong></td>
<td></td>
<td><strong>95.51</strong></td>
<td><strong>5.69</strong></td>
</tr>
</tbody>
</table>

Table 10

*General Work Skills Preparation Survey Scores: Estimated Marginal Means*

<table>
<thead>
<tr>
<th>Delivery</th>
<th>Mean</th>
<th>Standard Error</th>
<th>Age</th>
<th>Mean</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online (1)</td>
<td>92.68</td>
<td>1.38</td>
<td>18-24 (1)</td>
<td>93.15</td>
<td>1.91</td>
</tr>
<tr>
<td>Hybrid (2)</td>
<td>89.85</td>
<td>1.92</td>
<td>25-33 (2)</td>
<td>93.90</td>
<td>1.92</td>
</tr>
<tr>
<td>Campus (3)</td>
<td>95.20</td>
<td>1.79</td>
<td>34 &amp; &gt;</td>
<td>90.69</td>
<td>1.21</td>
</tr>
</tbody>
</table>

**Communication skills.** Similarly, as suggested by the results of the analysis reported in Table 11, there were no significant differences \((p > .017)\) in the Opticianry students’ perception of their communication skill preparation. The effect size was small for delivery method, age, and interaction. These results suggested that students believe their communication skills are about the same regardless of participation in different delivery formats or their age bracket.
Table 11

*Communication Skills Preparation Survey Scores: Tests of Between-Subjects Effects*

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>p value (Sig. &lt; .017)</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery</td>
<td>2, 103</td>
<td>1.35</td>
<td>.26</td>
<td>.03</td>
</tr>
<tr>
<td>Age</td>
<td>2, 103</td>
<td>.31</td>
<td>.74</td>
<td>.01</td>
</tr>
<tr>
<td>Delivery*Age</td>
<td>4, 103</td>
<td>.29</td>
<td>.88</td>
<td>.01</td>
</tr>
</tbody>
</table>

A confirmatory inspection of the mean scores on perception of communication skill preparation in Table 12 showed a pattern similar to general work skills. The highest mean score on the communication skills preparation survey questions for the youngest group of both online and campus-based graduates. Hybrid graduates had the highest scores in the middle age group. The scores across age brackets for campus-based students (within three points) and online students (within four points) were very similar. In contrast the score for oldest age group in the Hybrid method was five points lower than the middle age group.

Table 12

*Communication Skills Preparation Survey Scores: Descriptive Statistics*

<table>
<thead>
<tr>
<th>Delivery Method</th>
<th>Age</th>
<th>Mean COMM</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online (1)</td>
<td>18-24 (1)</td>
<td>91.75</td>
<td>9.81</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>90.81</td>
<td>14.97</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>87.24</td>
<td>14.78</td>
</tr>
<tr>
<td></td>
<td><strong>Total Online Mean</strong></td>
<td><strong>89.14</strong></td>
<td><strong>14.04</strong></td>
</tr>
<tr>
<td>Hybrid (2)</td>
<td>18-24 (1)</td>
<td>86.00</td>
<td>13.83</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>91.50</td>
<td>11.49</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>86.94</td>
<td>10.71</td>
</tr>
<tr>
<td></td>
<td><strong>Total Hybrid Mean</strong></td>
<td><strong>88.11</strong></td>
<td><strong>11.14</strong></td>
</tr>
<tr>
<td>Campus-Based (3)</td>
<td>18-24 (1)</td>
<td>94.94</td>
<td>6.53</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>92.25</td>
<td>10.40</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>93.86</td>
<td>6.01</td>
</tr>
<tr>
<td></td>
<td><strong>Total Campus Mean</strong></td>
<td><strong>94.20</strong></td>
<td><strong>6.65</strong></td>
</tr>
</tbody>
</table>
The complementary analysis of the estimated marginal means for each delivery method and age group reported in Table 13 provided additional confirmation of the observed results. The overall ranking of delivery method scores and age group scores mirror the results of the perceptions in general work skills. The top ranking for delivery method is campus-based followed by online and hybrid. The age bracket rankings again show the middle age at the top followed by the youngest and oldest. However, the mean for delivery method varies by less than four points and the age group mean varies by less than three points.

Table 13

*Communication Skills Preparation Survey Scores: Estimated Marginal Means*

<table>
<thead>
<tr>
<th>Delivery</th>
<th>Mean</th>
<th>Standard Error</th>
<th>Age</th>
<th>Mean</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online (1)</td>
<td>89.93</td>
<td>1.85</td>
<td>18-24 (1)</td>
<td>90.90</td>
<td>2.56</td>
</tr>
<tr>
<td>Hybrid (2)</td>
<td>88.15</td>
<td>2.57</td>
<td>25-33 (2)</td>
<td>91.52</td>
<td>2.57</td>
</tr>
<tr>
<td>Campus (3)</td>
<td>93.68</td>
<td>2.39</td>
<td>34 &amp; &gt;</td>
<td>89.35</td>
<td>1.62</td>
</tr>
</tbody>
</table>

Therefore, in light of the overall results, it is concluded that participation in different program delivery method and age group did not affect perception of communication skill preparation.

**Technical skills.** Likewise, as illustrated in Table 14, the results for the Technical Skills (TECH) section of the survey showed no significant differences \( p > .017 \) indicating that students in the Opticianry program reported relatively equal perceptions of technical skills preparation regardless of participation in different delivery formats or their age bracket. The effect size was small for delivery method, age, and interaction.
Table 14

*Technical Skills Preparation Survey Scores: Tests of Between-Subjects Effects*

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>p value (Sig. &lt; .017)</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery</td>
<td>2, 103</td>
<td>.89</td>
<td>.41</td>
<td>.02</td>
</tr>
<tr>
<td>Age</td>
<td>2, 103</td>
<td>2.10</td>
<td>.13</td>
<td>.04</td>
</tr>
<tr>
<td>Delivery*Age</td>
<td>4, 103</td>
<td>.49</td>
<td>.75</td>
<td>.02</td>
</tr>
</tbody>
</table>

Further inspection of the descriptive statistics reported in Table 15 show a slightly different pattern from the perception of general work and communication skills. The highest mean score on the technical skills survey questions for the youngest group of both Hybrid and campus-based graduates. Online graduates had the highest scores in the middle age group. The scores across age brackets had the same pattern as general work and communication perceptions, campus-based students (within three points) and online students (within two points) were very similar. In contrast the score for oldest age group in the Hybrid method was seven points lower than the youngest age group and five points lower than the middle age group.

