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A COMPARISON IN ACADEMIC PERFORMANCE BETWEEN DISTANCE
LEARNING AND TRADITIONAL ON-CAMPUS STUDENTS IN ALLIED
HEALTHCARE EDUCATION AT THE MEDICAL COLLEGE OF GEORGIA

by

BARBARA LANDIS RUSSELL

(Under the Direction of Ababayehu Tekleselassie)

ABSTRACT

The primary purpose of this study was to determine the differences in academic performance between distance learning students and traditional on-campus students in allied healthcare education. The research was conducted at an academic medical university and three programs were included in the study, clinical laboratory science, health information administration, and nuclear medicine technology. A total of 252 sets of student data were used in the statistical analyses, and of these 252, 174 (69%) were on-campus students and 78 (31%) were distance students.

The researcher sought to determine to what extent differences existed between the two groups by the background characteristics of gender, age, and previous academic performance. The researcher found that there was no significant difference between the two groups for gender or previous academic performance. However, there was a significant difference in age between the two groups. Sixty-four percent of the on-campus students were 25-years-old or less, while 72% of the distance students were greater than 25-years-old.

Academic performance was compared between distance students and on-campus students using the final GPA scores and external certification scores. The researcher found no significant difference in final GPA scores or in certification pass rates between the distance learning students and on-campus students. The pass rate for on-campus students was 86% and the pass rate for distance students was 87%.

When the three programs were looked at individually, it was found that there was no significant difference in final GPA scores within the three programs. There was also no significant difference in certification scores between distance learning students and on-campus students for clinical laboratory science and health informatics. However, for nuclear medicine technology, there was a statistically significant difference ($p < .01$) between the two groups. The mean distance certification score was 76.62 for the distance students while the mean certification score for the on-campus students was 79.94.

INDEX WORDS: Distance learning, Distance education, Final GPA scores, Math science GPA scores, Internet education, Allied healthcare, Clinical laboratory science, Health information administration, Nuclear medicine technology, Academic performance comparison studies

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B.S., Medical College of Georgia, 1991

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DOCTOR OF EDUCATION

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DEDICATION

I wish to dedicate this dissertation to my husband, Jerry Russell, who loves me and supports me in all of my endeavors; to Sandee Hooker, my sister, advisor, and best friend; to Bertha Landis, my mother and my champion; to my children Ben Adkins, Beth Adkins, and Jessica Russell; and in loving memory to my twin sister, Bonnie Counts, who was my defender and my better half.

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CHAPTER 1

INTRODUCTION

Distance learning is now being offered as a method of degree obtainment by many two-year and four-year higher education institutions (Waits & Lewis, 2003). The technologies incorporated into the distance learning environment have made it possible for students to attend higher education institutions that were in the past prohibited, due to relocation constraints. However, there are many differences between distance learning and traditional on-campus learning. Therefore, it is important that researchers conduct comparison studies to determine if the quality of distance learning programs is equivalent to the quality of traditional on-campus programs.

Distance Learning in Higher Education

Carrière and Harvey (2001) defined distance learning as an educational environment where the teacher and learner are separated in space and/or time. Distance learning is not a pedagogical phenomenon of recent origin. Its roots can be traced back to the 19th century. Sumner (2000) characterized the growth of distance learning into three generations. The first generation was correspondence study. The first recognized correspondence course in shorthand was offered in England in 1840. Later in the 19th century, correspondence courses were offered in the modern languages and in courses in preparation for university entrance. At the end of the century, correspondence courses were instituted at universities in Canada, America, and in other European countries.

The second wave of distance learning, the multimedia distance education, incorporated broadcast media and cassettes along with print material. The growth of the

multimedia stage was attributed to the Open University of the United Kingdom. The Open University began in 1969 and used the above mentioned media to lift distance learning to a new level. Even though new technologies were being used, by the end of the 1980s, print material was still the main media used in distance learning (Sumner, 2000).

The third generation of distance learning was identified by Sumner (2000) as the computer: mediated distance education. Technology incorporated into the computer: mediated generation included the internet and the World Wide Web (Sumner, 2000). Courses were created using synchronous and/or asynchronous technologies (Stewart & Wright, 2004). Video conferencing (Miller & King, 2003), audio conferencing, electronic mail, videotapes, audiotapes, and print materials were also incorporated (Sheppard & Mackintosh, 1998). Swisher and Mandich (2002), stated that various types of media can be incorporated into these distance environments to meet the educational objectives of the course. Educational technologies have advanced at a rapid pace and distance learning, via only printed material through correspondence courses, may well be a thing of the past.

In the 2000-2001 academic year, the National Center for Education Statistics reported that 56% of all two-year and four-year degree granting educational institutions offered distance learning courses. In this same academic year, private institutions were less likely to offer distance learning courses as opposed to public institutions. Of these public institutions, 90% of two-year schools and 89% of four-year schools were involved in distance learning. In the same academic year, there were 3,077,000 students enrolled in distance learning courses at two-year and four-year institutions. Two-year and four-year higher education institutions are offering entire programs by distance learning. Among

the 56% that offered distance learning in the academic year 2000-2001, 34% designed educational programs that could be taken entirely through distance learning (Waits & Lewis, 2003).

Distance learning in higher education is in its infancy and the current and future capabilities of this medium as a replacement for traditional classroom education has yet to be determined. Researchers have found that there are many issues that must be addressed before distance learning can be successful. These issues are, problems with technology (Andrusyszyn, Soeren, Laschinger, Goldenberg, & DiCenso, 1999; Crowley et al., 1999), feelings of isolation (Rodger & Brown, 2000; Swisher & Mandich, 2002), ineffective communication (Ali, Hodson-Carlton, & Ryan, 2004), lack of face-to-face interactions (Rovai & Barnum, 2003), not enough technology support (Lee, 2002), and faculty time commitment (Ryan, Hodson-Carlton, & Ali, 2004).

Another concern of researchers is distance learning students' academic performance. Researchers have attempted to determine if there are any student characteristics that may influence academic success (Cheung & Kan, 2002; Alstete & Beutell, 2004). Researchers have also compared course grades (Collins & Pascarella, 2003), retention rates (Naidr, Adla, Janda, Feberová, and Hladíková, 2004), and certification scores (Crowley, 1999; Freeman, 1995), of distance learning students to their traditional on-campus counterparts. Studies have been performed on distance learning students in general education courses, professional courses, and healthcare courses.

Age, gender, entrance examination results, and previous academic achievement are some of the characteristics that have been studied to determine what type of students perform best in the distance learning environment. Some researchers have found that

women performed better in a distance learning environment when compared to men (Cheung & Kan, 2002; Alstete & Beutell, 2004), while other researchers found that there was no relationship between gender and academic performance (Barakzai & Fraser, 2005). Cheung and Kan (2002) found no relationship between student age and academic performance. In contrast, Alstete and Beutell (2004) found a significant positive relationship between students' ages and grades received in online courses offered in a Masters in Business Administration program.

The relationship between previous academic performance and distance learning academic performance has also been studied by researchers. Alsete and Beutell (2004) found a significant positive relationship between undergraduate GPA and grades received in online courses. Bearden, Robinson, and Deis (2002) also found that students with lower GPAs did not perform as well as traditional on-campus students with the same GPA in a dental hygiene nutrition course.

There is abundant research comparing the academic performance of distance learning students to the academic performance of students who received their education in the traditional on-campus environment. Bernard et al. (2004) stated that this type of comparative research has continued to increase even though there are prominent voices within the field that have stated that there has been enough comparative research on distance learning. However, Bernard et al. stated that comparative research is useful because distance learning is growing at a phenomenal rate. Consequently, colleges and universities are competing for the worldwide market that this type of technology has created. Bernard et al. (2004) stated that researchers needed to design studies that

administrators and policymakers can use to determine whether distance learning can be a successful alternative for traditional on-campus education.

Educators of nursing (Jairath & Stair, 2004) and allied health programs have incorporated distance learning into their curriculums (Stewart & Wright, 2004). In the past, distance learning was not seen as a viable alternative for the traditional on-campus instruction that is used for the education of healthcare practitioners. However, due to the shortage of nurses (Ali et al., 2004) and some allied healthcare workers (Crowley et al., 1999; DiBartola, Miller, & Turley, 2001; Williams, 2004) within the United States, distance learning is now being considered as a possible solution. Some hold that distance learning will help alleviate many of these healthcare professional shortages (Ali et al., 2004; Crowley et al., 1999).

Researchers have compared the academic performance of distance learning students to that of traditional on-campus students in healthcare education (Beadern, Robinson, & Deis, 2002; Crowley et al., 1999; Duffy, Gilbert, Kennedy, & Kwong, 2002; Freeman, 1995; Jedlicka, Brown, Bunch, & Jaffe, 2002). Some researchers found that there was no significant difference on test scores between distance learning students and traditional on-campus students (Beadern, Robinson, & Deis, 2002; Jedlicka et al., 2002). Other researchers discovered that distance learning students outperformed their on-campus counterparts on academic evaluations (Gallagher, Dobrosielski-Vergona, Wingard, & Williams, 2005; Crowley et al., 1999; Duffy et al. 2002).

Researchers have also studied retention rates for distance learning students in healthcare education. Naidr, Adla, Janda, Feberová, and Hladíková (2004) found that health information administration students that were enrolled in a medical informatics

course via distance retained as much of the material as students in traditional classrooms. Gallagher et al. (2005) found that the retention rates for dental hygiene students were higher for those in web-based courses as compared to those in traditional courses.

The academic performance, retention rates, student perceptions, faculty perceptions, and various educational technologies have all been studied in distance healthcare education. In addition, there have been a few studies conducted that compares certification or licensing examinations scores for students who obtained their degree via distance learning to students that received the traditional on-campus education. Freeman (1995) compared learning styles and learning outcomes for medical technology students enrolled in distance learning to students who received traditional didactic lectures. Freeman used a quasi-experimental design to measure these outcomes and the experimental group, the students at the distance sites, received their didactic lectures via interactive video-teleconferencing for one semester. During the one semester, eight examination scores were compared for both groups and at the completion of the program the scores the students received on the American Society for Clinical Pathology (ASCP) Board of Registry examination were compared. Freeman found no significant difference in ASCP registry exam scores for the two groups. However, it is not clear from the research whether the medical technology students received their didactic lectures via distance for the entire program or for just one semester.

Crowley et al. (1999) also stated that there was no significant difference in ASCP examination results for students that had received their education via distance as compared to those that had received the traditional on-campus education. However, the students enrolled in the distance program were students that had obtained a previous

degree as medical laboratory technicians. These students were compared to students that may or may not have had any previous clinical laboratory education.

Bearden et al. (2002) compared dental hygiene students enrolled in an on-line nutrition course to those that had received the nutrition course on-campus. The researchers compared the two groups by examining the distance and on-campus students' scores on nutrition questions on the National Board Dental Hygiene Examination (NBDHE). Bearden et al. found that there was no significant difference on the nutrition NBDHE questions between the two groups.

One study was found that compared the scores received on the national board examinations between dental hygiene students that had received their entire education via distance to dental hygiene students that had received the traditional on-campus education. Olmsted (2002) analyzed the NBDHE scores for five classes of students. The researcher found that there was no significant difference on the national board examinations for the two groups, distance versus traditional on-campus. Furthermore, Olmsted found no difference between the two groups in grades earned for core curriculum courses and in grade point averages.

Researchers have shown that there are certain student characteristics that impact students' academic performance in the distance learning environment. Age, gender, and previous academic performance are some of the characteristics that have been reported as having an effect on academic success. Other researchers have found that these characteristics have no impact on student academic success. In academic performance comparison studies, researchers have discovered that distance learning students perform better than their on-campus counterparts while others have found no significant

difference between the two groups, and some have found that distance learning students perform more poorly when compared to on-campus students.

Statement of the Problem

The academic performance of distance learning students is a concern for many faculty, administrators, professional organizations, and accrediting agencies of distance learning courses and programs. For this reason, researchers have compared the academic performance of distance learning students to their traditional on-campus counterparts. Researchers have also attempted to determine what student characteristics influence student academic performance. Researchers have performed meta-analyses on the research data available and have concluded that there is great variation in the types of studies performed and the outcomes of these studies. However, as a whole, the researchers have found that the academic performance of distance learning students is comparable to that of traditional students.

Distance learning for the acquisition of course credits is now a common event in higher learning. In addition, many programs, including healthcare education programs, are now offering their entire curriculums via distance learning. Researchers have performed studies that compare distance learning students to their traditional counterparts however; very few studies have compared the academic performance and student characteristics of students who have obtained their entire degree through distance learning to those that have obtained their degree in the traditional setting. In addition, there has been very little research performed that compared certification or licensing scores from external agencies of distance learning students to their on-campus counterparts. Consequently, there is little known about how distance learning students

function as first-time practitioners when compared to those that obtained their degree in face-to-face campus settings.

