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The Relationship Between Fully online Gateway Science Courses and Student academic Performance in Health Career associate Degree Programs at Regional Community College

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ABSTRACT

THE RELATIONSHIP BETWEEN FULLY ONLINE GATEWAY SCIENCE COURSES AND STUDENT ACADEMIC PERFORMANCE IN HEALTH CAREER ASSOCIATE DEGREE PROGRAMS AT REGIONAL COMMUNITY COLLEGE

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Northern Illinois University, 2023
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The severe shortage of healthcare professionals creates an increased demand for new graduates in Allied health and Nursing programs. Gateway science courses to HCAD programs such as A&P are often considered predictors of student success in Allied health and Nursing programs. A&P courses have been traditionally taught face-to-face, and the COVID pandemic has forced institutions to switch these courses to a fully online format. Despite its increased popularity, the impact of fully online gateway courses on student academic performance in HCAD programs needed to be clarified. This quantitative study examined the relationship between fully online gateway science courses and student academic performance in HCAD programs at Regional Community College.

Data was collected from a large community college in the Southeastern region of the United States retrospectively over the academic years 2017-18 to 2021-22. The quantitative analysis included Welch's ANOVA tests with multiple comparisons and chi-square tests. The result indicated an association between the A&P II course completion format and the mean course grade points, which was statistically significant ($p < .05$). The findings demonstrated a

significant association between the A&P II course completion format and first-year student retention in HCAD programs. Multiple comparison tests revealed that even though the first-year HCAD program retention rates were lower among the post-COVID online group, those who advanced and graduated from HCAD programs in that group performed better academically. The results of this study indicated that online modality could be a viable course delivery option for instructing gateway science courses. It is unclear whether one course delivery method is better than other methods in improving student academic performance in HCAD programs due to various reasons.

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THE RELATIONSHIP BETWEEN FULLY ONLINE GATEWAY SCIENCE COURSES AND
STUDENT ACADEMIC PERFORMANCE IN HEALTH CAREER ASSOCIATE DEGREE
PROGRAMS AT REGIONAL COMMUNITY COLLEGE

BY

MUKESH GEORGE
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FOR THE DEGREE
DOCTOR OF EDUCATION

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Doctoral Director:
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PREFACE

This dissertation aims to analyze the relationship between online gateway science courses and student academic performance in HCAD programs at Regional Community College. This quantitative study explored six HCAD programs at a large Southeastern community college. The upcoming chapters delineate the comprehensive research project, encompassing the proposal, findings, and my scholarly reflection on the valuable insights gained during the study.

Chapter One is an artifact from the dissertation proposal defense. The proposal was defended in November of 2022, and this chapter outlines the initial plans to carry out the research. The original proposal was to approach the research using A&P II completion in a fully online and other course format context. As the study progressed, I realized that fully online A&P II courses were only offered after the COVID pandemic. Considering the variable differences, the variables were recoded to multiple levels, and the initial plan of using t-tests was replaced with Welch's ANOVA tests.

Chapter Two is a report of findings using a publishable paper model. This chapter details the research conducted throughout the spring of 2023, the participants involved, and the study findings. Descriptive sociodemographic student characteristics profiles in A&P II courses and HCAD programs were presented for comparison. The findings reflected a model comprised of the independent variable, A&P II course completion, with multiple levels: pre-COVID in-person, post-COVID in-person, and post-COVID online.

Chapter Three is a scholarly reflection on the valuable insights I gained during the study. This chapter discusses my reflections on the dissertation journey. The chapter also examines what I learned by conducting this research that can be applied to future research and applications to professional practice. Some significant takeaways include the importance of data accuracy, the need for more professional development opportunities related to data practices for HCAD programs, and the importance of selecting an effective course delivery modality for gateway science courses.