Table 15

*Technical Skills Preparation Survey Scores: Descriptive Statistics*

<table>
<thead>
<tr>
<th>Delivery Method</th>
<th>Age</th>
<th>Mean TECH</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online (1)</td>
<td>18-24 (1)</td>
<td>94.25</td>
<td>5.63</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>94.88</td>
<td>8.48</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>92.60</td>
<td>11.07</td>
</tr>
<tr>
<td>Total Online Mean</td>
<td></td>
<td><strong>93.61</strong></td>
<td><strong>9.46</strong></td>
</tr>
<tr>
<td>Hybrid (2)</td>
<td>18-24 (1)</td>
<td>94.75</td>
<td>6.19</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>94.50</td>
<td>6.16</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>87.38</td>
<td>11.21</td>
</tr>
<tr>
<td>Total Hybrid Mean</td>
<td></td>
<td><strong>90.46</strong></td>
<td><strong>9.86</strong></td>
</tr>
<tr>
<td>Campus-Based (3)</td>
<td>18-24 (1)</td>
<td>96.94</td>
<td>3.09</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>95.50</td>
<td>5.45</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>94.50</td>
<td>7.73</td>
</tr>
<tr>
<td>Total Campus Mean</td>
<td></td>
<td><strong>95.80</strong></td>
<td><strong>5.60</strong></td>
</tr>
</tbody>
</table>
The complementary analysis of the estimated marginal means for each delivery method and age group reported in Table 16 provided additional confirmation of observed results. The overall ranking of delivery method scores mirror the results of the perceptions in general work skills and communication skills. The top ranking for delivery method is campus-based followed by online and hybrid. The age bracket rankings changed slightly with youngest group on top followed by the middle and oldest. However, the mean for delivery method varies by less than three points and the age group mean varied by less than five points. Therefore, in light of the overall results, it is concluded that participation in different program delivery method and age group did not affect perception of technical skill preparation.

Table 16

Technical Skills Preparation Survey Scores: Estimated Marginal Means

<table>
<thead>
<tr>
<th>Delivery</th>
<th>Mean</th>
<th>Standard Error</th>
<th>Age</th>
<th>Mean</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online (1)</td>
<td>93.91</td>
<td>1.36</td>
<td>18-24 (1)</td>
<td>95.31</td>
<td>1.88</td>
</tr>
<tr>
<td>Hybrid (2)</td>
<td>92.21</td>
<td>1.89</td>
<td>25-33 (2)</td>
<td>94.96</td>
<td>1.89</td>
</tr>
<tr>
<td>Campus (3)</td>
<td>95.65</td>
<td>1.76</td>
<td>34 &amp; &gt;</td>
<td>91.49</td>
<td>1.19</td>
</tr>
</tbody>
</table>

Overall perceptions of workplace preparedness. Overall, as suggested by the results of the analysis reported in Table 17, there were no significant differences \((p > .05)\) for the totality of perceptions on work preparedness. The effect size was small for delivery method, age, and interaction. That is, based on the results, students in the Opticianry program perceive their overall workplace preparation to be about the same regardless of participation in different delivery formats or their age bracket.
Table 17

*General Work, Communication and Technical Skills Preparation Survey Scores: Tests of Between-Subjects Effects*

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>p value (Sig.&lt;.05)</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery</td>
<td>2, 103</td>
<td>1.48</td>
<td>.23</td>
<td>.03</td>
</tr>
<tr>
<td>Age</td>
<td>2, 103</td>
<td>1.49</td>
<td>.23</td>
<td>.03</td>
</tr>
<tr>
<td>Delivery*Age</td>
<td>4, 103</td>
<td>.50</td>
<td>.73</td>
<td>.02</td>
</tr>
</tbody>
</table>

A confirmatory inspection of the mean scores on perception of combined general, communication and technical skill preparation in Table 18 showed a pattern similar to general work and communication skills. The highest mean score on the combined skills preparation survey questions for the youngest group of both online and campus-based graduates. Hybrid graduates had the highest scores in the middle age group. The scores across age brackets for campus-based students (within two points) and online students (within four points) were very similar. In contrast the score for oldest age group in the Hybrid method was seven points lower than the middle age group.

Figure 5 shows that younger students had the highest scores for online and campus-based delivery methods and second highest for hybrid graduates. This may be due to their lack of previous work experience for comparison. Middle and older age bracket Opticianry students are typically entering a second career.
Table 18

*General Work, Communication and Technical Skills Preparation Survey Scores:*

*Descriptive Statistics*

<table>
<thead>
<tr>
<th>Delivery Method</th>
<th>Age</th>
<th>Mean Preparation</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online (1)</td>
<td>18-24 (1)</td>
<td>94.25</td>
<td>4.62</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>93.06</td>
<td>9.37</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>91.04</td>
<td>10.93</td>
</tr>
<tr>
<td><strong>Total Online Mean</strong></td>
<td></td>
<td><strong>92.22</strong></td>
<td><strong>9.59</strong></td>
</tr>
<tr>
<td>Hybrid (2)</td>
<td>18-24 (1)</td>
<td>91.25</td>
<td>8.73</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>93.88</td>
<td>6.40</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>86.69</td>
<td>10.31</td>
</tr>
<tr>
<td><strong>Total Hybrid Mean</strong></td>
<td></td>
<td><strong>89.39</strong></td>
<td><strong>9.43</strong></td>
</tr>
<tr>
<td>Campus-Based (3)</td>
<td>18-24 (1)</td>
<td>96.12</td>
<td>3.81</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>94.25</td>
<td>7.32</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>94.57</td>
<td>6.25</td>
</tr>
<tr>
<td><strong>Total Campus Mean</strong></td>
<td></td>
<td><strong>95.29</strong></td>
<td><strong>8.64</strong></td>
</tr>
</tbody>
</table>

Figure 5: Mean General Work, Communication and Technical Skills Preparation scores for age group across delivery methods.
The analysis of the estimated marginal means for each delivery method and age group reported in Table 19 provided additional confirmation of the observed results. The overall ranking of delivery method scores and age group scores are similar to the results of the perceptions in the individual skills. The top ranking for delivery method is campus-based followed by online and hybrid. The age bracket rankings show the youngest age at the top followed by the middle and oldest. However, the mean for delivery method varies by about two points and the age group mean varies by about three points. Therefore, it was concluded that participation in different program delivery method and age group did not affect perception of job skill preparation.

Table 19

*General Work, Communication and Technical Skills Preparation Survey Scores: Estimated Marginal Means*

<table>
<thead>
<tr>
<th>Delivery</th>
<th>Mean</th>
<th>Standard Error</th>
<th>Age</th>
<th>Mean</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online (1)</td>
<td>92.78</td>
<td>1.34</td>
<td>18-24 (1)</td>
<td>93.87</td>
<td>1.85</td>
</tr>
<tr>
<td>Hybrid (2)</td>
<td>90.60</td>
<td>1.86</td>
<td>25-33 (2)</td>
<td>93.73</td>
<td>1.86</td>
</tr>
<tr>
<td>Campus (3)</td>
<td>94.98</td>
<td>1.74</td>
<td>34 &amp; &gt;</td>
<td>90.77</td>
<td>1.17</td>
</tr>
</tbody>
</table>

**Do Instructional Methods and Age Affect Program Quality Perceptions?**

The fourth research question sought to determine whether Community College Opticianry student participation in different instructional methods and age bracket affect graduates’ perceptions of the program quality. Once again a two-way ANOVA was used to examine the main effect of instructional delivery method, the main effect of student age and the interaction effect between them. As suggested by the results of the analysis reported in Table 20, there were no significant differences ($p > .05$) leading to the conclusion that students in the Opticianry program reported relatively equal perceptions
of program quality regardless of participation in different delivery formats or their age bracket. The effect size was small for delivery method and age with a medium interaction effect.