Distance learning in allied healthcare education is now a reality for many of its disciplines. Entire programs are now being offered via distance. However, little research has been conducted that attempts to discover how distance learning programs compare to traditional on-campus programs. Therefore, the researcher's purpose was to determine the differences in academic performance between distance learning students and traditional on-campus students in allied health care education.

Research Questions

The researcher intended to answer the following research question: What are the differences in academic performance between the two groups of students, distance learning students versus traditional on-campus students? The researcher used the following subquestions to answer the main research question:

1. To what extent do the two groups, distance learning students and traditional on-campus students, differ by the background factors of gender and age.
2. To what extent do the two groups, distance learning students and traditional on-campus students, differ by previous academic performance (overall admission GPA, and math/science admission GPA).
3. To what extent does academic performance (final GPA and external certification examination pass rates) differ between distance learning students and traditional on- campus students?

4. To what extent does academic performance (final GPA and external certification examination scores) differ between distance learning and traditional on-campus students within the specific programs of clinical laboratory science, health information administration, and nuclear medicine technology?

Significance of the Study

This research study can be used by administrators and educators of allied health care programs who are considering offering or who are currently offering distance learning programs. Administrators and educators are required to evaluate and report their programs' outcomes to their respective accrediting bodies. An allied healthcare program's continuing accreditation is dependent on the successful acquisition of these outcomes. Academic success is one outcome that allied healthcare administrators are required to report to their respective accrediting body. Therefore, it is imperative that administrators and educators consider student academic success when determining the efficacy of offering or continuing to offer a distance learning allied healthcare program. The data from this research has provided insight into the academic success of the two groups of students, distance learning and traditional on-campus learning, and allied healthcare administrators and educators can use this research in their evaluation process.

Researchers have performed studies to determine if there are certain student characteristics that can predict student academic success. This research determined what students characteristics, if any, were predictors of student academic success in allied healthcare programs. Data obtained from this research can be used by healthcare education admission committees in determining what students characteristics, such as

minimal overall and math/science admission GPA scores, should be considered in the admission process.

This research is significant to practicing managers of allied healthcare professions in determining the quality of distance learning students and traditional on-campus students. Determining certification pass rates of allied healthcare graduates is one measure of academic success. Most students begin working as healthcare practitioners before they have completed their national certification examinations. Healthcare managers invest time and money orienting these new graduates in the workplace. Therefore, it is important to these managers that their new graduates pass their national certification examinations so they can continue to practice.

This research makes a significant contribution to the distance learning literature. Very little research has been published that compares the performance of students that have obtained their entire allied healthcare degree through distance learning to traditional on-campus students. In addition, the researcher found very few studies in which the certification scores were measured as an indicator of academic success when comparing distance learning students to traditional on-campus students. This research fills a void in the literature and also provides a foundation for future research on distance learning in allied healthcare education.

This findings of this research project is important for the investigator who holds a position as a Program Director in an allied healthcare program, Clinical Laboratory Science. As a program director in an allied healthcare program, the researcher must ensure that the graduating students, who have obtained their degree through distance learning or through traditional on-campus education, are academically successful and one

measure of academic success is to determine students' certification pass rates. In addition, if there are student characteristics that influence academic success, the researcher may consider using these potential predictors of academic success in the admission process. The investigator, as program director, is responsible for ensuring student academic success in the distance learning programs and for this reason research on distance learning needs to be performed to determine student academic success for this form of educational delivery.

Procedure

Creswell (1994), described quantitative research as a method to inquire about a human problem by testing variables. Variables of interest can be numerated and then analyzed through statistical procedures. A quantitative research procedure allows the researcher to make generalizations about the research questions being studied. A researcher will use a quantitative design to determine differences in the dependent variable between two or more groups or to determine a relationship between independent and dependent variables. In this study, the researcher used a quantitative research design to determine if there were differences in academic performance between traditional on-campus students and distance learning students. In addition, analyses were performed to determine if the two groups differed by the background characteristics of gender and age, and by previous academic performance as measured by overall admission GPA and math/science admission GPA. A quantitative research design best answered these research questions and allowed the researcher to determine if there were differences in distance learning students and traditional on-campus students in allied healthcare education.

The population of interest in this study was allied healthcare students that had graduated from programs that were offering their curriculums by traditional on-campus learning and distance learning. The researcher collected student data from three allied healthcare programs at the academic medical university, the Medical College of Georgia. The three allied healthcare programs that were used in this study were clinical laboratory science, health information administration, and nuclear medicine technology.

Existing data were collected from two groups of students, those that have received their education in the traditional on-campus setting and those that received their education through distance learning. The dependent variable, academic achievement, was measured by comparing final GPA scores and certification pass rates of distance and on-campus students who were enrolled in allied healthcare programs. The data on final GPA scores were collected from the academic institutions' registrar. The certification examination data used in this study were received from each disciplines respective certifying agency. The certification examination results were sent to each program director and the certification scores were collected from the three program directors for clinical laboratory science, health information administration, and nuclear medicine technology. The certifying examinations that were used in this study are the American Society for Clinical Pathology (ASCP) Board of Registry examination for clinical laboratory scientists, Registered Health Informatics Administrator examination (RHIA) for health information administrators, and Nuclear Medicine Technology Certification Board Examination (NMTCB) for nuclear medicine technologists.

The student background factors that were measured in relation to academic success were gender and age. The data collected to determine previous student academic

success were the overall admission GPA and math/science admission GPA. Gender, age, overall admission GPA, and math/science admission GPA were collected from the institution's admission database.

The data collected were analyzed to discover if student characteristics impacted student academic success. Descriptive statistics were performed to determine the demographics of the students included in the study. To answer the first research question, the differences in background characteristics the Chi-square statistical analysis was used. The two-sample *t*-test analysis was used to answer the second research question on differences in previous academic performance. The statistical analyses for the third and fourth research questions were the Chi-square and the two-sample *t*-test.

Delimitations

The researcher limited the study to clinical laboratory science, health information administration, and nuclear medicine technology and the data were collected from one medical university. Therefore, the findings can not be generalized to other allied healthcare programs or to other medical universities. Also, students that have graduated from the distance learning programs and the on-campus program may or may not have had previous education or experience in their respective areas.

Limitations

The findings from this study reflected the differences in academic performance between distance learning students and traditional on-campus students from three allied healthcare programs at the Medical College of Georgia. Potential predictors of academic success were studied. The three allied healthcare programs included in this research were

clinical laboratory science, health information administration, and nuclear medicine technology. Due to this, the study had the following limitations:

1. Students were not randomly assigned to the distance learning groups or the traditional on-campus group. Their assignment to the learning environment was by preference. Therefore, this is not an experimental study and a cause and effect relationship can not be determined from these data.
2. Educational researchers have determined that socioeconomic status (SES) does have an impact on academic success. However, these data were not available to the researcher.
3. Not all students will take the certification examination upon graduation. For this reason, certification examination data were not available on all students included in the study.

Definition of Terms

For the purpose of this study, the following terms are defined as follows:

1. Allied healthcare programs – educational programs that educate students for allied healthcare professions. Allied health care practitioners provide healthcare to patients through the delivery of health or through health related services (The Association of Schools of Allied Health Professions, 2006).
2. American Society for Clinical Pathology (ASCP) Board of Registry – the certifying agency for clinical laboratory scientists (American Society for Clinical Pathology, 2006a).

3. Certification examinations – “is the process of initially recognizing individuals who have satisfied certain standards within a profession” (The American Registry of Radiologic Technologists, 2006, ¶ 7).
4. Clinical Laboratory Scientist – an allied health care professional that performs laboratory tests that are used in the diagnosis and treatment of disease and in the maintenance of health (Medical College of Georgia, 2005).
5. Distance learning – an educational environment where the instructor and student are separated by space and/ or time (Carrière and Harvey, 2001).
6. Health Information Administrator – an allied healthcare professional that manages information in the healthcare delivery system (Medical College of Georgia, 2006a).
7. Math science grade point average – the grade point average of the math and science courses taken at an accredited college or university prior to admission into the allied healthcare program (Medical College of Georgia, 2006b).
8. Nuclear Medicine Technologist – an allied healthcare professional that prepares and administers radiopharmaceuticals and performs patient imaging (Medical College of Georgia, 2006c).
9. Nuclear Medicine Technologists Certification Board – the certifying agency for nuclear medicine technologists (Nuclear Medicine Technologists Certification Board, 2006a).
10. Overall grade point average – the grade point average of all courses taken at an accredited college or university prior to admission into the allied healthcare program (Medical College of Georgia, 2006b).

11. Registered Health Informatics Administrator examination – the certification examination administered by the American Health Information Management Association for health information administrators (American Health Information Management Association, 2006a).

Summary

Many higher education institutions are offering distance learning as a means of degree attainment. Nursing and allied healthcare education programs are also offering first professional degrees through distance learning. Research has been performed that compared distance learning students' academic performance to that of traditional on-campus students. However, little research has been performed that determined how allied healthcare distance learning students' academic performance compared to that of their traditional on-campus counterparts. In addition, few research studies have been performed in allied health that studied student characteristics as potential predictors of academic success.

This purpose of this study was to determine the differences in academic performance between distance learning students and traditional on-campus students in allied health care education. Differences in academic performance, as measured by final GPA scores and external certification scores, were measured. The researcher also determined the differences in student background characteristics and previous academic performance between the two groups of students, distance learning and traditional on-campus.

This study fills a void in the literature and forms the basis for future research in distance learning allied healthcare education. The findings of this research can be used by

administrators, educators, and practicing allied healthcare practitioners when determining the quality of distance learning in allied healthcare.

CHAPTER 2

REVIEW OF RELATED LITERATURE

Distance learning programs can reach large audiences at long distances and can increase enrollments (Farrior & Gallagher, 2000). Investigators have explored many aspects of distance learning environments and have researched many of the issues that should be considered when using distance learning as a means of educational delivery. Crowley et al. (1999) found that there were administration issues, technology issues, communication issues, and problems with finding clinical internships sites. Miller and King (2003) found that there were low completion rates with distance education students, with as many as one-third of the students dropping-out before completing the class. The high dropout rate was attributed to “lack of feedback; feelings of isolation; frustrations with the technology; anxiety; and confusion” (p. 286). Cuellar (2002) found that the cons of on-line courses were increased time commitment, cost, and lack of support for online learning and teaching. However, Cuellar also identified many positive outcomes, such as, increased flexibility, no geographical barriers, personalized learning, and collaboration and interactions among students.

In addition to the positive and negative issues listed above, there is also the concern of student academic success in the distance learning environment. The purpose of this study was to determine to what extent distance learning students and traditional on-campus students differed in academic achievement in allied healthcare education. A comparison between the two groups of students, distance learning and traditional on-campus students, was also performed to determine how the groups differed on background characteristics and previous academic performance. The objective of this

chapter is to present an overview of the recent research that has occurred in distance learning. The areas that have been addressed in this chapter are the background characteristics and previous academic performance of distance learning students' related to academic success, academic performance comparative studies in non-medical distance education, and distance learning in healthcare education.

Characteristics and Previous Academic Performance

Students' background characteristics have been studied by researchers as predictors for academic success. If certain student characteristics truly impact academic success in distance learning environments then these predictors could be used as advisement tools when counseling students in whether to attempt an allied health program in the distance learning environment. In addition, previous academic performance can be used by admission committees as criteria for admittance into distance learning programs. In this research, the student background characteristics and previous academic performance indicators that will be studied are gender, age, overall admission GPA, and math/science admission GPA.

Gender

Gender has been considered a student characteristic that may have an impact on academic achievement in the distance learning environment. Cheung and Kan (2002) discovered that gender was significantly correlated to student academic achievement in the distance learning environment. The authors were not sure why women outperformed men, but hypothesized that it could have been because the women put more effort in to the course than the men did. In addition, the authors noted that the course studied was a business communication class and women typically perform better than men in these

types of courses as opposed to math and science courses where men traditionally outperform women.

Alstete and Beutell (2004) studied gender in relation to academic achievement in distance undergraduate and graduate business management courses. Interestingly, they found that gender was related differently to academic success in undergraduate and graduate courses. The researchers found that women in the undergraduate courses were more active participants than men in the distance courses through the use of discussion board postings; however, there was no relationship between gender and overall course performance at this level. Women also participated more than men in discussion board activities at the graduate level; however, at this level, Alstete and Beutell (2004) did discover that gender was significantly related to overall course performance, because women outperformed their male counterparts in the distance learning courses studied.

Brown and Liedholm (2002) found conflicting relationships between gender and academic performance in three learning environments; traditional live courses, hybrid courses, and virtual courses. The researchers determined that females performed significantly worse than men in the live environment. In the hybrid and virtual course environments, they found the relationship between the female variable and academic performance to be slightly negative however, the relationship was not significant.