CHAPTER 1

INTRODUCTION TO THE STUDY

Introduction

Online education has evolved over the past two decades due to the advancements and accessibility of technology, the internet, and smart devices. Unlike traditional face-to-face courses, online learning provides students the flexibility to access course materials anytime, anywhere. Both face-to-face and online teaching methods have proven effective in delivering course content, actively engaging students, providing timely feedback, and achieving learning outcomes (Greenhalgh, 2001). However, transitioning from a face-to-face course into a fully online environment has raised questions regarding the effectiveness of the delivery system (Bell & Federman, 2013). The debate on the effectiveness of online courses became a central concern as, in 2020, faculty and administrators in higher education were forced to transition all the face-to-face courses to an online environment due to the global COVID pandemic. Gateway courses for Health Career programs were also forced to follow the path.

Healthcare occupations are one of the fastest-growing job sectors in the United States. According to the United States Bureau of Labor Statistics, employment in healthcare occupations is projected to grow approximately 13%, adding about 2 million new jobs from 2021 to 2031 (U.S. Bureau of Labor Statistics, 2022). Frogner and Skillman (2015) mentioned that most healthcare occupations require a post-secondary education to work in the field. The Federal Code and Affordable Care Act (ACA) specifies Allied health professionals to complete a professional

degree certificate in a higher educational institution to work in the field (Affordable Care Act, 2009). Health Careers Associate Degree (HCAD) programs in community colleges prepare competent students to become qualified professionals and leaders across multiple healthcare settings. Examples of HCADs include but are not limited to, Nursing, Radiography, Dental Hygiene, Diagnostic Sonography, Cardiovascular Technology, and Respiratory programs. HCAD programs prepare to offer students the opportunity to earn national certifications and or state licensures within the specific medical profession.

The admission process and structure of HCAD programs are unique and different from other associate degree programs (Salvatori, 2001). Each associate degree program in Health careers has its own accreditation and professional regulatory requirements. Student admission to HCAD programs is competitive and based on a selective admission process. Program curricula and course outcomes for these programs are chosen based on programmatic accreditation needs (Ingrassia, 2016). However, HCAD programs have some structural and curricular similarities with each other. The gateway courses required for these programs are similar or the same. In addition, associate degree programs in health careers are structured with didactic and clinical courses. Didactic courses provide students with experiences designed to support conceptual learning and provide an opportunity for students to gain hands-on skills in a simulated environment (Adler & Carlton, 2019). Clinical courses allow students to observe and perform procedures and activities in the clinical setting.

Gateway science courses are generally identified as foundation-level courses that students must complete for each academic major. According to Newton et al. (2007), successful completion of gatekeeper courses such as Anatomy and Physiology (A&P) is predictive of student success in Allied health and Nursing programs. Even though some of the A&P courses in

community colleges were historically offered in a fully online format, there were questions regarding the effectiveness of this delivery format. According to the National Center for Education Statistics-NCES (2019), approximately 65% of the students enrolled in undergraduate higher education institutions in 2018 were not taking online courses. The COVID pandemic forced colleges to offer all their courses in an online format. This forced transition was a learning opportunity for several community colleges to explore the advantages and disadvantages of online learning. However, the impact of fully online gateway courses in HCAD programs is under-explored.

Purpose of the Study

Anatomy and Physiology courses, similar to many other science courses, have been traditionally taught face-to-face, predominantly due to the psychomotor nature of these courses (Johnston et al., 2015). These science courses are considered gatekeeper courses for HCAD programs in community colleges. Advancements in technology and societal changes have made community colleges shift some of these courses into a fully online format. Despite its increased popularity, the impact of fully online gateway courses on student academic performance in HCAD programs is unclear. While there has been some research regarding student success in online science courses (Garman, 2012), such research has not explicitly focused on students in health careers programs. This study aims to explore whether online learning in gateway science courses is related to student academic performances in HCAD programs.

The purpose of this quantitative study is to determine the relationship between fully online gateway science courses and student academic performance in HCAD programs at Regional Community College (RCC). The study will first identify student demographic characteristics such as age, sex, and race/ethnicity to get a broader picture of the specific student

population. Additionally, I will evaluate whether the mode of course delivery in gateway courses relates to the academic success of health career students before and after program admission.

The following research questions guided the current study.

RQ 1: Is there a difference in final course grades among students who completed A&P courses in a fully online format and other course delivery formats?