Table 20

Program Quality Survey Scores: Tests of Between-Subjects Effects

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>p value (Sig.&lt;.05)</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery</td>
<td>2, 103</td>
<td>2.07</td>
<td>.13</td>
<td>.04</td>
</tr>
<tr>
<td>Age</td>
<td>2, 103</td>
<td>.76</td>
<td>.47</td>
<td>.02</td>
</tr>
<tr>
<td>Delivery*Age</td>
<td>4, 103</td>
<td>1.60</td>
<td>.18</td>
<td>.06</td>
</tr>
</tbody>
</table>

Further inspection of descriptive statistics reported in Table 21 confirmed the analysis of variance for the results associated with age groups. Although, there are observed differences for age groups between and within delivery methods, the differences in mean quality scores were minimal. Students in the 34 & > years old bracket in the Campus-Based method showed the highest mean quality score (95.14) while the Hybrid method in that same age group showed the lowest quality score (82.50). Again, the difference between the highest and lowest mean quality scores did not produce a statistically significance.
Table 21

*Program Quality Survey Scores: Descriptive Statistics*

<table>
<thead>
<tr>
<th>Delivery Method</th>
<th>Age</th>
<th>Mean Quality</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online (1)</td>
<td>18-24 (1)</td>
<td>90.63</td>
<td>8.48</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>88.88</td>
<td>9.14</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>89.64</td>
<td>9.99</td>
</tr>
<tr>
<td><strong>Total Online Mean</strong></td>
<td></td>
<td><strong>89.55</strong></td>
<td><strong>9.32</strong></td>
</tr>
<tr>
<td>Hybrid (2)</td>
<td>18-24 (1)</td>
<td>92.25</td>
<td>7.81</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>90.50</td>
<td>12.98</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>82.50</td>
<td>10.78</td>
</tr>
<tr>
<td><strong>Total Hybrid Mean</strong></td>
<td></td>
<td><strong>86.18</strong></td>
<td><strong>11.58</strong></td>
</tr>
<tr>
<td>Campus-Based (3)</td>
<td>18-24 (1)</td>
<td>92.71</td>
<td>7.02</td>
</tr>
<tr>
<td></td>
<td>25-33 (2)</td>
<td>93.00</td>
<td>6.48</td>
</tr>
<tr>
<td></td>
<td>34 &amp; &gt; (3)</td>
<td>95.14</td>
<td>5.28</td>
</tr>
<tr>
<td><strong>Total Campus Mean</strong></td>
<td></td>
<td><strong>93.71</strong></td>
<td><strong>6.24</strong></td>
</tr>
</tbody>
</table>

Figure 6 shows that older campus-based students reported the highest quality scores. Yet, the older hybrid students had the lowest opinion of program quality. This may be due to their experiencing both online and campus-based delivery methods and preferring one method over the other.
An examination of the estimated marginal means, reported in Table 22 for each delivery method and age group, provides additional evidence of equivalent performance regardless of age and delivery method. In this case, as noted in Table 22, the mean quality score for the lowest (Online = 89.7) and the highest (Campus-Based = 93.6) varied by less than four points. Based on the results, it is concluded that participation in different program delivery method and age group did not affect perception of program quality.
Table 22

Program Quality Survey Scores: Estimated Marginal Means

<table>
<thead>
<tr>
<th>Delivery</th>
<th>Mean</th>
<th>Standard Error</th>
<th>Age</th>
<th>Mean</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online (1)</td>
<td>89.713</td>
<td>1.45</td>
<td>18-24 (1)</td>
<td>91.86</td>
<td>2.00</td>
</tr>
<tr>
<td>Hybrid (2)</td>
<td>88.417</td>
<td>2.01</td>
<td>25-33 (2)</td>
<td>90.79</td>
<td>2.01</td>
</tr>
<tr>
<td>Campus (3)</td>
<td>93.616</td>
<td>1.88</td>
<td>34 &amp; &gt;</td>
<td>89.09</td>
<td>1.27</td>
</tr>
</tbody>
</table>
Chapter 5: Conclusions and Implications

The results in chapter 4 indicated no significant difference in the outcomes of Opticianry program graduates related to instructional delivery method or age. The findings are further summarized in this chapter in the context of student outcomes, program quality and delivery options, and the fit with the theoretical framework of equivalency in technician preparation. The chapter concludes with implications for practice and recommendations for further research.

Measures of Student Performance

The impact of participation was measured using the Grade Point Average (GPA) upon graduation based on 57 program-specific credits. That is, the influence of general credits was removed from the estimation of the GPA to reflect only the results of performance in the Opticianry program. Another key measure of graduates’ performance was the score on the National Opticianry Competency Examination (NOCE) based on a scale of 0-100. Based on the analysis of results, it was concluded that participation in different program delivery method and age group did not affect performance as measured by graduates’ Grade Point Average and national certification scores.

About GPA, an inspection of marginal means for delivery methods suggested that there is no effect of delivery methods with a difference of only .02 between the highest and lowest mean GPA. Similarly, the difference in mean GPA between the highest and lowest scoring group was only 0.15. In turn, national examination scores were also remarkably similar with a difference between lowest and highest scoring delivery method.
of only .37 and only 2.8 for the highest and lowest scoring age groups. Considering a scale of 0-100, even the differences for age groups is minimal and thus the rather equivalent scores.

Furthermore, marginal means were used for analysis in that they are the overall means used for estimating the effect for each independent variable, averaging across the other independent variable. When groups contain an unequal number of subjects, estimated or unweighted marginal means are recommended for examining the main effects. Related findings suggested that there is essentially no gain for participation associated with any particular delivery method in terms of overall GPA and scores on the national examination. Students completing the Opticianry program primarily online, on campus, or in a hybrid format would be expected to perform at equivalent rates as measured by GPA and national examination score. The results are consistent with other studies focused on different populations. Fjermestad, Hiltz and Zang (2005) analyzed 30 comparative studies of online and hybrid occupational courses and also found no significant differences. A 2004 study by Benson et al. compared online and campus-based student outcomes for career and technical education (CTE) programs at three community colleges. The study found that CTE students (N=200) performed equally well in online and campus-based courses. The study also found that the online students were as motivated and satisfied as campus-based students.

**Perceptions of Job Preparedness**

Job preparedness in this study is defined as an occupational program graduate’s ability to perform the program’s terminal competencies upon employment. The survey instrument allowed graduates to rate their perception of job readiness in the areas of
general work habits and skills, communication skills, and technical skills. The scores in all three areas were analyzed individually and collectively. The analysis revealed no significant difference; although it appears campus-based students have a slightly higher opinion of their preparation for work. This may be facilitated by the more frequent face-to-face interaction with faculty and other college staff. Another explanation could be the quality of the mentors at the off-campus optical sites. The mentors are all licensed Opticians or Optometrists and competent professionals. However the off-site mentors do not have any formal training in mentoring or education, which may affect how online students perceive overall work preparation.