Gender has also been studied as a predictor of academic performance in healthcare education. Barakzai and Fraser (2005) studied the relationship between gender and academic performance in 290 students enrolled in advanced healthcare practitioner courses at three universities. The researchers determined that women as a group scored

higher than the men did, however, they found no statistically significant difference between men and women and academic performance.

Age

The demographic characteristics of higher education institutions have changed greatly over the past 20 years. In 2001, 18-22 year-old students that lived on-campus and attended school full-time accounted for only 16% of the total college student enrollment. In the 1980s and 1990s, there was a large influx of students over the age of 25 who were female, and who were working and going to school part-time (Levine, 2001). Due to the large age ranges of students attending higher education, many researchers have focused their research on how age and academic performance are related. Cheung and Kan (2002) found that there was no relationship between age and student performance in distance learning courses. They postulated that this could be due to the fact that most of the students in their study were working adults and more mature than the traditional college student.

Alstete's and Beutell's (2004) research findings conflicted with those reported by Cheung and Kan (2002). Alstete and Beutell found that age was significantly related to academic performance. They also found that older students participated more in discussion board activities and that discussion board activities were positively and significantly related to final course grades. These researchers noted that younger students may not be ready to handle the independent learning that must occur in the distance learning environment and that this could be a reason they do not perform as well as older students. The researchers also stated that older students have more work experience and

that this could be an intimidating factor for the younger students which may inhibit them from becoming involved in discussion threads.

Age as an academic performance indicator has also been researched in allied healthcare education. Bearden, Robinson, and Deis (2002) compared traditional and distance learning students' academic performance in a nutrition course in dental hygiene. The researchers found that there was no significant difference between the mean age of each group, traditional versus distance, and the academic performance measured by the final course grade for each group. In addition, they found no relationship between age and pre-course GPA, and age and National Board Dental Hygiene Examination (NBDHE) certification scores.

Previous Academic Performance

Baccalaureate and masters level programs in allied health sciences require certain prerequisites for entrance into the programs. For this reason, the successful completion of prerequisites is an important consideration in allied healthcare education. Many prerequisites are offered through distance learning, therefore, researchers have attempted to determine if these types of courses adequately prepare students for the higher level courses. Dominguez and Ridley (2001) performed a study to determine whether students who had taken on-line prerequisite courses were as prepared for the advanced courses as students who had taken the prerequisites on-campus. The researchers found that there was no significant difference in the scores of students in an advanced course between those that had taken the prerequisite on-line as compared to the students that had taken the traditional on-campus prerequisite.

Students typically admitted to allied healthcare programs have at least two years of previous college work. This previous coursework can be used as a predictor of academic success in allied healthcare programs. Academic success in previous courses, GPAs, and standardized tests scores have been studied by researchers to determine how these variables impact academic achievement. Cheung and Kan (2002) reported that previous academic performance in foundational business level courses was related to success in a distance learning business course. These researchers found that there was a significant positive correlation between student performance and previous academic achievement. Alstete and Beutell (2004) also considered previous academic achievement in relation to academic performance. However, these researchers found that there was no relationship between Scholastic Aptitude Test (SAT) scores and undergraduate students' academic performance in distance learning management and human resource management courses. In addition, they found that there was no relationship between high school GPA and academic performance. Conversely, Alstete's and Beutell's findings were in concordance with that of Cheung and Kan (2002), in that they found that there was a significant positive correlation between undergraduate GPA and academic performance in the distance learning masters level management courses.

Brown and Liedholm (2002) also associated GPA with academic success. They studied three different learning environments and determined how previous GPA predicted success on an examination that the students took at the end of the course. The three learning environments that were compared consisted of a live course, a hybrid course that had both live and virtual class time, and a virtual course. They found that an

increase of one point in pre-course admission GPA led to an increase in 15 points on the end-of-course examination in all three learning environments.

A study that was performed in allied healthcare education related mean cumulative GPA on admission to certification pass rate. McNeill and Brockmeier (2005) found a positive correlation between admission GPA and the percentage of students passing the RHIA certification examination at 46 accredited health information programs. However, the researchers did not discuss whether any of these programs were offered through distance learning. Another research study in allied health education performed by Bearden, Robinson, and Deis (2002), discovered that distance students with a high pre-distance course GPA, 3.4 or above, outperformed those students on-campus with the same GPAs. Conversely, distance students with a low pre-distance course GPA performed less satisfactorily than their on-campus equivalents. Due to this, the researchers concluded that colleges and universities should consider using admission criteria, such as GPA scores, for admittance into distance learning courses.

Academic Performance Comparative Studies

Researchers have performed comparative studies that evaluated the types of learning environments, traditional versus distance education. Investigators have also compared synchronous learning and asynchronous learning environments in distance learning. In addition, media, pedagogical principles, and methodologies in distance learning have been compared in research studies. Hundreds of researchers focused their research on these distance learning concepts. For this reason, researchers have attempted to synthesize the abundant research published by performing meta-analyses.

An extensive meta-analysis was performed by Bernard et al. (2004), to determine the effectiveness of distance education. The review included 232 comparative studies that were performed between the years of 1985 and 2002. Independent achievement, attitude, and retention were compiled and analyzed from comparative research. The researchers noted that there was extreme variability in all the constructs measured. This implied that some researchers reported that distance education worked extremely well while other researchers reported that it worked very poorly. However, Bernard et al. (2004) found that those students in distance education had slightly higher overall achievement than those in traditional classrooms. Furthermore, achievement was higher for those students in an asynchronous learning environment as opposed to those in a synchronous learning environment. Students in a synchronous distance setting preferred traditional classroom instruction more than those students in an asynchronous setting. However, the retention rate was lower in the asynchronous setting as opposed to the synchronous distance education setting (Bernard et al., 2004).

Another meta-analysis of more than 500 manuscripts was performed by Allen et al. (2004). These researchers showed similar results to that found by Bernard et al. (2004), in that students in distance education courses performed slightly better than those in on-campus courses. However, in contrast to the Bernard et al. (2004) findings, Allen et al. (2004) concluded that there was no difference in student performance between the synchronous and asynchronous learning environments. These researchers also found a relationship between course content and success in distance learning environments. The researchers concluded that there was no difference in academic performance between distance learning students and on-campus students in natural science courses and

education courses. However, they discovered that students enrolled in military-related instruction had lower performance in distance learning courses when compared to on-campus courses. Even though the researchers investigated different types of course content, healthcare education was not mentioned in this meta-analysis.

Healthcare education was identified as one content variable in a meta-analysis performed by Zhao, Lei, Yan, Lai, and Tan (2005). This meta-analysis was performed on 51 journals articles and the authors focused their examination on previous distance education studies to determine how different variables of the distance education research affected learning outcomes reported in the research. The factors that were determined by the authors to have a possible influence on the outcomes of distance education studies were the publication year, instructor as author, instructor involvement, status of the instructor, teacher training for teaching distance education courses, content area, instructional level of the student, interaction type between students and teacher, and the media used. Overall, the researchers found that there was no difference in outcomes between distance and face-to-face instruction. However, as Bernard et al (2004) and Allen et al. (2004) discovered, there was great variability in the effect size.

Zhao et al. (2005) attempted to explain the variation in effect size by examining the different factors that may influence the outcomes reported in distance education publications. They found that the research published before 1998 showed no significant difference in outcomes while research published in or after 1998 found that distance education was more effective. If the instructor was the author, distance education was reported as more effective. If the students had a high school diploma then distance education was reported as more effective while no difference was found if the students

already had a college degree. When the researchers examined content area in relation to outcomes, they found that those researchers that focused their comparison studies on business, computer science, and medical science courses found that distance education was more effective than traditional face-to-face education. In social science and science courses there was no difference between distance learning and traditional face-to-face education, however, face-to-face education was found to be slightly more effective in military, mathematics, and specific skill courses. However, there were only a few studies included in this meta-analysis that examined medical science, skills, military, and only one study focused on mathematics. For this reason, caution must be taken when attempting to interpret this data.

Even though there are researchers that have performed meta-analyses in an attempt to make sense of the abundant research performed on comparative studies of distance learning and traditional on-campus learning, there are important publications, that are not meta-analyses, which are relevant and need to be included in this overview. One such publication by Collins and Pascarella (2003), was a research project that compared three groups of students enrolled in a firefighting tactics and strategy course. The researchers utilized an experimental and quasi-experimental design to determine whether students enrolled in a two-way interactive course would perform as well as students in the traditional on-campus face-to-face course. Also compared were students that had self-selected the telecourse. The researchers found that the self-selected telecourse group performed better than the two randomized groups. The randomized telecourse and on-campus group participants performed equally on both the pre-test and post-test. Collins and Pascarella concluded that researchers that attempt to compare self-

selected distance learners to their on-campus counterparts may have confounded their findings due to the significant differences in the groups with which they began. This group of self-selected students scored two standard deviations above the randomized groups on the pre-test, they had more postsecondary credits, and previous fire science credits. More of the self-selected students were trained as emergency medical technicians and more were certified fire fighters. All of these variables led to a self-selected group with more experience and knowledge than the two randomly formed groups.

Many researchers have found that there is no difference in the academic performance of distance learning students and traditional on-campus students. Others have found that distance learning students out perform their traditional on-campus counterparts. However, other researchers have found that distance learning was a poor substitute for the face-to-face interaction that occurs in the traditional classroom. Brown and Liedholm (2002) studied how different learning environments impacted students' academic performance. This research included over 700 students enrolled in three different learning environments; traditional live courses, hybrid courses which contained both live and virtual classes, and virtual courses taught entirely through distance technology. The researchers found that students enrolled in the virtual courses performed significantly worse on examinations than the students enrolled in the live courses. More importantly, they found that the questions that the virtual students performed more poorly on were those that required the student to apply basic concepts to more complex matters. In other words, the students in the live courses performed significantly better on questions that required a higher level of thinking than the students in the virtual courses.

Distance Learning in Healthcare Education

Educators of allied healthcare programs are faced with the decision as to whether to change their traditional pedagogical practices. Healthcare educational courses have traditionally been taught with face-to-face interaction between the instructor and students. With this form of educational delivery, the student must travel to the instructor's classroom. The technological advances of the late 20th and early 21st century have developed to the extent that this is no longer necessary. Through the use of technology, the students are able to stay where they live and work and attend classes through a distance learning environment. Students who have not traditionally been able to relocate to a university or campus now have the opportunity to receive their desired degree or continuing professional education while remaining in their home community.

Research has been performed that has evaluated the need for distance learning in healthcare education. Mathur, Stanton, and Reid (2005) evaluated the need of distance learning continuing education (CE) for Canadian physical therapists. Canada's population distribution and geographic barriers make it difficult for physical therapists to obtain the CE that is needed to maintain their licenses. For this reason, the researchers believed that distance education would be of great value to those individuals. Seventy-eight percent of all Canadian physical therapists were interested in computer-assisted learning as a means of obtaining CE.

Distance learning in healthcare education has presented educators with many unique challenges not previously realized in the traditional learning environment. Researchers have explored many of these challenges that have arisen from this form of educational delivery with the hope that these challenges can be met and overcome. One

challenge that has been addressed by many researchers is student academic performance in the distance learning environment. Researchers have used comparative studies to determine if there are any differences in traditional on-campus and distance learning environments. In healthcare education, these comparative studies include first professional degree education.

Distance Learning for Degree Obtainment

Distance learning is being utilized to educate first-time healthcare practitioners. Research has been performed that demonstrates the effectiveness of such an endeavor. Farrior and Gallagher (2000), evaluated dietetic students' perceptions of their own performance, the instructor evaluations of students performances, and the students' opinion of the instruction received in four distance education courses. There was no formal method to evaluate the distance students to their on-campus counterparts. However, the instructor of one course taught both the on-campus and distance courses and observed that the performance of the distance students was as good as or better than the traditional students. The students opinions of the instruction were measured by an on-line questionnaire and were rated from 1 to 7, where 1 was strongly disagree and 7 was strongly agree. Responses to most questions ranged from 6 to 7. This indicated that the students were pleased with the instruction received and they held that distance education was an effective tool for the courses taught. Negative comments were received in regards to technological difficulties (Farrior & Gallagher, 2000).

Instructional outcomes are used by researchers when determining student academic performance. Instructional outcomes that can be measured include test scores, projects, discussion postings, skills, final course grades, final GPAs and certification

scores from external agencies. Gallagher, Dobrosielski-Vergona, Wingard, and Williams (2005) performed research to determine if there was a difference in instructional outcomes between dental hygiene distance students and dental hygiene traditional on-campus students. The instructional outcomes measured by the researchers were letter grades on assignments, a case study project, two examinations, and the final course grade. The researchers discovered that the distance students scored significantly higher on the graded assignment, the second exam, the case study, and the final grade. This led the researchers to ascertain that the distance students had greater success than the traditional students in realizing the course objectives. The researchers found that the students in the web-based course realized significantly higher instructional outcomes than the traditional on-campus students (Gallagher et al., 2005).