RQ 2: Is there a difference in first-year retention among HCAD program students who completed A&P courses in a fully online format and other course delivery formats?

RQ 3: Is there a difference in cumulative GPA among HCAD program students who completed A&P courses in a fully online format and other course delivery formats?

Review of Literature

This section includes a review of relevant literature on previous studies supporting and establishing the context of the study. The literature evaluation begins with an overview of online education and student success, followed by some history, advantages, and disadvantages of online education. This is followed by a review of studies examining student academic success factors in community colleges and health career programs. The relevance of A&P courses in health career programs is also explained. The review concludes by exploring the relationship between online gateway science courses and student success in health career programs.

Online Education and Student Success

Online education is an instructional method delivered and administered through the Internet. The current online education evolved from distance education methodology, which utilized correspondence, audio, and video tools to provide and assist instruction in the past (Kentnor, 2015). The advancement of the Internet and the accessibility of technology created a surge in demand for online teaching and learning. Montelongo (2019) explained how students

experience online education through different learning modes. Online teaching and learning environments include fully online, blended, or hybrid formats and traditional courses using online supplements (Montelongo, 2019). Fully online courses are conducted entirely on the internet in synchronous or asynchronous formats with no physical in-person interaction. All aspects of the course are completed online either synchronously, asynchronously, or using both strategies. Blended or hybrid courses consist of both online and face-to-face sessions, and the amount of time allotted for each session varies depending on the curricula (Ruiz et al., 2006). Traditional formats require students to meet face -to face; however, these courses often use online technology to deliver supplemental materials for the course.

Notably, online instructional delivery methods gained popularity long before the COVID pandemic. Among the higher education students enrolled in 2012, 32.5% were enrolled in online courses (Allen & Seaman, 2013). Even before the pandemic, more than 60% of postsecondary educational leaders welcomed online learning as a part of their long-term strategies (Gering et al.,2018). Online education helps community colleges in increasing student access to postsecondary education. Crawford and Persaud (2012) mentioned how online enrollment in community colleges grew by 8.2% in 2011 while overall enrollment remained somewhat stagnant. While online learning was in use before the global pandemic, as COVID gripped the nation, forcing educational institutions to shutter their doors, online learning became one of the only methods of instruction. The rapid shift from in-person to online delivery opened a new perspective on digital pedagogy.

History of Online Learning

The history of online education dates to distance education initiatives in the 1800s. Bower and Hardy (2004) identified the method of learning through postal mail as the first form

of distance education. According to the authors' Anna Eliot was one of the pioneers in distance education for housebound women in the late 1800s. In the early to mid-1900s, audio courses and television courses started getting popular. The authors explain how satellite technology in the 1960s and fiber optics technology in the late 1980s paved the way for the development of distance education. Advancements in computers and the internet created a radical transition in distance education. Southern Association of Colleges and Schools Commission on Colleges (2020) defined distance education as a process in which the majority of the instruction occurs when the instructors and students are not physically in the same. According to their report, online education is one of the many instructional methodologies used in distance learning.

Online education continues to play an essential role in education in the United States. According to Kentnor (2015), the rapid growth of online education in traditional nonprofit colleges occurred during the late 90s. The author explains how several online nonprofit educational institutions had to later shut down their doors due to several factors. Lack of understanding of the online pedagogy and learning styles shortage in online educators were some of the issues listed by Marcus (2004) as the possible reasons for the shutdowns. Bernard et al., (2004) reported how faculty in these institutions failed to recognize the difference between the different mediums of teaching and learning. Even though several nonprofit institutions that focused primarily on online education shut down, the need for online learning continued to grow.

The popularity and need for online learning kept growing in higher education institutions. According to Ortagus (2017), post-secondary student enrollment in online courses increased from 5.9% in 2000 to 32.1 % in 2012. Community colleges in the United States, known for their diverse population and open-access mission, also lead in enrolling students online. Fredericksen (2018) mentioned that in 2017 approximately 1.9 million community college students were

enrolled in at least one online course. The author also notes how the flexibility of online classes attracted the diverse student population in community colleges and became attractive to students. The COVID pandemic forced higher educational institutions and students to experience online education at a new level.