No clear trend emerged related to age. The middle age group rated their perception of general work skills and communication skills the highest. This 25-33 year old group is usually at their peak for technician preparation. They are mature enough to function as self-directed learners regardless of the delivery method but young enough to adapt to new technology. In this regard, the 18-24 year old group rated their perception of technical skills preparation and total skills preparation higher than the other two groups. One explanation regarding their perception of preparation may be their lack of experience entering a new job, and thus the perceptions of greater gains in work preparation compared to students in older groups. Another explanation for the higher perceptions of work preparation in the younger group may be a reflection of the advanced instrumentation and equipment the program has incorporated into the curriculum. Manual equipment and instruments in the optical field are rapidly being replaced with computer controlled, highly sophisticated products. In this context, students initially learn to perform tasks using the manual equipment, and as they become proficient they advance
to the newer equipment and instruments. Hence, younger students may view these experiences with greater appreciation for work preparation compared to older students who may have been exposed already to practices high tech equipment in the workplace.

**Perceptions of Program Quality**

Graduate’s perception of satisfaction with program quality was defined as the student’s satisfaction with instructional technology, equipment and faculty interaction aligned with the conceptual framework on equivalency of teaching and learning experiences. The eighteen survey items asked the graduates their perception of the quality of faculty, course design, technology, and support materials. It did not focus on issues outside of the program like student services. The Opticianry faculty members were evaluated on their ability to present, motivate, organize and interact. Program courses were evaluated on content, design, equipment and instructional technology used for delivery. The highest mean score (95.14) for the perception of quality was the campus-based older (34&>) students. The other campus-based students also gave high marks and were within three points of the oldest group. It is interesting to note that the lowest mean (82.50) was associated with the older students in the hybrid method. Being that this group engaged in both online and campus-based instruction, it is difficult to determine which method contributed to their lower perception of quality. It may be that with an opportunity to compare delivery method side by side, the student wishes they could participate on a full time basis with the method that best matches their learning style. That is, the older experienced student may be in a better position to determine which method works for them. The older online also students had a slightly lower mean than the other online groups however the means were within one point of each other.
The marginal means for perception of program quality were quite close for delivery method (four points) and age group (three points). This again leads to the conclusion that the perceptions of program quality vary little and are equivalent across delivery method and age.

**Equivalent Outcomes: Program Development Context**

Based on the overall results in the study, the overall conclusion is that students in the Opticianry program should achieve similar outcomes whether they complete the program online, on campus, or in a hybrid format. To put the results in perspective, it is important to clarify the program development context and the fit with components of the theoretical framework.

**Program development context.** The campus-based Opticianry A.S. Degree program at Hillsborough Community College in Tampa Florida has operated since 1973. In 1999 the faculty contributed to the development of online Opticianry course materials as part of an initiative by the National Federation of Opticianry Schools (NFOS). The goal of the initiative was to develop materials for a uniform online Opticianry degree program that could be delivered by any of the member schools.

The curriculum consisted of fourteen courses covering subjects typically contained in an Opticianry degree program. Each course contained primarily text lectures, worksheets, assignments and quizzes. Laboratory courses had competency checklists designed to be used by mentors at the student’s worksite. If a member school signed an agreement to use all 14 courses as part of an online Opticianry A.S. degree program, the college could link to the courses on the NFOS website. As these courses were being developed, HCC decided to begin offering Opticianry program students the
option of online or hybrid delivery in addition to the traditional campus-based instruction. Beginning in the fall of 2000, the online option was made available to anyone in the world. To be accepted as a student, they had to have access to an optical business to practice the competencies we were teaching. The optical site had to have the instruments and equipment required for the competencies being taught in the courses the student was registered for. The student also had to identify a worksite mentor with acceptable credentials, and be willing to return to campus at the end of each semester for final exams if they wanted to participate in the program. The hybrid delivery option allowed students to take theory courses online and laboratory courses on campus. This option also began in 2000. To expand the delivery area for hybrid students, HCC entered an agreement with Edison Community College (ECC) in Ft. Myers Florida. The agreement called for Edison (now Edison State College) to provide space for a laboratory and a room for students to receive live instruction from Tampa via compressed video. HCC provided the laboratory equipment and an onsite coordinator/instructor.

The goal from the beginning in 2000 was to provide online and hybrid delivery option students with an educational experience equivalent to campus-based students. HCC signed the agreement with the National Federation of Opticianry Schools and provided links to the course materials through a learning management system known as WebCT. A shell was created within WebCT for each of the 25 Opticianry courses in the campus-based curriculum. Relevant links to the NFOS materials were accessed by the students through WebCT. The faculty felt that to provide an equivalent experience, online students should have access to the same lectures that were presented to campus-based students. The faculty videotaped a lecturer for every unit of every course that was
offered. In 2000, WebCT did not have the capability to host streaming video and student internet connections would not support it. At the beginning of each semester, every online and hybrid student was mailed all the video tapes for the courses they were registered for. Students in the Ft. Myers area had the option of viewing their lectures live via a compressed video connection at Edison Community College.

Both new instructional delivery options were well received. Enrollment in the Opticianry program increased substantially in the first three years. By 2003 it was becoming almost impossible to produce and mail all the required video tapes. The program also was experiencing technical and scheduling problems connecting live to Edison Community College for all theory courses. The program began converting the video tapes to steaming video to be placed in WebCT. In the fall of 2004 all online and hybrid students began viewing their videos through WebCT. The compressed video connection to Edison was reduced to guest speakers and special events. Campus-based students were also given full access to WebCT. All Opticianry students, regardless of delivery method took their quizzes online. By 2005 most of the NFOS materials had been replaced by materials created by HCC faculty. From 2005 to 2012 (the cohorts in this study) the approach to instructional delivery has remained essentially unchanged. The curriculum consists of eleven theory courses, ten laboratory courses, and four clinical courses. Descriptions of the twenty five Opticianry courses can be found in Appendix B. Videos have been updated as content changes and technology improves. The same faculty members have taught the same courses during this time period. The faculty member teaches campus-based, hybrid and online students for the same course.
Alignment with equivalency framework. By providing students a proper balance of interactions and supports, learning experiences, and application experiences, the results indicate that the Opticianry program has allowed graduates to achieve equivalent outcomes regardless of delivery method. Both teacher determined (Grade Point Average, Certification Score) and learner determined (Job Preparedness, Program Quality) outcomes were found to be equivalent.

Through planning and by chance the development and delivery of the Opticianry program using campus-based, online and hybrid methods has contained many of the elements of the framework of equivalency in technician preparation. Responsive faculty provided interaction through face-to-face meetings, discussion board postings and e-mail. Sufficient student-instructor, student material, and student-student interaction in the three delivery methods has allowed students to achieve equivalent and effective outcomes.

Clear syllabi and informative videos have reduced the transactional distance described by Moore (1993) as “A psychological and communication space to be crossed, a space of potential misunderstanding between the inputs of the instructor and those of the learner” (p.22). As promoted in the equivalency theory of distance education proposed by Simonson, Schlosser and Hanson (1999), the Opticianry program has identified students by the course and not the instructional delivery method. The program used the same assessment methods and expected the same learning outcomes regardless of the instructional delivery method. The institution and instructors provided equivalent support for all students regardless of their physical location. For example, all quizzes are taken online and assignments are submitted online regardless of delivery method. Performance feedback is provided online and is equally accessible to all students.
Faculty office hours include “cyber hours” when off campus students can communicate live with their instructors.

The study outcomes lend support to Simonson, Schlosser and Hanson’s theory “If the distance education course is effectively designed, and equivalent experiences are available, then potential learners will reach the course’s instructional objectives” (p. 60).