Buckley (2003) studied students' academic performances and perceptions in nursing nutrition courses utilizing three different learning environments. The learning environments included were traditional on-campus classes, web-enhanced courses that included web-based instructional materials and live classes, and the third environment utilized only web-based modules. Academic performance was measured by the midterm and final examination scores. The researcher found that there was no difference in student academic performance between the three groups, however, the students in the web-based course were the least satisfied with the course. The highest satisfaction scores were received from those in the web-enhanced course.

Technical skills, as an instructional outcome, can be difficult to teach in a distance learning environment. The majority of researchers have focused their research on academic performance measured by the acquisition of knowledge and not by the

measurement of technical skills. However, one group of researchers attempted to determine academic performance, measured by the evaluation of technical skills and didactic material learned, in the distance learning environment. An experimental study was conducted by Bello et al. (2005), to determine whether the academic performance of graduate physicians in an anesthesiology and intensive care residency program would differ between traditional class-room based courses and internet-based courses. Academic performance was measured by evaluating knowledge gained and practical skills. The researchers found that there were no significant differences in knowledge gain between the two groups of students, and that the on-line method was effective for teaching both procedural and technical skills.

Researchers have also compared distance learning methods. Jedlicka, Brown, Bunch, and Jaffe (2002) compared the distance learning methods of two-way interactive video, chat rooms, and independent learning for occupational therapy students. The outcomes studied were the student examination scores and perceptions of these three learning methods. The researchers found that there was no significant difference in mean examination scores between the three groups. Seventy-seven percent of the students preferred the two-way interactive video over the other two methods. The students believed it was helpful to have face-to-face communication with the instructor, however the negative aspects were video freezes, audio problems, and some felt the spontaneity was missing from the interactive video method.

Knowledge Retention

Allied health researchers have been concerned with the knowledge retention rates of distance learners. Naidr, Adla, Janda, Feberová, and Hladíková (2004) performed a

study to measure students' knowledge retention rates from a distance education health information administration course taken the previous year. The results were compared to a test given at the completion of the course. The researchers found that the retention rate at one-year was 67%, which was comparable to the knowledge retention rates experienced with students in traditional classrooms. They also found that there was a significant positive correlation between retention rate and whether the student liked the on-line course more than the traditional classroom and between the numbers of hours spent weekly with the computer. Gallagher et al. (2005), also studied retention rates. Retention was measured at six months after completion of a gerontology course and was determined by a 20 multiple choice review test. The researchers determined that knowledge retention rates were higher for dental hygiene students in the web-based course than those in traditional course. Eighty-nine percent of the web-based students answered 75% to 95% of the questions correctly while only 64% of the on-campus students answered questions correctly in that range.

Comparison of Final GPAs and Certification Scores

One important measure of academic success utilized by an allied healthcare program director is successful completion of the program, measured by the final GPA. Another important measure of academic success utilized by both program directors and accrediting bodies to determine if healthcare educational programs are graduating competent first-time practitioners is successful completion of the external certification examinations. Some researchers in healthcare education have performed research comparing final GPAs and/or certification scores between distance learning students and traditional on-campus students. Bearden, Robinson, and Deis (2002) performed a

statistical analysis comparing dental hygiene students' grades in on-line and on-campus nutrition courses and their performance on nutrition questions on the National Board Dental Hygiene Examination. Researchers found that there was no significant difference in the academic performance of online versus on-campus students. This included the students' course averages, their pre-course GPAs, and their scores on the national board examinations.

Crowley et al. (1999) performed outcome studies on a Bachelor of Science articulation program for clinical laboratory technicians. Clinical laboratory technicians have previous education and work experience in the clinical laboratory. The academic performances of 27 distance learning students were compared to their traditional on-campus counterparts. The researchers found that the pass rate on the national certifying examination was higher with the distance education students as compared to their on-campus counterparts. The distance students had a 96% pass rate on the certification examination which was higher than the 80% pass rate for the on-campus students during the same time frame. However, the comparison did not include specific scores that the students received, it only included whether the student passed or failed the certification examination. In addition, the clinical laboratory technicians had previous laboratory experience, in contrast, the traditional on-campus students may or may not have had any previous laboratory experience.

Freeman (1995) studied academic performance and learning styles in clinical laboratory science students enrolled in a distance learning course utilizing interactive video-teleconferencing. Forty students were included in the quasi-experimental research study to determine if learning styles and delivery method had an impact on student

academic performance. Academic performance was measured by eight objective-based examinations and national certification scores. The researcher found that there was no significant difference in clinical laboratory scientist students' examination course scores and ASCP national certification scores for distance learning utilizing interactive video teleconferencing as compared to traditional on-campus methods. She also determined that there was no significant difference in examination scores and learning styles. However, it is not clear from the research if the entire program was offered by distance or just one course.

Researchers that have compared certification scores have typically focused their research on certain components of the certification exam or they have only offered one or two of the core curriculum courses by distance. However, one research study was found that compared the certification scores and final GPAs of distance learning students who had taken their entire program through distance learning to traditional on-campus students. Olmsted (2002) studied five consecutive classes of dental hygiene students to determine how they performed on the national board examinations. A total of 115 distance students were compared to 105 traditional on-campus students. The researcher found that there was no significant difference in scores on the national board examination, core curriculum courses, and final GPAs between the two groups of students. The researcher also found that there was a strong correlation for both distance learning and on-campus students between GPA scores and national board examination scores.

Summary

Distance learning is an area of great interest to many researchers. There is a tremendous amount of published research on distance learning and researchers have

studied many of the issues that are encountered in the distance learning environment. The issues addressed have included student and faculty perceptions of distance learning, technological and administrative issues encountered in the distance learning environment, student characteristics that impact student success in distance learning, and the overall academic performance of distance learning students. Researchers have also studied distance learning in undergraduate and graduate education, in general and professional education, and in healthcare education. This research project was undertaken to determine how the academic performance of distance learning students in allied healthcare education compared to that of their on-campus counterparts. For this reason, the literature was examined and chosen for this review if the researcher focused on distance learning student background characteristics and previous academic performance and how these factors influenced academic success; if the study was a distance learning comparative study in general or professional education; and if the researcher studied distance learning in healthcare education.

Student background characteristics and previous academic performance have been studied by researchers to determine if these factors can be used as predictors for academic success. Some researchers found that gender, age, and admission GPA significantly impacted academic success while others have found no relationship between these variables. Comparative studies have also been performed to determine if distance learning students performed as well as their traditional on-campus counterparts. Again, there is great variability in the research findings. Some researchers found that student academic performance was better in the distance learning environment while other researchers found that there was no difference in academic performance between distance

learning and traditional on-campus learning. In addition, some researchers discovered that distance learning students performed more poorly than their on-campus counterparts and consequently, the distance learning students did not perform as well as on-campus students on questions that required higher level thinking.

Distance learning has also been incorporated into healthcare education. Researchers that have performed studies in healthcare education distance learning have reported varying results. One measure of academic performance in healthcare education is student certification pass rates. Studies have been performed that compares certification pass rates, however, only one research study was found that compared the certification scores of distance learning students who had taken their entire degree through distance to traditional on-campus students' certification scores.

CHAPTER 3

METHODOLOGY

This objective of this chapter is to outline the methods that were used to conduct this study. The sections included in this chapter are the introduction, research questions, the research design, population, sample, instrumentation, the data collection procedures, the data analysis procedures, and a summary.

Introduction

The purpose of this study was to determine the differences in academic performance between distance learning students and traditional on-campus students in allied healthcare education. This research included three allied healthcare programs, clinical laboratory science, health information administration, and nuclear medicine technology that utilized distance learning as a method of degree attainment. Differences between the two groups, distance learning and traditional on-campus, were also determined to discover how the groups differed on student background characteristics and previous academic performance.

Research Questions

The researcher intended to answer the following research question: What are the differences in academic performance between the two groups of students, distance learning students versus traditional on-campus students? The researcher used the following subquestions to answer the main research question:

1. To what extent do the two groups, distance learning students and traditional on-campus students, differ by the background factors of gender and age?

2. To what extent do the two groups, distance learning students and traditional on-campus students, differ by previous academic performance (overall admission GPA and math/science admission GPA)?
3. To what extent does academic performance (final GPA and external certification examination pass rates) differ between distance learning students and traditional on-campus students?
4. To what extent does academic performance (final GPA and external certification examination scores) differ between distance learning and traditional on-campus students within the specific programs of clinical laboratory science, health information administration, and nuclear medicine technology?

Research Design

Gall, Gall, and Borg (2003) defined quantitative research as the ability to explain aspects of an objective reality “by collecting numerical data on observable behaviors of samples and by subjecting these data to statistical analysis” (p. 634). Creswell (1994) also stated that variables of interest can be studied by performing statistical analyses. Researchers will then use these analyses to determine differences in variables in an attempt to answer their research questions. Gall, Gall, and Borg (2003) stated that another term used for quantitative research is positivist research. This means that the researcher will take an objective stance towards the research and not become involved in the research setting or with the participants. The researcher will also study samples of populations in relation to certain variables and will collect numerical data that can then be analyzed through the use of statistical tools. This data will then be used in an attempt to generalize the research findings to a defined population.

Gall, Gall, and Borg (2003) stated that causal-comparative research designs are used by researchers in an attempt to explain educational phenomena. This design is a nonexperimental investigation in which researchers seek to identify cause-and-effect relationships by forming groups of individuals in whom the independent variable is present or absent-or present at several levels-and then determining whether the groups differ on the dependent variable. (p. 296)

In the causal-comparative research design the independent variable is not manipulated in order to observe its effect on the dependent variable. In addition, a critical factor of this type of research design is that the independent variable is measured in categories (Gall, Gall, and Borg, 2003).

The researcher of this study used a quantitative causal-comparative research design. The researcher used pre-existing numerical data in an attempt to determine if there were differences in academic performance between two groups of students, distance learning and on-campus students. The independent variable was the program, distance learning or traditional on-campus, in which the students received their education. The dependent variable was student academic performance, and this was measured by the student's final GPA score and external certification score. One other aspect of this study was to determine if there were differences between the two groups on student background characteristics and previous academic performance. The researcher used an independent variable that was measured by categories and it was not manipulated. In addition, numerical data were collected for comparison of groups. For these reason, the researcher determined that a quantitative causal-comparative research design would best answer the research questions.

Population

The population of interest in this study was students that had graduated from allied healthcare programs at an academic medical university. The programs the students graduated from offered both distance learning and traditional on-campus learning for degree obtainment. The allied healthcare programs that were included in this research project were clinical laboratory science, health information administration, and nuclear medicine technology. These data obtained from this population of students provided the data needed to determine if there were any differences in academic performance between the two groups.

Sample

Existing data were collected from two groups of students, those that have received their education through distance learning and those that received their education through traditional on-campus learning, in allied healthcare programs at the Medical College of Georgia. A convenience sample is described as a sample that is collected because it is easily accessible to the researcher and one that fits the purpose of the study (Gal, Gall, & Borg, 2003). The researcher used a convenience sample to collect data from three allied healthcare programs that offered both distance learning and traditional on-campus programs concurrently.

The sample size was ascertained by determining what years the three programs had graduated distance learning students. If no distance students graduated in a particular year than that year was excluded from the study. A total number of 78 distance students and 174 traditional on-campus students were included in the study. The following information is a breakdown of the total sample from the following programs:

1. The clinical laboratory science program graduated distance learning students in 1995, 1996, 1997, 1998, 2002, 2004, and 2005. There were a total of 42 distance learning students and 113 on-campus students.
2. The health information administration program graduated distance learning students in 2005 and 2006. There were 14 distance learning students and 17 on-campus students.
3. The nuclear medicine technology program graduated distance learning students in 2002, 2003, 2004, and 2005. There were a total of 22 distance learning students and 44 on-campus students.

Existing data were collected from the academic medical center's admission database for gender, age, race, overall admission GPA scores, and math/science admission GPA scores of the students included in the study. The registrar's database was utilized to collect the students' final GPA scores. Each disciplines' program director had the data on the students' external certification scores. The researcher obtained Institutional Review Board (IRB) approval from Georgia Southern University and from the academic medical center where the research study was being conducted.

Instrumentation

Student external certification scores were collected and used in the study as a measure of the dependent variable, academic performance. The three external certifying bodies that were used were the American Society for Clinical Pathology Board of Registry (ASCP) for clinical laboratory science, the Registered Health Informatics Administrator examination (RHIA) for health information administration, and the

Nuclear Medicine Technology Certification Board Examination (NMTCB) for nuclear medicine technology.

ASCP Board of Registry

The ASCP Board of Registry is a criterion-referenced examination. This examination is used to measure the competencies defined for clinical laboratory scientists. Before 2003, the examination consisted of six sections: blood bank, urinalysis and other body fluids, chemistry, hematology, immunology, and microbiology. The examination was broken down into the following percentages: blood bank 20%, urinalysis and other body fluids 10%, chemistry 20%, hematology 20%, immunology 10%, and microbiology 20%. A laboratory operations component was a part of the exam but was included in each of the six sections (American Society for Clinical Pathology, 2000).

In 2002, the Joint Generalist Examination Committee of the ASCP Board of Registry modified the examination and made laboratory operations a separate category. Beginning in 2003, the examination subtests with percentages were blood bank 19%, chemistry 19%, hematology 19%, microbiology 19%, immunology 9%, body fluids 9%, and laboratory operations 6% (American Society for Clinical Pathology, 2006c).

Annually, the Joint Generalists Examination Committee divides questions in the examination pool into their subject areas. These questions are then reviewed by content specialists in the subject areas and all test item images are reviewed for clarity and accuracy. When new questions are added to the pool they are field tested for one year before appearing on the examination (American Society for Clinical Pathology, 2006b).

The ASCP certification examination is administered by a computerized adaptive test (CAT) format. The examination consists of 100 questions and each examinee is administered a unique set of questions. The Rasch model has been used to calibrate each question for difficulty. The first question that the examinee receives has a difficulty level that is near or at the pass cutoff point for the examination. If the examinee answers the question correctly, the individual's next question is more difficult. If the examinee answers the question incorrectly, an easier question is presented. The examinee is required to answer all 100 questions. Once the questions have been answered, the examinee is allowed to review and change answers to any questions (Sekula-Wacura & Brito, 2000).

The examinee has 2 hours and 30 minutes to take the 100 question exam. Each examinee takes a different form of the examination and a scaled score is statistically derived from the raw score. The scaled score makes the tests comparable (American Society for Clinical Pathology, 2006d). The minimum passing score for the ASCP Board of Registry examination is 400. The minimum scaled score is 100 and the maximum scaled score is 999 (ASCP personal communication, January 25, 2006).

Registered Health Informatics Administrator Examination (RHIA)

The American Health Information Management Association (AHIMA) sponsors the Registered Health Information Administrator certification (RHIA). AHIMA has contracted with Thomson Prometric, an independent testing agency, to help develop, administer, and score the RHIA certification examination (American Health Information Management Association, 2006b).

The examinee is given four hours to take a 180 question examination. Of the 180 questions, 160 are scored items and 20 are pretest items. The examination is based on a specific set of competencies. The competencies were determined through a job analysis. From these competencies, five domains were developed. The five domains with percentages are: Health Data Management 25%, Health Statistics, Biomedical Research and Quality Management 10%, Health Services Organization and Delivery 20%, Information Technology and Systems 20%, and Organization and Management 25% (American Health Information Management Association, 2006b).

Thomson Prometric performs a technical, psychometric, and language review of the questions in the test bank. The tests are then constructed and an item analysis is performed. Each test is reviewed to ensure that it is psychometrically balanced so that every examination has the same level of difficulty, the same number of questions, and the takes the same amount of time to take (Thomson Prometric, 2006).

The examination is computer-administered. The passing score is the minimum number of questions that must be answered correctly to pass the test. An Angoff procedure is used to set the minimum passing score. This is a psychometric procedure that uses content experts to estimate the passing probability for each question. The passing score before September 30, 2005 was 102 out of 160. The passing score beginning in October 2005 was 103 out of 160 (American Health Information Management Association, 2006b).

Nuclear Medicine Technology Certification Board Examination (NMTCB)

The NMTCB examination was created to provide a certification examination for nuclear medicine technologists that represented their current practice and covered their

entire scope of practice. The NMTCB contracted with the American College Testing (ACT) program to develop and administer the examination. The NMTCB provides a competency based criterion-referenced certification examination (Nuclear Medicine Technology Certification Board, 2006b).

The NMTCB certification examination is based on a comprehensive task analysis. This task analysis defines the tasks that the nuclear medicine technologist would be expected to perform their first year of practice. Four domains were defined through the task analysis. The domains with the following test percentages are: Radiation Safety 15%, Instrumentation 20%, Clinical Procedures 45%, and Radiopharmacy 20% (Nuclear Medicine Technology Certification Board, 2006b).

The NMTCB Board of Directors writes a large percentage of the test items along with NMTCB certificants. The Board of Directors review all of the test items for appropriateness, accuracy of the content, potential for bias, quality of images, and for psychometric issues (Nuclear Medicine Technology Certification Board, 2006b).

The NMTCB utilizes a computer adaptive testing (CAT) methodology for the administration of the certification examination. This examination is given on a computer and the program adapts to the knowledge level of the student. In other words, if the student answers the questions significantly above or below the passing rate they will receive fewer questions. If a student's knowledge level is not clearly determined by their question responses then he or she will receive more questions to determine their knowledge level. In addition, the questions are given in random order, and no two students who are taking the exam at the same time will receive the same questions (Nuclear Medicine Technology Certification Board, 2006b).

A criterion-reference standard is used by the NMTCB to ensure that all examinees received a consistent standard of competency. This means that whether the student passes or fails the examination depends on how the student performs on the set of questions the student receives. The examination stops when either of the following three events have occurred, when a minimum number of questions has been administered and the computer determines that a passing or failing score has been obtained, the maximum number of questions have been answered, or when the maximum time limit has been met. The maximum number of questions that a student may receive is 90 and the maximum amount of time for the test is 1 hour and 45 minutes (Nuclear Medicine Technology Certification Board, 2006b). The passing score for the examination is 75% (B.R. Dawadi personal communication, May 18, 2006).

Data Collection

The following is a step by step procedure of how the data were collected, following IRB approval, for this study:

1. The researcher obtained a list of distance learning graduates and traditional on-campus students from each disciplines' program director.
2. The researcher then requested from the registers office the gender, age, race, overall admission GPA, and the math/science admission GPA on each student on the list.
3. The researcher then requested from the registrar's office the final GPA of each student.
4. The next step was to obtain the student's external certification score from their respective program director.

5. These data were then entered in to the Statistical Package for Social Scientists software program (SPSS) for analyses.

Data Analysis

Various statistical tools were used to answer the research questions. However, to begin with, descriptive statistics were used to describe the demographic characteristics of the sample. Sprinthall (2003) defined descriptive statistics as describing data and Gall, Gall, and Borg (2003) stated that descriptive statistics are mathematical techniques that are used for summarizing numerical data.

To answer research question number one, which was to determine to what extent the two groups, distance learning students and traditional on-campus students, differed by the background factors of gender and age, the researcher used the Chi square analysis. For age, two groups were formed. One group were those students that were less than or equal to 25-years-old and the other group were those students that were greater than 25 years-old. For research question two, which was to determine how the two groups differed on previous academic performance, a two-sample *t*-test was used.

The independent variable in this study was how the program was administered, through distance learning or through traditional on-campus methods. The independent variable was categorical. The variables of gender and age were also categorical. For this reason, the statistical method used was the Chi square. The Chi square is a nonparametric analysis that is a test of significance. This analysis allowed the researcher to determine whether frequency differences within the groups differed significantly from what was expected (Sprinthall, 2003).

For differences in previous academic performance, research question two, a two-sample *t*-test was used. The two-sample *t*-test allows a researcher to make a probability statement as to whether two samples represent a single population. To use the two-sample *t*-test the two groups must be independent of each other (Sprinthall, 2003). In addition, the dependent variable must be in the form of interval or ratio data (Gall, Gall, and Borg, 2003). In this research, the independent variable, distance learning or traditional on-campus learning, was categorical and the two groups were independent of each other. The variables of overall admission GPA and math/science admission GPA were ratio data. The researcher also determined in research question two, if there was a significant difference between the two groups. For these reasons, the two-sample *t*-test best answered research question two.

In research question three, the researcher determined if there were significant differences in academic performance between the two groups of students, distance learning and on-campus. Academic performance was determined by comparing final GPA scores and external certification pass rates between the two groups. A two-sample *t*-test was utilized first to determine if there was a significant difference in final GPA scores between the two groups. A Chi-square test was then used to determine if there was a significant difference in the certification pass rates between the two groups of students.

Research question four was similar to research question three in that the researcher determined if there were differences in academic performance between the two groups of students. However, in question three, all three programs of clinical laboratory science, health information administration, and nuclear medicine technology students was grouped together in the analyses. In question four, the analyses were

performed within the specific fields. In other words, there were separate analyses performed for each discipline. The statistical analysis used was the two-sample *t*-test. The final GPA scores and the certification scores were compared to determine if there were differences in academic performance between the distance learning and traditional on-campus students.

Summary

The researcher's main purpose was to determine if there were differences in academic performance between two groups of students, distance learning and traditional on-campus students. The population in this study was allied healthcare graduates at an academic medical center that were utilizing either distance learning or traditional on-campus learning for degree obtainment. The sample was obtained from three allied healthcare programs that offered both distance learning and traditional on-campus learning for degree obtainment. The programs that were included in this study were clinical laboratory science, health information administration, and nuclear medicine technology.

The researcher chose a quantitative causal-comparative research design to answer the research questions. The independent variable was the program in which the student received their education, either by distance learning or by traditional on-campus learning. The dependent variable was academic performance.

Pre-existing data were utilized in this study to answer the research questions. The first and second research questions were developed to determine if there were differences in background characteristics and previous academic performance between the two groups of students. A third research question was used to determine if there were

differences in academic performance, which was measured by the students' final GPA scores and external certification pass rates, between the two groups. The fourth research question was to determine if there were differences in academic performance between the distance learning students and on-campus students within the specific disciplines.

After the researcher received IRB approval, the preexisting data were collected. The researcher obtained a list of distance learning and traditional on-campus students that had graduated from each of the three programs. The researcher then requested from the admissions office the gender, age, overall admission GPA, and math/science admission GPA. The researcher then collected the final GPA of each student from the registrar. External certification scores were requested from each disciplines' program director. Once all of the data were collected and entered into the SPSS software program, the statistical analyses were performed.

The data analyses consisted of two statistical tests. The Chi-square test was used to determine if there were any differences in gender and age between the two groups of students. The two-sample *t*-test was used to determine if there were any differences between previous academic performance, measured by overall admission GPA and math/science admission GPA, between the two groups. The two-sample *t*-test was also used to determine if there were any differences between the two groups in academic performance, measured by final GPA scores. Differences in academic performance, measured by the external certification pass rates, was determined by using the Chi-square test. The final analyses that was performed was to determine if there were differences in academic performance between distance learning and on-campus students in the separate

disciplines of clinical laboratory science, health information administration, and nuclear medicine technology. To perform these analyses the two-sample t -test was used.

CHAPTER 4

REPORT OF DATA AND DATA ANALYSIS

The purpose of this study was to determine the differences in academic performance between distance learning students and traditional on-campus students in allied healthcare education. In addition, the researcher also determined if there were differences in the two groups on student background characteristics and previous academic performance.

Three allied healthcare programs that utilized distance learning as a means of degree obtainment at the academic medical center, the Medical College of Georgia, were included in this research study. The allied healthcare programs included were clinical laboratory science, health information administration, and nuclear medicine technology.

Research Questions

The primary purpose of this study was to determine the differences in academic performance between distance learning students and traditional on-campus students in allied healthcare education. Additionally, the researcher sought to determine if there were any differences between the two groups in student background characteristics and previous academic performance. With these purposes in mind, the researcher focused on the following research questions:

1. To what extent do the two groups, distance learning students and traditional on-campus students, differ by the background factors of gender and age?

2. To what extent do the two groups, distance learning students and traditional on-campus students, differ by previous academic performance (overall admission GPA and math/science admission GPA)?
3. To what extent does academic performance (final GPA and external certification examination pass rates) differ between distance learning students and traditional on-campus students?
4. To what extent does academic performance (final GPA and external certification examination scores) differ between distance learning and traditional on-campus students within the specific programs of clinical laboratory science, health information administration, and nuclear medicine technology?

Research Design

The researcher utilized a quantitative causal-comparative research design. Pre-existing data were used to determine if there were any differences in academic performance between the two groups of students, distance learning and on-campus students. The independent variable was the program offered either distance or traditional on-campus. The dependent variable was the academic performance of the two groups of students. Academic performance was measured by the students' final GPA scores and scores on the external certification examination. The researcher also compared differences in the two groups on gender, age, and previous academic performance, which was measured by overall admission GPA and math science admission GPA.