The learning experiences in the Opticianry program take place primarily in the theory courses with the online video lectures mirroring the face-to-face lectures. The application experiences mostly occur during the student’s laboratory and clinical courses. The same competency checklists are used by both off campus mentors and on campus instructors. The learning and application experiences of the students during the program led to equivalent perceptions of program quality, job preparedness and certification exam results. The course design elements, recommended by Moore (1993), of presentation of instructional materials, support of learner motivation, stimulation of analysis and criticism, giving advice and counsel, arranging practice, application, testing and evaluation, and arranging for student creation of knowledge were structured to provide an equivalent experience.

**Implications for Practice and Further Research**

This study focused on a single program and a single occupation at a large community college in Florida. As such, although the results may not be generalizable to technician preparation in general, they provide evidence about the potential for achieving equal outcomes resulting from participation in online occupational programs. To that end, some suggestions for practice and further research were derived from the study.
Implications for practice. The results of the study provide support for the idea that it is possible to provide equivalent technician preparation using a variety of instructional delivery methods. The study adds to a limited body of knowledge about the impact of participation in online or hybrid courses compared to traditional courses in technical preparation. The outcomes provide support that distance education is a promising strategy for increasing access to adult learners seeking flexible opportunities for technical preparation. The results should also reduce the reluctance of institutions offering career and technical education programs, to offer complete programs via distance learning in fear that distance students will not achieve program outcomes equivalent to face-to-face students. The study has generated positive comparative evidence of student performance as a function of instructional method, and documented students’ evaluative perspectives about their occupational readiness and program quality.

The optical industry should recognize that a flexible, comprehensive training program for employees serving in roles less than an Optician is possible through distance education. Cooperative agreements with community colleges in their state can create new Opticianry programs with reduced costs for the business and the college. State Opticianry organizations now have a study they can share with community colleges considering starting a distance education Opticianry program. Community colleges may also be able to generalize some aspects of the study to other A.S. degree programs. Colleges with existing campus-based Opticianry programs can use the historical development of this program as a guide for their expansion into distance learning. The key to developing an online delivery option capable of providing equivalent outcomes is faculty and institutional commitment of time and resources.
Suggestions for further research. Several suggestions for further research were identified. The first would be to repeat the study with a larger population of graduates. The partial eta squared values for the seven SPSS analysis displayed small to medium effect sizes. The medium effect sizes may be predictive of significance in a study with a larger sample size. The hybrid delivery method would be of special interest in that even though it showed no significant difference, it had the greatest variance by age.

The second would be to look at the relationship between delivery method and program completion. Some studies have shown that the failed retention rate for online courses could be 10% to 20% higher than traditional face-to-face classroom courses (Herbert, 2006). Research is also needed on the comparison of technician preparation program completion rates for different instructional delivery methods and background characteristics.

A third area related to retention would be the impact of ancillary support on student graduation rates for online technician preparation programs. Graduates could also be surveyed on their perception of the quality of these support services.

A final area for further research would be to study the relationship between the quality of mentoring and student outcomes. Mentors are frequently highly qualified in their field but quite often do not have any formal training as a mentor. A comparative study of mentee performance based on mentor training would be beneficial. A related area of research would be a study of clinical performance across delivery methods.
References


Chen, Y. (2011). Notes from a lecture on multiple regression. EDF 7408 Statistical analysis of educational research II. Tampa, FL: University of South Florida.


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Giannoni, D., & Tesone, D. (2003) What academic administrators should know to attract senior level faculty members to online environments. Online Journal of Distance Learning Administration 6(1).


Appendices
Appendix A: Opticianry Graduate Survey

### Opticianry Graduate Survey Final Version 2013

1. What is your first name?

2. What is your last name?

3. What did you like most about the HCC Opticianry Program?

4. What did you like least about the HCC Opticianry Program?

### Instructional Delivery Method

Please indicate for each Opticianry course if you took it on-campus or off-campus

5. **OPT 1000 Ophthalmic Orientation**
   - On-Campus
   - Off-Campus

6. **OPT 1155 Ophthalmic Lens I**
   - Lens On-Campus
   - Off-Campus

7. **OPT 1156 Ophthalmic Lens II**
   - On-Campus
   - Off-Campus

8. **OPT 1400L Ophthalmic Laboratory I**
   - On-Campus
   - Off-Campus
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Location Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPT 1430L</td>
<td>Ophthalmic Laboratory II</td>
<td>On-Campus, Off-Campus</td>
</tr>
<tr>
<td>OPT 1460</td>
<td>Ophthalmic Dispensing I</td>
<td>On-Campus, Off-Campus</td>
</tr>
<tr>
<td>OPT 1460L</td>
<td>Ophthalmic Dispensing Laboratory I</td>
<td>On-Campus, Off-Campus</td>
</tr>
<tr>
<td>Ophthalmic Board Review</td>
<td></td>
<td>On-Campus, Off-Campus</td>
</tr>
<tr>
<td>OPT 2204</td>
<td>Anatomy &amp; Physiology of the Eye</td>
<td>On-Campus, Off-Campus</td>
</tr>
<tr>
<td>OPT 2375</td>
<td>Refractometry</td>
<td>On-Campus, Off-Campus</td>
</tr>
<tr>
<td>OPT 2375L</td>
<td>Refractometry Laboratory I</td>
<td>On-Campus, Off-Campus</td>
</tr>
<tr>
<td>OPT 2376L</td>
<td>Refractometry Laboratory II</td>
<td>On-Campus, Off-Campus</td>
</tr>
<tr>
<td>OPT 2461</td>
<td>Ophthalmic Dispensing II</td>
<td>On-Campus, Off-Campus</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>On-Campus</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------------</td>
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</tr>
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<td>18. OPT 2461L</td>
<td>Ophthalmic Dispensing Laboratory II</td>
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</tr>
<tr>
<td>19. OPT 2463L</td>
<td>Ophthalmic Skills Laboratory I</td>
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<tr>
<td>20. OPT 2500</td>
<td>Contact Lens Theory I</td>
<td></td>
</tr>
<tr>
<td>21. OPT 2500L</td>
<td>Contact Lens Laboratory I</td>
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</tr>
<tr>
<td>22. OPT 2501</td>
<td>Contact Lens Theory II</td>
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</tr>
<tr>
<td>23. OPT 2501L</td>
<td>Contact Lens Laboratory II</td>
<td></td>
</tr>
<tr>
<td>24. OPT 2502L</td>
<td>Contact Lens Laboratory III</td>
<td></td>
</tr>
<tr>
<td>25. OPT 2800L</td>
<td>Vision Care Clinical I</td>
<td></td>
</tr>
<tr>
<td>26. OPT 2801L</td>
<td>Vision Care Clinical II</td>
<td></td>
</tr>
</tbody>
</table>
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27. OPT 2802 Vision Care Clinical III
   - [ ] On-Campus
   - [ ] Off-Campus

28. OPT 2803L Vision Care Clinical IV
   - [ ] On-Campus
   - [ ] Off-Campus

29. OPT 2910 Directed Research
   - [ ] On-Campus
   - [ ] Off-Campus

### Instructional Quality

Please rate the overall instructional quality of the Opticianry program by indicating your degree of agreement with the following statements.