Sample Demographics

Three allied healthcare programs were included in this study, clinical laboratory science, health information administration, and nuclear medicine technology. Student

Table 1
Frequency Distribution for Age

Variable	n	Valid %	Cumulative %
16-20	13	5%	5%
21-25	121	48%	53%
26-30	42	17%	70%
31-35	31	12%	82%
36-40	22	9%	91%
41-45	11	4%	95%
45-46	8	3%	98%
51-55	4	2%	100%
Total	252		

Table 2
Frequency Distribution for Race

Variable	n	Valid %	Cumulative %
White	160	64%	64%
African American	64	25%	89%
Asian	25	10%	99%
Hispanic	3	1%	100%
Total	252		

data were collected from the years that had both distance learning and traditional on-campus student graduates. Clinical laboratory science graduated distance learning students in 1995, 1996, 1997, 1998, 2002, 2004, and 2005. A total of 155 students graduated during these seven years which accounted for 62% of the total sample. One hundred and thirteen of the 155 students (73%) were on-campus students and 42 (27%) were distance students. Health information administration graduated distance learning students in 2005 and 2006. A total of 31 students graduated during these two years which accounted for 12% of the total sample. Of these 31 students, 17 (55%) were on-campus students and 14 (45%) were distance students. Nuclear medicine technology graduated distance students in 2002, 2003, 2004, and 2005. A total of 66 students graduated during these four years which was 26% of the total sample. Forty-four (67%) of the 66 students were on-campus students and 22 (33%) were distance students. Therefore, the total sample size was 252 students, and 174 (69%) were on-campus students and 78 (31%) were distance students.

Descriptive statistics were performed to determine the demographic profile of the sample. Of the 252 students, 193 students (77%) were female and 59 (23%) were male. Table 1 displays the frequency distribution of the age of the students included in the sample. The ages ranged from 19 to 52. Fifty-three percent of the students were between the ages of 19-25 years old. The non-traditional students, 26-55 years old, accounted for 47% of the sample. Table 2 displays the frequency distribution for race. Eight-nine percent of the sample was composed of white and African American students.

Table 3

Results of Chi-square Test for Program and Age

Age	Program	
	On-Campus	Distance
≤ 25 years old	112(64%)	22(28%)
> 25 years old	62(36%)	56(72%)

Note: Numbers in parentheses indicate column percentages

$\chi^2 = 28.29$, $df = 1$, $p = <.01^*$

Research Findings

The purpose of this research study was to determine the differences in academic performance between the two groups, distance learning students and on-campus students. The researcher answered four research questions. The following is a discussion of the findings obtained from the four research questions.

Research Question One

The first research question addressed the differences in student background characteristics between the two groups, distance learning students and traditional on-campus students. The two background characteristics that were studied in this research project were gender and age. The Chi square statistical analysis was used to determine if there were differences between the two groups in gender and age.

The total number of female students that were enrolled in the campus programs was 132 and the total enrolled in distance programs was 61. For males, the total enrolled in the campus program was 42 and the total enrolled in the distance program was 17. There was no statistically significant difference between the number of males and females enrolled in each program, distance and on-campus. The campus program was comprised of 76% females and 24% males, while the distance programs were comprised of 78% females and 22% males.

The next background characteristic that was studied was age. Age was divided into two categories, those students less than or equal to 25-years-old and those that were greater than 25-years-old. Table 3 shows the Chi-square value for this research question. The analysis of the differences of age between the two groups was statistically significant

Table 4

Results of the t-tests for Program and Outcomes of Previous Academic Performance

Outcome	Program								
	On-Campus			Distance			95% CI for Mean Difference	t	df
	M	SD	n	M	SD	n			
Overall GPA	3.06	0.42	173	3.08	0.40	78	-0.13, 0.09	-0.40	249
Math/Science GPA	2.95	0.51	173	2.87	0.50	78	-0.06, 0.21	1.09	249

p < .05*

($p < 0.01$). The majority of on-campus students (64%) were less than or equal to 25-years-old, while the majority of distance students (72%) were greater than 25-years-old.

Research Question Two

The second research question addressed to what extent the two groups, distance learning students and traditional on-campus students, differed by previous academic performance. Previous academic performance was measured by data collected on students' overall admission GPA scores and their math/science admission GPA scores. There were a total of 251 out of 252 total student scores used in these analyses; the overall admission GPA and the math/science admission GPA were unavailable for one student. The statistical analysis used to answer this question was the two-sample t -test.

The overall admission GPA mean for the entire sample was 3.07 on a scale from 0.00 – 4.00. When the overall admission GPA mean was studied between the two groups, distance and on-campus, there was no statistically significant difference. The overall admission GPA mean for the on-campus students was 3.06, while the overall admission GPA mean for the distance students was 3.08. Table 4 shows the two-sample t -test statistical analysis for this research question.

The math/science GPA for the entire sample had a mean of 2.93. The difference between the math/science admission GPA for the on-campus students ($M = 2.95$, $SD = 0.51$, $n = 173$) was not statistically significant from the math/science admission GPA for the distance students ($M = 2.87$, $SD = 0.50$, $n = 78$). Table 4 shows the t -test statistical analysis for this research question. The results from this research question indicates that there is no significant differences in previous academic performance, measured by overall

Table 5

Results of the t-test for Program and Final GPA Scores

Outcome	Program								
	On-Campus			Distance			95% CI for Mean Difference	t	df
	M	SD	n	M	SD	n			
Final GPA	3.55	0.35	174	3.57	0.34	78	-0.12, 0.07	-0.50	250

p < .05*

admission GPA and math/science admission GPA, between the on-campus students and distance students enrolled in the allied healthcare programs.

Research Question Three

The third research question was to determine to what extent academic performance differed between the two groups, distance learning students and traditional on-campus students. Academic performance was measured by determining the students' final GPA scores and their external certification pass rates. The statistical analyses used to answer this research question were the Chi-square and the two-sample *t*-test. The two-sample *t*-test was used to determine whether there was a statistically significant difference in final GPA scores between the two programs, distance and on-campus. The Chi-square analysis was used to test for a significant difference in certification pass rates between the two programs.

The first measure of academic performance was the students' final GPA scores. There were a total of 252 student scores used for this analysis. The mean final GPA scores for the entire sample was 3.56 on a scale from 0.00 – 4.00. The difference between the distance students' final GPA scores ($M = 3.57, SD = 0.34, n = 78$) and the on-campus students' final GPA scores ($M = 3.55, SD = 0.35, n = 174$) was not statistically significant. Table 5 shows the results for the *t*-test statistical analysis for this research question.

The second measure of academic performance was the students' external certification pass rates. The total number of student certification scores included in this study was 216 which accounted for 86% of the total possible scores. One limitation of

Table 6

Results of Chi-square Test for Program and Certification Pass Rates

Certification Pass Rates	Program	
	On-Campus	Distance
Pass	134 (86%)	53 (87%)
Fail	21 (14%)	8 (13%)

Note: Numbers in parentheses indicate column percentages
 $\chi^2 = 0.01$, $df = 1$, $p = 0.93$

Table 7

Results of the t-tests for the Program and Final GPA Scores Within the Three Allied
Healthcare Programs

Outcome	Program						95% CI for Mean Difference	t	df
	On-Campus			Distance					
	M	SD	n	M	SD	n			
CLS Final GPA	3.49	0.36	113	3.53	0.34	42	-0.16, 0.09	-0.58	153
HI Final GPA	3.47	0.41	17	3.56	0.38	14	-0.38, 0.20	-0.61	29
NMT Final GPA	3.72	0.27	44	3.66	0.33	22	-0.09, 0.21	0.80	64

p < .05*

this study was that not all students took the external certification examination upon graduation, so for this reason certification scores were not available on all students. Again, the researcher found no significant difference in the certification pass rates for on-campus students and distance students. The on-campus students had a pass rate of 86% while the distance students had a pass rate of 87%. Table 6 shows the Chi-square analysis for this research question.

Research Question Four

The fourth research question was to determine the extent to which academic performance, measured by final GPA scores and external certification scores, differed between the distance learning and traditional on-campus students within the specific programs of clinical laboratory science, health information administration, and nuclear medicine technology. The statistical analysis used to measure these two outcomes was the two-sample *t*-test.

The total number of students final GPA scores used for clinical laboratory science was 155, for health information administration 31, and for nuclear medicine technology 66. There was no statistically significant difference in final GPA scores for clinical laboratory science students in the distance program ($M = 3.53$, $SD = 0.34$, $n = 42$) when compared to the students in the clinical laboratory science on-campus program ($M = 3.49$, $SD = 0.36$, $n = 113$). The health information administration program had a total of 31 student final GPA scores included in this study. Again, there was no statistically significant difference in health information administration distance students' final GPA scores ($M = 3.56$, $SD = 0.38$, $n = 14$) when compared to their on-campus counterparts

Table 8

Results of the t-tests for the Program and External Certification Scores Within the Three Allied Healthcare Programs

Outcome	Program						95% CI for Mean Difference	t	df
	On-Campus			Distance					
	M	SD	n	M	SD	n			
CLS Cert Score	495.34	99.35	112	523.17	77.25	36	-63.62, 7.96	-1.54	146
HI Cert Score	122.00	20.17	7	115.25	14.50	4	-19.45, 32.95	0.58	9
NMT Cert Score	79.94	3.59	36	76.62	3.40	21	1.39, 5.26	3.44*	55

p < .01*

($M = 3.47$, $SD = 0.41$, $n = 17$). Nuclear medicine technology program results were the same. There was no statistically significant difference between nuclear medicine technology distance students' final GPA scores ($M = 3.66$, $SD = 0.33$, $n = 22$) and the nuclear medicine on-campus students' final GPA scores ($M = 3.72$, $SD = 0.27$, $n = 44$). However, caution should be taken in interpreting the health information administration results and the nuclear medicine technology results due to the small sample size of each group. Table 7 shows the two-sample t -test statistical analyses for these results.

The second outcome measured for research question four was external certification scores. As stated earlier, not all students take the external certification examination upon graduation. For clinical laboratory science, the total number of students who took the external certification examination was 148 which was 95% of the total clinical laboratory science sample. The minimal scaled score for this examination, the American Society for Clinical Pathology Board of Registry, is 100 and the maximum score is 999 and the minimal passing score is 400. The researcher found that the distance students scored slightly higher ($M = 523.17$ $SD = 77.25$, $n = 36$) on the external certification examination than the on-campus students ($M = 495.34$, $SD = 99.35$, $n = 112$). However, the difference was not statistically significant.

A small number of health information administration students took the external certification examination at the time this research study was conducted. Out of a total of 31 students, who had graduated in 2005 and 2006, 11 had taken the examination. Seven of these were on-campus students and 4 were distance students. The external certification examination is the Registered Health Informatics Administrator examination and the passing score before September, 2005 was 102 out of a possible 160 and the passing

score beginning in October, 2005 was 103 out of a possible 160. Again, the researcher found no significant difference in external certification scores between the two groups of students. The on-campus students did score slightly higher ($M = 122.00$, $SD = 20.17$, $n = 7$) on the external certification examination than the distance students ($M = 115.25$, $SD = 14.50$, $n = 4$). However, caution must be taken in interpreting these results due to the small sample size.

The total number of nuclear medicine technology students who took the external certification examination, the Nuclear Medicine Technology Certification Board examination, was 57. To receive a passing score on this examination the student must get 75% of the questions right out of a total of 90 questions. There was a statistically significant difference in certification scores between the two groups of students, for the on-campus students ($M = 79.94$, $SD = 3.59$, $n = 36$) outperformed their distance student counterparts ($M = 76.62$, $SD = 3.40$, $n = 21$) on this examination. Again, caution should be taken in interpreting the results due to the small sample size. The two-tailed t-test statistical analyses for all three programs are shown in Table 8.

Summary

Four research questions were developed to determine the differences in student background characteristics, previous academic performance, and academic performance between the two groups of allied healthcare education students, distance and traditional on-campus. Student data from three allied healthcare programs were used in this study. The three programs were clinical laboratory science, health information administration, and nuclear medicine technology. When the data on the student background characteristic of gender were analyzed, it was found that there were no differences in the percentage of

males and females in the two types of programs, distance and traditional on-campus. In contrast, there was a significant difference in age between the two groups. The majority of on-campus students (64%) were less than or equal to 25-years-old, while the majority of the distance students (72%) were greater than 25-years-old.

There was no statistically significant difference in previous academic performance, measured by overall admission GPA scores and math/science admission GPA scores, between distance learning students and on-campus students. In addition, there was no difference in academic performance, measured by final GPA scores, between distance and on-campus students. When the external certification pass rates were compared, the researcher found no significant difference in pass rates between the two groups of students.

The final analyses performed compared the academic performance of distance students and on-campus students in the three specific programs of clinical laboratory science, health information administration, and nuclear medicine technology. Again, there were no significant differences in academic performance, measured by the final GPA scores between the two groups within the three allied healthcare programs. In addition, there were no statistically significant differences in external certification scores within the two programs clinical laboratory science and health information administration. However, there was a statistically significant difference ($p < .01$) in external certification scores between the two groups of students in nuclear medicine technology. The distance nuclear medicine technology students scored lower than their on-campus counterparts on the examination.