30. Instructors utilized class time effectively.
   - [ ] 4 = Strongly agree
   - [ ] 3 = Agree
   - [ ] 2 = Disagree
   - [ ] 1 = Strongly disagree

31. Students had the opportunity to ask questions.
   - [ ] 4 = Strongly agree
   - [ ] 3 = Agree
   - [ ] 2 = Disagree
   - [ ] 1 = Strongly disagree

32. Instructors encouraged me to participate in the courses.
   - [ ] 4 = Strongly agree
   - [ ] 3 = Agree
   - [ ] 2 = Disagree
   - [ ] 1 = Strongly disagree
33. Instructors motivated me to do my best work.
   ○ 4 = Strongly agree
   ○ 3 = Agree
   ○ 2 = Disagree
   ○ 1 = Strongly disagree

34. Instructors were enthusiastic when presenting course materials.
   ○ 4 = Strongly agree
   ○ 3 = Agree
   ○ 2 = Disagree
   ○ 1 = Strongly disagree

35. Instructors utilized a variety of teaching methods to help students learn.
   ○ 4 = Strongly agree
   ○ 3 = Agree
   ○ 2 = Disagree
   ○ 1 = Strongly disagree

36. Instructors presented material in a clear manner.
   ○ 4 = Strongly agree
   ○ 3 = Agree
   ○ 2 = Disagree
   ○ 1 = Strongly disagree

37. Instructors stimulated my thinking.
   ○ 4 = Strongly agree
   ○ 3 = Agree
   ○ 2 = Disagree
   ○ 1 = Strongly disagree
38. Instructors provided constructive feedback during the courses.
   - 4 = Strongly agree
   - 3 = Agree
   - 2 = Disagree
   - 1 = Strongly disagree

39. The course packs were helpful.
   - 4 = Strongly agree
   - 3 = Agree
   - 2 = Disagree
   - 1 = Strongly disagree

40. The courses were well organized.
   - 4 = Strongly agree
   - 3 = Agree
   - 2 = Disagree
   - 1 = Strongly disagree

41. The assignments helped me understand the course content.
   - 4 = Strongly agree
   - 3 = Agree
   - 2 = Disagree
   - 1 = Strongly disagree

42. The instructor's methods of evaluating my performance were fair.
   - 4 = Strongly agree
   - 3 = Agree
   - 2 = Disagree
   - 1 = Strongly disagree
43. Instructors were well prepared for each class.
   - 4 = Strongly agree
   - 3 = Agree
   - 2 = Disagree
   - 1 = Strongly disagree

44. I understood what was expected of me in the courses.
   - 4 = Strongly agree
   - 3 = Agree
   - 2 = Disagree
   - 1 = Strongly disagree

45. Instructors were readily available for consultation with students.
   - 4 = Strongly agree
   - 3 = Agree
   - 2 = Disagree
   - 1 = Strongly disagree

46. I felt comfortable asking for extra help from my instructors.
   - 4 = Strongly agree
   - 3 = Agree
   - 2 = Disagree
   - 1 = Strongly disagree

47. Instructors returned graded assignments in a timely manner.
   - 4 = Strongly agree
   - 3 = Agree
   - 2 = Disagree
   - 1 = Strongly disagree

48. Please share any additional comments about the quality of instruction you received.
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49. The use of a learning management system (Blackboard/WebCT) was very important for the courses I completed.
   ○ 4 = Strongly agree
   ○ 3 = Agree
   ○ 2 = Disagree
   ○ 1 = Strongly disagree

50. I felt comfortable using Blackboard/WebCT
   ○ 4 = Strongly agree
   ○ 3 = Agree
   ○ 2 = Disagree
   ○ 1 = Strongly disagree

51. The organization and sequence of Blackboard/WebCT was easy to navigate.
   ○ 4 = Strongly agree
   ○ 3 = Agree
   ○ 2 = Disagree
   ○ 1 = Strongly disagree

52. I had little or no difficulty completing class assignments in Blackboard/WebCT.
   ○ 4 = Strongly agree
   ○ 3 = Agree
   ○ 2 = Disagree
   ○ 1 = Strongly disagree

53. I had few technology problems when using Blackboard/WebCT.
   ○ 4 = Strongly agree
   ○ 3 = Agree
   ○ 2 = Disagree
   ○ 1 = Strongly disagree

54. Please share any additional comments about the instructional technology used in the program.

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Job Preparedness: General work habits and skills.

Please indicate to what extent the Opticianry Program prepared you in the following areas.

55. The ability to work in teams.
   - 4 = Very prepared
   - 3 = Somewhat prepared
   - 2 = Not well prepared
   - 1 = Not at all

56. Being motivated for success.
   - 4 = Very prepared
   - 3 = Somewhat prepared
   - 2 = Not well prepared
   - 1 = Not at all

57. The ability to meet deadlines.
   - 4 = Very prepared
   - 3 = Somewhat prepared
   - 2 = Not well prepared
   - 1 = Not at all

58. The ability to accept constructive criticism.
   - 4 = Very prepared
   - 3 = Somewhat prepared
   - 2 = Not well prepared
   - 1 = Not at all

59. The ability to solve problems.
   - 4 = Very prepared
   - 3 = Somewhat prepared
   - 2 = Not well prepared
   - 1 = Not at all
60. To have confidence in your abilities.
- 4 = Very prepared
- 3 = Somewhat prepared
- 2 = Not well prepared
- 1 = Not at all

61. The ability to make decisions when necessary.
- 4 = Very prepared
- 3 = Somewhat prepared
- 2 = Not well prepared
- 1 = Not at all

62. The ability to work independently.
- 4 = Very prepared
- 3 = Somewhat prepared
- 2 = Not well prepared
- 1 = Not at all

63. The ability to be organized.
- 4 = Very prepared
- 3 = Somewhat prepared
- 2 = Not well prepared
- 1 = Not at all

64. The ability to work with customers/patients.
- 4 = Very prepared
- 3 = Somewhat prepared
- 2 = Not well prepared
- 1 = Not at all
65. The willingness to work beyond "normal" working hours.
   - 4 = Very prepared
   - 3 = Somewhat prepared
   - 2 = Not well prepared
   - 1 = Not at all

66. The ability to work with matters concerning diversity (age, socio-economic class, race, gender, sexual orientation, religion, ability, etc.)
   - 4 = Very prepared
   - 3 = Somewhat prepared
   - 2 = Not well prepared
   - 1 = Not at all

67. Please share any additional comments about your ability to perform general work skills following graduation.

Job Preparedness: Communication skills.

Please indicate the extent to which the opticianry program prepared you in the following communication skills.