The results presented in this chapter will be the basis of the discussion in Chapter 5. Chapter 5 will include an analysis of research findings, a discussion of findings, conclusions and implications for the field of education administration along with recommendations for further studies.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

In the 2000-2001 academic year, 56% of all two-year and four-year higher education institutions were offering distance education courses, furthermore, 34% of those institutions were offering entire programs through distance learning (Waits & Lewis, 2003). Higher education institutions that are offering healthcare education, such as nursing and allied healthcare, have also incorporated distance learning into their programs (Stewart & Wright, 2004). Healthcare educators believe that distance learning will help alleviate the shortages that are being encountered in their professional fields (Ali et al., 2004; Crowley et al., 1999). However, many researchers have found that there are issues, such as problems with technology and feelings of isolation, that must be addressed before distance learning can be successful (Crowley, 1999; Rodger & Brown, 2000). Another concern for many researchers is the academic performance of those taking distance learning courses. For this reason, researchers have performed studies that compared the academic performance of distance learning students to their on-campus counterparts. In addition, researchers have attempted to determine if there are any student characteristics that may influence student academic success in the distance learning environment.

Researchers have performed academic performance comparison studies of distance learning students and traditional on-campus students, however there have only been a few studies performed that compared the academic performance of students that have taken their entire program through distance to their on-campus counterparts. In

addition, there have only been a few studies that have used external certification scores as a measure of academic performance.

Researchers have reported varying results from these academic performance comparison studies. Some reported that distance students performed more poorly than their on-campus counterparts, others reported that there was no difference between the two groups, while others reported that distance learning students outperformed on-campus students.

The deficit of research on academic performance studies in allied healthcare education and the conflicting results obtained in some of these studies establishes the importance of developing studies to answer the question of whether distance learning is a viable alternative for traditional on-campus learning. For this reason, the purpose of this study was to determine if there were any differences in academic performance between the two groups of allied healthcare students, distance and on-campus. Four research questions were created to determine if there were any differences in academic performance between the two groups. The first research question was used to determine if the two groups differed by the background characteristics of gender and age. The second research question determined if the two groups differed in previous academic performance, as measured by overall admission GPA and math/science admission GPA. The third and fourth research questions were created to determine if there was a difference in academic performance between the two groups. In question three, the final GPA scores and certification pass rates were compared between on-campus and distance for the entire sample while in question four the final GPA scores and certification scores were compared in each respective discipline.

A causal-comparative research design was utilized to determine if there were significant differences in academic performance between the two groups, distance learning students and on-campus students. The population of interest was graduates from allied health programs that had both on-campus and distance learning programs at one academic medical university. The three programs that offered both on-campus and distance learning were clinical laboratory science, health information administration, and nuclear medicine technology. The sample consisted of 252 students, and of those 252 students, 174 (69%) had completed their programs in the traditional on-campus setting and 78 (31%) completed theirs through distance learning. Existing data were collected on each student and the statistical analyses that were used included descriptive statistics to describe the demographic characteristics of the sample, the Chi-square test, a nonparametric analysis, to determine frequency differences in the two groups, and the two-sample *t*-test to determine if the two samples studied represented a single population. Based on the casual comparative research methodology and the data collected the statistical analyses were performed to answer each research question and the results were reported.

The student background characteristics of gender and age along with previous academic performance were studied in this research project. There was no statistically significant difference between the number of males and females enrolled in each of the two groups, distance and on-campus. However, there was a statistically significant difference in age between the two groups. Sixty-four percent of the on-campus students were 25-years-old or younger, while 72% of the distance students were greater than 25-years-old.

Previous academic performance was measured by overall admission GPA and math/science admission GPA. A comparison was made to determine if there was a difference between the two groups, distance learning students and on-campus students, in previous academic performance. The researcher found that there were no statistically significant differences in the two groups for overall admission GPA and math/science admission GPA.

Academic performance was compared between distance learning students and on-campus students. The first indicator of academic performance measured was the students' final GPA scores. The mean final GPA score for the on-campus students was slightly lower than the mean final GPA score for the distance students however, the difference was not statistically significant. The final measure of academic performance between the two groups was the pass rate on the external certification scores. The total number of certification scores utilized in this statistical analysis was 216, which accounted for 86% of the total sample. Again, there was no statistically significant difference in external certification pass rates between the two groups.

The final piece of this research study was to determine if there were differences in academic performance between the two groups within the three specific programs of clinical laboratory science, health information administration, and nuclear medicine technology. Again, the researcher found no statistically significant difference between the two groups, distance learning and on-campus, in final GPA scores within the three programs. In clinical laboratory science, the external certification scores were slightly higher for distance students as opposed to the on-campus students; however, the results were not statistically significant. External certification scores were slightly lower for

health information administration distance students when compared to their on-campus counterparts however, the results were not statistically significant. In contrast to the preceding two programs, there was a statistically significant difference in nuclear medicine technology external certification scores between the distance learning students and the on-campus students. The mean certification score was lower for the distance students when compared to the mean certification score for the on-campus students.

Analysis of Research Findings

The purpose of this study was to determine if there was a difference in academic performance between distance learning and on-campus students in allied healthcare education. Differences between the two groups in student background characteristics and previous academic performance were also compared. One key finding of this research is that there was a significant difference in the background characteristic of age between the two groups. The on-campus students consisted of the more traditional college students in regards to age while the distance students were older and could be classified as nontraditional college students.

Another important finding of this study was that there were no statistically significant differences between distance students and on-campus students in academic performance. In other words, the two groups performed equally well academically when final GPA scores and certification pass rates were compared. In addition, the two groups performed equally well on final GPA scores when the three disciplines were analyzed individually. However, when certification scores were examined, nuclear medicine technology's distance students scored significantly lower than their on-campus counterparts.

Discussion of Research Findings

Research question one was utilized to determine if there were differences in the student background characteristics of gender and age between the distance learning and on-campus students. The researcher found that the two groups did not differ significantly in gender. Both groups had more females enrolled than males. However, when the background characteristic of age was studied, the researcher did find a significant difference between distance learning and on-campus students. There were more traditional students, 25-years-old and younger, enrolled in the on-campus programs as opposed to more non-traditional students, over the age of 25, enrolled in the distance programs. Therefore, the researcher did find that the two groups were not equal in regards to age.

The differences in the background characteristics of gender and age were important to determine because some researchers have found that certain background characteristics have an impact on academic performance in the distance learning environment. Cheung and Kan (2002) and Alstete and Beutell (2004) found that gender did have an impact on student academic success in the distance learning environment. Both groups of researchers found that women outperformed men in the distance learning environment. In this research study, both the campus and distance programs had more females than males enrolled, so this background characteristic should not influence the results when academic performance is compared.

Levine (2001) stated that since the 1980s and 1990s there has been a large influx of nontraditional students, over the age of 25, who have sought to obtain a higher education degree. The researcher of this study found this to be true in that there were

more distance students that could be classified as non-traditional; however, the majority of the on-campus students were still comprised of the traditional, less than 25-years-old, college age students. Again, age is an important consideration when comparing academic performance between distance and on-campus students because some researchers have found that there is a significant positive relationship between age and academic performance (Alsete & Beutell, 2004; Bearden et al., 2002). Even though the two groups differed significantly on age in this study, with the distance students being older than the on-campus students, this researcher did not find that the distance students significantly outperformed their on-campus counterparts academically, and in addition, there was one area where the on-campus students performed significantly better than their distance counterparts.

For research question two, the researcher determined if there were any significant differences in previous academic performance measured by overall admission GPA and math/science admission GPA, between the two groups. The two groups of students, distance and on-campus, were not found to be significantly different in either overall admission GPA or math/science admission GPA. Again, this was an important construct to consider for researchers have linked academic success in the distance learning environment to previous academic performance. Researchers have found a significant positive relationship between previous academic performance, as measured by previous course grades, GPAs, and standardized test scores, to success in the distance learning environment (Brown & Liedholm, 2002; Bearden et al., 2002; Cheung & Kan, 2002).

By answering research question one and two, the researcher showed that the two groups of students, distance and on-campus, were of the same population in regards to

gender, mean overall admission GPA, and mean math/science admission GPA. However, the groups were different on the student background characteristic of age. Since the two groups are not equal on the construct of age and researchers have found that age can have a significant positive relationship with academic performance than it could be theorized that the distance students might significantly outperform their on-campus counterparts academically. However, this theory was not realized when the statistical tests were performed and the results were analyzed for academic performance.

Research question three was used to ascertain whether the two groups differed in academic performance. The researcher discovered that the two groups did not differ on final GPA scores. In addition, when certification pass rates were analyzed as a measure of academic performance, the two groups were found to be the same. These research findings are in contrast to the findings of Bernard et al (2004) and Allen et al. (2004). These researchers performed meta-analyses of distance learning research and found that distance students performed slightly better than their on-campus counterparts. Another group of researchers, Zhao et al. (2005) looked at course content and found that students enrolled in distance medical science courses performed better than their on-campus counterparts. The contrasting results of this research and those previously performed by Bernard et al. (2004), Allen et al. (2004), and Zhao et al. (2005) could be do to the fact that the studies utilized in these meta-analyses were based on comparisons of single courses and not entire programs, as this study was.

The findings on academic performance as measured by final GPA scores and external certification pass rates are in concordance with the findings reported by Olmsted (2002). Olmsted found that there was no difference in final GPA scores or in external

certification scores between the two groups. In contrast to the meta-analyses of Bernard et al. (2004), Allen et al. (2004), and Zhao et al. (2005), Olmsted compared the final GPA scores and external certification scores for students who had taken their entire program via distance learning to their on-campus counterparts instead of comparing academic performance for students in single courses only. In addition, Olmsted's research was performed in dental hygiene which is classified as a type of allied healthcare education.

Research question four was used to determine the differences in academic performance, measured by final GPA scores and external certification scores, between the two groups. However, in contrast to research question three, this research question was used to determine the differences between the two groups in the separate disciplines of clinical laboratory science, health information administration, and nuclear medicine technology. Again, the researcher found that there was no significant difference in final GPA scores between the two groups for the three separate disciplines and these results are in concordance with that found by Olmsted (2002). As stated earlier, Olmsted's research compared distance students that had taken their entire program via distance learning to their on-campus counterparts. Out of all of the studies reviewed, Olmsted's is the most similar to this study in regards to the programs compared and the data collected.

Numerical certification scores were used in this study to determine if there were differences in academic performance between the two groups within the specific programs of clinical laboratory science, health information administration, and nuclear medicine technology. In the clinical laboratory science program, the distance students slightly outperformed the on-campus students; however, the results were not statistically significant. For health information administration, the on-campus students slightly

outperformed the distance students, though again, the results were not statistically significant. The analyses on both of these programs are in concordance with the studies performed by Freeman (1995) and Olmsted (2002). Freeman (1995) compared academic performance by using the numerical certification scores. She compared external certification scores for students who had taken a distance learning course during one semester and found no significant difference between the two groups. Similarly, Olmsted (2002) compared certification scores between the two groups and found no statistically significant difference.

In contrast to these findings, are the results obtained for the nuclear medicine technology program. The mean external certification score for the distance students was lower when compared to the mean certification score for the campus students. These results, when analyzed statistically were found to be significant, and this is in contrast to the previous studies performed by Freeman (1995) and Olmsted (2002). However, the samples sizes for both the health information administration sample and the nuclear medicine technology sample were small so caution should be taken when interpreting these results.

Conclusions

The researcher's purpose for this project was to determine if there were differences in academic performance between two groups of students, distance learning students and traditional on-campus students in allied healthcare education. Four research questions were developed to answer this overarching question. The first research question was used to determine the differences between the two groups in regards to the student background characteristics of age and gender. From the sample obtained from this study,

it was determined that there were no differences in gender between the two groups. However, one factor that researchers have shown has an effect on distance learning academic performance was age. The two groups in this study differed significantly in their ages, with the on-campus students being younger than the distance students. Even though age has been shown by researchers to have an effect on academic performance, this study showed that the two groups, while differing significantly in age, did not differ significantly in academic performance, measured by final GPA scores and external certification pass rates.

In addition, the researcher found through research question two, that previous academic performance, as measured by overall admission GPA and math/science GPA between the two groups were similar. This shows that the two groups, distance and on-campus were similar on these characteristics that previous researchers have shown to influence academic performance in the distance learning environment.

The analysis of research questions one and two showed that the two groups were similar on many of the variables that have been proven to impact student academic performance. For this reason, the researcher could be confident that there were no extreme differences in the groups that could have biased the results. Therefore, the researcher can ascertain that the two groups are similar in regards to gender and previous academic performance and that these constructs should have no influence on the conclusions derived from research questions three and four.

For research question three, the researcher found that there were no differences in academic performance, measured by final GPA scores and certification pass rates, between the two groups. Therefore, it can be postulated that distance learning programs

are as effective in educating allied healthcare practitioners as the traditional on-campus programs.