68. The ability to communicate verbally with peers.
   - 4 = Very prepared
   - 3 = Somewhat prepared
   - 2 = Not well prepared
   - 1 = Not at all

69. The ability to communicate verbally with customers/patients
   - 4 = Very prepared
   - 3 = Somewhat prepared
   - 2 = Not well prepared
   - 1 = Not at all
70. The ability to write clearly.
   ○ 4 = Very prepared
   ○ 3 = Somewhat prepared
   ○ 2 = Not well prepared
   ○ 1 = Not at all

71. The ability to use proper grammar.
   ○ 4 = Very prepared
   ○ 3 = Somewhat prepared
   ○ 2 = Not well prepared
   ○ 1 = Not at all

72. The willingness to ask for clarification.
   ○ 4 = Very prepared
   ○ 3 = Somewhat prepared
   ○ 2 = Not well prepared
   ○ 1 = Not at all

73. Developing listening skills.
   ○ 4 = Very prepared
   ○ 3 = Somewhat prepared
   ○ 2 = Not well prepared
   ○ 1 = Not at all

74. The ability to speak to groups of people.
   ○ 4 = Very prepared
   ○ 3 = Somewhat prepared
   ○ 2 = Not well prepared
   ○ 1 = Not at all
### Opticianry Graduate Survey Final Version 2013

#### 75. The ability to give constructive feedback to others.

- **4** = Very prepared
- **3** = Somewhat prepared
- **2** = Not well prepared
- **1** = Not at all

#### 76. Please share any additional comments about your ability to communicate following graduation.

... (Blank space for comments)

### Job Preparedness: Technical Skills

Please indicate the extent to which the opticianry program prepared you in the following technical skills.

#### 77. The ability to perform basic mathematical and algebraic operations.

- **4** = Very prepared
- **3** = Somewhat prepared
- **2** = Not well prepared
- **1** = Not at all

#### 78. The ability to demonstrate knowledge of the human eye structure, function and pathology.

- **4** = Very prepared
- **3** = Somewhat prepared
- **2** = Not well prepared
- **1** = Not at all

#### 79. The ability to determine facial measurements.

- **4** = Very prepared
- **3** = Somewhat prepared
- **2** = Not well prepared
- **1** = Not at all
80. The ability to neutralize eyewear/ophthalmic devices prescriptions.

- 4 = Very prepared
- 3 = Somewhat prepared
- 2 = Not well prepared
- 1 = Not at all

81. The ability to assess lifestyle needs of the customer/patient.

- 4 = Very prepared
- 3 = Somewhat prepared
- 2 = Not well prepared
- 1 = Not at all

82. The ability to assist the customer/patient in selection of proper frames and lenses.

- 4 = Very prepared
- 3 = Somewhat prepared
- 2 = Not well prepared
- 1 = Not at all

83. The ability to price and collect fees from customers/patients for ophthalmic goods and services.

- 4 = Very prepared
- 3 = Somewhat prepared
- 2 = Not well prepared
- 1 = Not at all

84. The ability to prepare ophthalmic laboratory job orders.

- 4 = Very prepared
- 3 = Somewhat prepared
- 2 = Not well prepared
- 1 = Not at all
<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
</table>
| **85. The ability to deliver prescription eyewear/ophthalmic devices and instruct customers/patients in use and care.** | 4 = Very prepared  
3 = Somewhat prepared  
2 = Not well prepared  
1 = Not at all                                                               |
| **86. The ability to maintain customer/patient records.**                | 4 = Very prepared  
3 = Somewhat prepared  
2 = Not well prepared  
1 = Not at all                                                               |
| **87. The ability to provide follow-up service to customers/patients, including periodic eyewear/ophthalmic devices adjustment, repair, lens and frame replacement.** | 4 = Very prepared  
3 = Somewhat prepared  
2 = Not well prepared  
1 = Not at all                                                               |
| **88. The ability to respond to customer/patient complaints.**           | 4 = Very prepared  
3 = Somewhat prepared  
2 = Not well prepared  
1 = Not at all                                                               |
| **89. The ability to apply rules and regulations for safe work practices.** | 4 = Very prepared  
3 = Somewhat prepared  
2 = Not well prepared  
1 = Not at all                                                               |
<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>The ability to understand the function of equipment.</td>
<td></td>
</tr>
<tr>
<td>91</td>
<td>The ability to utilize and maintain equipment.</td>
<td></td>
</tr>
<tr>
<td>92</td>
<td>The ability to demonstrate proficiency in finishing techniques.</td>
<td></td>
</tr>
<tr>
<td>93</td>
<td>The ability to assist in the business related area of opticianry, including record maintenance, frame and lens inventory, supply and equipment maintenance, and third party forms.</td>
<td></td>
</tr>
<tr>
<td>94</td>
<td>The ability to dispense and fit contact lenses and low vision aids.</td>
<td></td>
</tr>
</tbody>
</table>
95. The ability to discuss prescription eyewear/ophthalmic devices and other customer/patient related information (verbal and written) with the eye doctor.

- 4 = Very prepared
- 3 = Somewhat prepared
- 2 = Not well prepared
- 1 = Not at all

96. Please share any additional comments about your ability to perform technical skills following graduation.

Thank you for completing the survey!
Appendix B: HCC Opticianry Course Descriptions

OPT-1000
Ophthalmic Orientation
1 Credit
Presents an introduction to the field of vision care, including opticianry, optometry, ophthalmology and optical manufacturing. Topics include ophthalmic history, legal and ethical principles, patient history, terminology and abbreviations.
Credit for this course does NOT apply to the Associate in Arts degree.

OPT-1155
Ophthalmic Lens I
3 Credits
Provides a brief history of the development of glass and plastic lenses, the various sphere, cylinder and prism powers, the use of optical cross, flat and toric transposition, and the aberrations of lenses.
Credit for this course does NOT apply to the Associate in Arts degree.

OPT-1156
Ophthalmic Lens II
3 Credits
This course continues the study of optical theory.
Topics include: prism notation; vertical imbalance and methods of correcting for it; vertex power; luminance; reflection and absorption; diffraction; third-order lens aberrations, and lens tilt; anisometropia, and spectacle magnification.
Credit for this course does NOT apply to the Associate in Arts degree.

OPT-1400L
Ophthalmic Laboratory I
3 Credits
Introduces the student to terms, instruments, lenses, frames, and materials to be used in the surfacing and finishing of ophthalmic prescription eyewear.
Credit for this course does NOT apply to the Associate in Arts degree.

OPT-1430L
Ophthalmic Laboratory II
3 Credits
Introduces the student to terms, instruments, lenses, frames and materials to be used in the finishing process and handwork of ophthalmic prescription eyewear. This course is a continuation of Ophthalmic Laboratory I.
Credit for this course does NOT apply to the Associate in Arts degree.
OPT-1460  
Ophthalmic Dispensing I  
3 Credits  
This course introduces the student to the skills necessary for becoming a dispensing optician.  
Included are the history of the profession, patient/client measurements, frame and lens materials, frame and lens selection, prescription, prescription analysis, and adjustment techniques.  
Credit for this course does NOT apply to the Associate in Arts degree.

OPT-1460L  
Ophthalmic Dispensing I Laboratory  
3 Credits  
Designed to introduce the students to the practical dispensing of optical products. The students will perform competencies related to the neutralization of single vision lenses and multifocal lenses for duplication, measurement of frames and mountings, and the measurement of PD’s.  
Credit for this course does NOT apply to the Associate in Arts degree.

OPT-2030  
Ophthalmic Board Review  
1 Credit  
Provides a comprehensive review and update of opticianry dispensing in preparation for the Florida State Board of Opticianry examination.  
Credit for this course does NOT apply to the Associate in Arts degree.

OPT-2204  
Anatomy and Physiology of the Eye  
3 Credits  
Investigates the anatomical structure of the eye and the function of its parts as they pertain to the process of vision.  
Credit for this course does NOT apply to the Associate in Arts degree.

OPT-2375  
Refractometry  
2 Credits  
Designed to instruct the students in the theory of refractometry and testing for visual acuity. It will include identifying ametropias, the etiology and distribution of refractive errors and anomalies of binocular vision. The steps in performing retinoscopy, objective and subjective refraction procedures will be covered.  
Credit for this course does NOT apply to the Associate in Arts degree.
OPT-2375L
**Refractometry Laboratory**

2 Credits
Continuation of OPT 2375 designed to introduce the students to the procedures of an objective and subjective refraction. Students will perform competencies related to retinoscopy, patient history, binocular balance and subjective testing for visual acuity. Primarily a hands-on course. The students will gain practice in testing VA (cc and sc), retinoscopy, subjective refraction and binocular balancing in a clinically safe environment.

Credit for this course does NOT apply to the Associate in Arts degree.

OPT-2376L
**Refractometry Laboratory II**

1 Credit
Continuation of OPT 2375L. Designed to fine tune the procedures of objective and subjective refractions. Students will perform competencies related to measuring visual acuity and taking a patient history, retinoscopy (review), confrontations and EOM’s, pupillary functions, balance and binocular/phoria/tropia testing. Primarily a hands-on course to help the students gain speed and accuracy in performing objective and subjective refractions.

Credit for this course does NOT apply to the Associate in Arts degree.

OPT-2461
**Ophthalmic Dispensing II**

3 Credits
This course presents ophthalmic instruments and devices; analysis of absorptive lenses; computing and compensation of vertical imbalance; discussion of ethics and legal issues; record keeping and communications; optical salesmanship, and visual impairment.

Credit for this course does NOT apply to the Associate in Arts degree.

OPT-2461L
**Ophthalmic Dispensing II Laboratory**

3 Credits
Designed to introduce students to the practical aspects of frame alignments and adjustments, and the insertion and removal of lenses from various frames. Includes further instruction and practice on neutralization of lenses for verification and duplication of an Rx order, measure and calipering of lenses and frames, the facial measurements of orders (PD and seg heights), frame repair and the identification of various types of lenses.

Credit for this course does NOT apply to the Associate in Arts degree.
OPT-2463L
Ophthalmic Skills Lab I
2 Credits
This course is designed to educate students in the technical skills of performing various procedures within the ophthalmic visual assessment area of a dispensary. The course will present technical equipment procedures, maintenance and use, as well as the skills needed in assisting Optometrists and patients with various procedures such as administering medicines and pharmacology identification and uses.
Credit for this course does NOT apply to the Associate in Arts degree.

OPT-2500
Contact Lens Theory I
3 Credits
This course includes a historical review as well as theory; design and optical principle of contact lenses; indications and contraindications for contact lens wear; patient evaluation; discussion of lens types and availability; fundamental techniques and fitting philosophies including the role of the biomicroscope, keratometer and radiuscope; patient education on care, cleaning, insertion and removal of contact lenses.
Credit for this course does NOT apply to the Associate in Arts degree.

OPT-2500L
Contact Lens Theory I Laboratory
2 Credits
Students will perform competencies related to the handling of instruments and charts used in the fitting and designing of contact lenses. Also, the handling and evaluation of contact lenses by the fitter and the patient.
Credit for this course does NOT apply to the Associate in Arts degree.

OPT-2501
Contact Lens Theory II
2 Credits
Emphasizes contact lens verification, dispensing, and follow up care. The fitting of astigmatic, presbyopic, and special needs patients will also be covered.
Credit for this course does NOT apply to the Associate in Arts degree.

OPT-2501L
Contact Lens Theory II Laboratory
2 Credits
Students will perform competencies related to the design, inspection, modification, evaluation and dispensing of spherical contact lenses. The fitting of astigmatic, presbyopic, and other special contact lens patients will also be covered.
Credit for this course does NOT apply to the Associate in Arts degree.
**OPT-2502L**  
**Contact Lens Laboratory III**  
1 Credit  
Advanced hands-on experience in fitting contact lenses.  
Prerequisite: OPT-2501L  
Credit for this course does NOT apply to the Associate in Arts degree.

**OPT-2800L**  
**Vision Care Clinical I**  
2 Credits  
This course is designed to allow students to apply knowledge gained in lectures and laboratories to clinical situations. Depending on the placement, the student may utilize skills related to management, fabrication, dispensing, contact lenses or visual assessment.  
Credit for this course does NOT apply to the Associate in Arts degree.

**OPT-2801L**  
**Vision Care Clinical II**  
2 Credits  
This course is designed to allow students to apply knowledge gained in lectures and laboratories to clinical situations. Depending on the placement, the student may utilize skills related to management, fabrication, dispensing, contact lenses or visual assessment.  
Credit for this course does NOT apply to the Associate in Arts degree.

**OPT-2802L**  
**Vision Care Clinical III**  
2 Credits  
This course is designed to allow students to apply knowledge gained in lectures and laboratories to clinical situations. Depending on the placement, the student may utilize skills related to management, fabrication, dispensing, contact lenses or visual assessment.  
Credit for this course does NOT apply to the Associate in Arts degree.

**OPT-2803L**  
**Vision Care Clinical IV**  
2 Credits  
This course is designed to allow students to apply knowledge gained in lectures and laboratories to clinical situations. Depending on the placement, the student may utilize skills related to management, fabrication, dispensing, contact lenses or visual assessment.  
Credit for this course does NOT apply to the Associate in Arts degree.
OPT-2910
Directed Research

3 Credits

Covers the research, planning and development of an optical dispensary. Topics include the type, size, location and design, as well as financing, business structure, taxes, licenses and equipment.

Credit for this course does NOT apply to the Associate in Arts degree.
Appendix C: Institutional Review Board Approval Letter

April 10, 2013

William Underwood
Adult Career and Higher Education
Tampa, FL 33596

RE: Expedited Approval for Initial Review
IRB#: Pro00012042
Title: Examination of the Relationship of Community College Opticianry Student Outcomes with Instructional delivery Methods and Student Age.

Study Approval Period: 4/9/2013 to 4/9/2014

Dear Mr. Underwood:

On 4/9/2013, the Institutional Review Board (IRB) reviewed and APPROVED the above application and all documents outlined below.

Approved Item(s): Protocol Document(s):

Underwood Dissertation Proposal 2-22-13.docx

Please note data collection cannot begin until the HCC IRB letter is submitted thru the Amendment process.

Consent/Assent Document(s)*:

Adult Online Consent form granted a Waiver of Informed Consent Doc.

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent document(s) are only valid during the approval period indicated at the top of the form(s). (Consent forms granted a waiver are not stamped).

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories...
outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:

(5) Research involving materials (data, documents, records, or specimens) that have been collected, or will be collected solely for nonresearch purposes (such as medical treatment or diagnosis).

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Your study qualifies for a waiver of the requirements for the documentation of informed consent as outlined in the federal regulations at 45CFR46.117(c) which states that an IRB may waive the requirement for the investigator to obtain a signed consent form for some or all subjects.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval by an amendment.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

John Schinka, Ph.D.,
Chairperson USF
Institutional Review Board