Even when the programs were looked at individually, as they were for research question four, there was no difference in academic performance as measured by the final GPA scores between the two groups. In addition, when external certification scores were studied, there was no statistically significant difference in scores for the two programs of clinical laboratory science and health information administration. However, the sample size for the health information administration certification scores was small so caution must be taken when trying to interpret these findings. Nevertheless, it is still an indication that distance learning is a viable alternative to the traditional on-campus environment that has dominated healthcare education since its inception.

There was a statistically significant difference in academic performance as measured by certification scores between the two groups in nuclear medicine technology. The sample size was small for the certification scores in this group so caution should be taken when trying to deduce meaning from these results. However, since there were no differences in academic performance in final GPA scores in the three programs and there was no significant difference in certification scores in two out of three programs it can be concluded that distance learning does work in some allied healthcare programs.

The researcher's findings show that there is no significant difference in academic performance between distance learning students and on-campus students. For this reason, it can be postulated that distance learning can be used as a successful alternative to the traditional on-campus learning for allied healthcare education. However, as indicated in the recommendation section of this chapter, more research needs to be performed with

larger sample sizes, over longer periods of time, and in more allied healthcare disciplines to determine the true impact of distance learning as a replacement for traditional on-campus allied healthcare education.

Implications

The researcher's findings are important to administrators and educators of allied healthcare programs who are considering offering or who are currently offering distance learning programs. This research project is a comparison study between distance learning and on-campus learning. The researcher has shown that overall, there is no difference in the academic performance between the two groups. For this reason, distance learning can be a viable alternative to the traditional on-campus learning prevalent in allied healthcare education and administrators and educators can feel confident that they are graduating distance students who are as academically prepared as their on-campus counterparts.

This research is also significant for students who are considering attending an accredited distance learning program as a way to obtain their allied healthcare degree. These research findings can assure these students that they are receiving a quality healthcare degree via distance learning.

Admission committees often use previous academic performance as a marker of student success. In this research, there was no difference in previous academic performance between the two groups of students. Both groups had the same mean overall admission GPA scores and the same mean admission math/science GPA scores. In other words, the programs included in this study used the same admission criteria for both groups of students and at the end of the program there was no difference in the academic performance measures in the three programs as a whole and in two-out-of-three programs

when studied separately. Therefore, admission committees do not need to alter their practices by changing admission criteria, they can feel assured that the admission criteria they use for their on-campus students is adequate for their distance students.

There is often concern that students who have graduated from distance learning programs are not as well prepared as the students that graduated from the traditional on-campus programs. Many students will be hired to work in their profession immediately following graduation, before they have passed the external certification examination. Healthcare managers invest time and money into training these new graduates, so it is imperative that the students pass the examination so they can continue to practice. This research can be used to show healthcare managers that there is no difference in the pass rates between distance learning students and on-campus students, thus relieving any anxiety they may have over hiring a distance learning student.

This research fills a gap in the literature on distance learning. Many research articles have been published that focuses on academic performance comparison studies. However, very little research has been performed that studies the academic performance of distance students that have taken their whole program by distance learning. In addition, very few studies have used external certification scores as a measure of academic success. For this reason, this research makes a significant contribution to the literature and provides a foundation for future research on academic performance and distance learning.

The findings of this research project have also been important for the researcher, who is a program director. It is imperative, as program director, to ensure that the students graduating from the distance programs are as academically successful as those

graduating from the traditional on-campus programs. This research has shown that distance learning students are as successful as on-campus students and that distance learning can be used as a viable alternative to the traditional on-campus education. However, as stated earlier, more research needs to be performed in this area, especially in regards to allied healthcare education.

Recommendations

Based on these findings, the final recommendations to education administrators and to the profession are as follows:

1. program directors, use the findings of this study as justification for beginning a distance learning program;
2. healthcare managers, use the findings of this study to justify hiring allied healthcare graduates who have obtained their degrees through accredited distance learning programs;
3. healthcare education accrediting bodies, use this study as proof that distance learning can be a viable alternative to the traditional on-campus education program.

The findings of this study have left many unanswered questions concerning distance learning and academic performance. For this reason, the following recommendations for further study are as follows:

1. research is needed for the correlation of age and previous academic performance, as measured by overall admission GPA scores and math/science GPA scores, to academic success in allied healthcare education in the on-campus and distance learning environment;

2. research needs to be performed that incorporates more allied healthcare programs with larger sample sizes for the comparison of academic performance between distance learning students and on-campus students.
3. research needs to be performed that compares the sub-categories of the external certification examinations as measures of academic performance between distance and on-campus students.

Dissemination

The results of this research project will be disseminated in three ways. A poster presentation will be developed to present at the American Society for Clinical Laboratory Science (ASCLS) Clinical Laboratory Educators' Conference. The second method of dissemination will be to submit a proposal for a member submitted research project presentation at the annual ASCLS meeting. The third method will be to submit an article to the peer-reviewed journal, *Journal of Allied Healthcare* for publication.

Concluding Thoughts

Distance learning is now a part of higher education, including healthcare professional education. It can be postulated, that as technologies improve, distance learning will continue to be seen as a method of degree obtainment. In addition, many believe that distance learning in healthcare education will help alleviate the shortages of qualified healthcare practitioners. However, there is a concern that distance learning is a poor substitute for traditional on-campus learning. This research project was chosen by the researcher to try and ascertain whether distance learning could be used successfully as an alternative to traditional on-campus programs. Through this study, the researcher has shown that distance learning can be a successful alternative to traditional on-campus

healthcare education. Therefore, distance learning can be used to educate those individuals, who due to life commitments, can not travel to an academic institution to obtain their desired degree.

As a program director of distance learning programs, it was imperative to discover if allied healthcare distance learning students performed as well as their on-campus counterparts. Through this research project, it was discovered that the overall academic performance between the two groups is the same. However, it was also realized that the research on distance education needs to continue as technology grows and distance learning expands into new curriculums.

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APPENDICIES

APPENDIX A

IRB APPROVAL FROM THE MEDICAL COLLEGE OF GEORGIA



Human Assurance Committee (HAC)
Institutional Review Board (IRB)

Barbara L Russell, MHE
BP-2220 Medical Technology

July 25, 2006

RE: A Comparison in Academic Performance Between Distance Learning and Traditional On-Campus Students in Allied Healthcare Education at the Medical College of Georgia

HAC File Number: 06-06-326

Approval Date: 07/24/2006

Expiration Date: 07/23/2007

Dear Dr. Russell:

The Human Assurance Committee (HAC) reviewed and approved the referenced study and waiver of written informed consent in accordance with the Department of Health and Human Services (DHHS) policy, the Institutional Assurance on file with the DHHS and the Health Insurance Portability and Accountability Act (HIPAA) policy because:

- 1) The research involves no more than minimal risks to subjects.
- 2) The alteration or waiver of consent will not adversely affect the privacy rights and welfare of the individuals.
- 3) The research could not practicably be carried out without access to and use of the protected health information.
- 4) The research could not practicably be carried out without the waiver or alteration.
- 5) The privacy risks to individuals whose protected health information is to be used or disclosed are reasonable in relation to the anticipated benefits, if any, to the individuals, and the importance of the knowledge may reasonably be expected to result from the research.
- 6) There is an adequate plan to protect the identifiers from improper use and disclosure.
- 7) There is an adequate plan to destroy identifiers at the earliest opportunity consistent with the conduct of the research unless there is a health or research justification for retaining the identifiers, or such retention is required by law.
- 8) There are adequate written assurances that the protected health information will not be reused or disclosed to any other entity or person except as required by law, for authorized oversight of the research project, or for other research for which the use of disclosure of the protected information will be permitted.

Barbara L Russell, MHE
06-06-326

The Committee calls your attention to the following obligations as Principal Investigator of this study. Under the terms of our approved Institutional Assurance to DHHS, a progress report at the termination of the study, or prior to the expiration of this approval, whichever comes first, must be provided to the HAC. If the study will continue beyond the initial approval term, review by the Human Assurance Committee is required, with the progress report constituting an important part of the review. The Committee will send an HAC Form 107 [Clinical Study Status Report] for completion approximately two months prior to the expiration date noted above. Failure to return the HAC Form 107, Clinical Study Status Report by its due date will result in an automatic termination of this study. Reinstatement will only be granted following resubmission of the study to the HAC.

If patients are research subjects, as Principal Investigator, you must insure that all medical records contain appropriate indication of study participation, as specified in the Medical College of Georgia's Hospital and Clinics Policy and Procedures Guidelines (1.6.0, 3/17/95).

If Veterans Affairs (VA) patients or facilities will be involved in this study, a letter of approval from the VA Research Development Committee must also be obtained prior to involvement of VA patients or facilities.

Sincerely,



George S. Schuster, D.D.S., Ph.D.
Chairman, Human Assurance Committee
CJ-2103

C: HAC file, chron

APPENDIX B

IRB APPROVAL FROM GEORGIA SOUTHERN UNIVERSITY

Georgia Southern University Office of Research Services & Sponsored Programs Institutional Review Board (IRB)		
Phone: 912-681-5465		Administrative Annex
		P.O. Box 8005
Fax: 912-681-0719	Ovrsight@GeorgiaSouthern.edu	Statesboro, GA 30460

To: Barbara L. Russell
4789 Orchard Hill Frive
Grovetown, GA 30813

cc: Dr. Michael Richardson, Faculty Advisor
P. O. Box 8131

From: Office of Research Services and Sponsored Programs
Administrative Support Office for Research Oversight Committees
(IACUC/IBC/IRB)

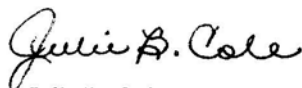
Date: July 31, 2006

Subject: Status of Application for Approval to Utilize Human Subjects in Research

After a review of your proposed research project numbered: **H06227**, and titled "**A Comparison in Academic Performance Between Distance Learning and Traditional On-Campus Students in Allied Healthcare Education at the Medical College of Georgia**", it appears that your research involves activities that do not require approval by the Institutional Review Board according to federal guidelines.

Therefore, as authorized in the Federal Policy for the Protection of Human Subjects, I am pleased to notify you that your research is exempt from IRB approval. You may proceed with the proposed research.

Sincerely,



Julie B. Cole
Director of Research Services and Sponsored Programs

APPENDIX C

VITA

VITA

The researcher is program director for the clinical laboratory scientist program and an assistant professor in the Department of Biomedical and Radiological Technologies at the Medical College of Georgia (MCG), Augusta Georgia. She has an associates degree in Medical Laboratory Technology from Wytheville Community College, Wytheville VA, a baccalaureate degree in Medical Technology from the Medical College of Georgia, and a Masters in Health Education from the Medical College of Georgia. She has a Specialist in Hematology certification and the Medical Technologist certification from the American Society for Clinical Pathology (ASCP). As an assistant professor, she has been involved in course development for on-campus courses as well as being heavily involved in developing the course materials for the internet programs.

The researcher's publications include:

- Meta-analysis published to the NACB Laboratory Medicine Practice Guidelines webpage. Evidenced Based Practice for POCT. Chapter 8 Infectious Diseases: Campbell, S., Campos, J., Hall, G., LeBar, W.D., Touse, D., Rudrik, J., Russell, B., Sautter, R. (2005) Chapter 8: NACB Laboratory Guidelines for Infectious Disease @ http://www.nacb.org/lmpg/poct_LMPG_draft_PDF.stm.
- CD publication: Sautter, B., Campos, J. M., Russell, B. L., Hall, G., Greene, W., Campbell, S. (2005) *Point of care testing for infectious diseases: Have we arrived?* American Society for Microbiology 105th General Meeting June 5-9, 2005.

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- Day, D. S., Gay, J. N., Krauss, J. S., Sabio, H., Satya-Prakash, K. L., Russell, B., Wansley, W. Erythroleukemia of Childhood and Infancy. (1997). *Annals of Clinical and Laboratory Science*, 27(2), 142-150.
- Crowley, J. R., Russell, B. L. Martin, S. M. (1995). Challenges of distance learning for the allied health educator. *Journal of AHIMA*, 66(7), 61-63.

The writer has presented as a guest lecturer at many national, regional, state, and local conferences. The most recent are listed below:

- Mycology in the 21st Century, ASCLS-Georgia Annual State Meeting, Macon Georgia, March 8, 2006.
- Distance Teaching Using the Tegrity Platform: A Case Study, University System Annual Computing Conference Annual State Meeting, Rock Eagle, Georgia. October 2, 2005.
- POCT for Infectious Mononucleosis – Are We There Yet, American Society for Microbiology Annual National Meeting, Atlanta, Ga. June 7, 2005.
- Mycology and Parasitology Review, ASCLS-Georgia Annual State Meeting, Atlanta, Ga, March 1, 2005.
- A Case Study in Evidence Based Practice in Clinical Laboratory Science, GSCLS Annual State Meeting, February 25, 2004.
- Evidence Based Practice in Clinical Laboratory Science, ASCLS Annual National Meeting, Philadelphia, PA., July 30, 2004.