Advantages of Online Education

The advantages of online courses include accessibility, flexibility, and affordability. Francescucci and Rohani (2019) have mentioned flexibility and convenience as some of the significant benefits of online learning. Online courses allow students to participate in the course from their convenient locations using their laptops or computers (Francescucci & Rohani, 2019). The asynchronous online course format offers students the benefit of flexibility and accessibility by allowing them to take classes anywhere and anytime. Bourdeaux and Schoenack (2016) explained how most community college students juggle their careers and personal life commitments while achieving their academic goals. Reducing or eliminating time and place constraints improves student accessibility for community college students.

Online course delivery enables the institution to offer instruction to a more significant number of students. Choe et al. (2019) have explained the advantage of online education in accommodating more students in classrooms without needing additional physical space. According to the author, online courses help institutions cut the cost of staffing and space, making them more affordable to students. In addition to accessibility, flexibility, and affordability, online learning also enriches and broadens the learning experience. The delivery method allows a multi-modal approach to teaching and learning. Soffer and Nachmias (2017) explained how students enjoy online videos and activities better than the activities in face-to-face courses.

Disadvantages of Online Education

Along with the advantages, online education has several disadvantages. Dumford and Miller (2018) found that higher education students who take a more significant number of online courses tend to engage less in collaborative learning and student-faculty interactions. The study also reported that these students tend to have less exposure to effective teaching practices and lower quality of interactions. The lack of human interaction and increased chances of distraction are drawbacks of online learning. One of the significant issues Herman (2020) noticed in his online courses was the lack of immediate interactions between students and faculty. The author found out that most of his students who had taken the same courses in the face-to-face and online mode disliked the online version of the course. The article mentions how some students were concerned about the increased chances of distractions in online learning. The author noted that most of his students who were disappointed with online courses missed human interaction.

The COVID pandemic forced community colleges to shift all their face-to-face courses into an online mode. Transforming traditional courses to the online environment requires adequate time and effort. Switching face-to-face courses to an online format in a short time is more like conducting conventional courses at a distance. Underprepared faculty and lack of adequate training affect online program quality. According to Lopez (2020), some experienced professors at the Glendale community college needed more experience teaching in an online environment. Almost half of the faculty who taught in the college requested additional time to switch from face-to-face courses to online. According to the author, several students also expressed concerns about the switch. Single parents worked to continue their courses while taking care of their kids. Students who needed additional academic help, counseling, and face-to-face support also had difficulty catching up with their semesters.

Health Career Program Student Success and Gateway Science Courses

Student academic success is generally defined as Grade Point Averages (GPA), persistence, retention, completion, and time to graduation rates. York et al. (2015) explained how researchers differ in their views of academic success. The authors mention how academic success relies on factors such as academic achievement, satisfaction, persistence, learning objectives, skills acquisition, and career success. The authors also mentioned how most researchers focus on grades or GPA to measure academic success. However, grades and GPA are not the only methods of predicting student academic success. Factors such as affordability, student demographics, and Institutional characteristics also play a role in student academic success.

Community colleges are facing several internal and external barriers to promoting academic success. The major barriers include the need for more persistence, retention, and completion among students. According to Sternberg (2013), a drop in student retention negatively affects the student and the institution. A drop-in retention rate can affect the student's ability to attain education and career goals, whereas it will affect the institution financially due to the loss of revenue. Student persistence and completion depend on several factors. Bulger and Watson (2006) mentioned the influence of internal and external barriers affecting student persistence and completion rates. According to the authors, most students who do not advance or complete courses in community colleges are academically underprepared or have unrealistic goals.

Online courses offered at community colleges have similarities and differences compared to traditional face-to-face courses. Most online courses follow the same objectives, outlines, study materials, and assessments as face-to-face courses. As the need for flexibility, accessibility

and affordability is rising, community colleges rely more on online education (Crawford & Persaud, 2012). Even though online education is gaining popularity in community colleges, the reputation of this instructional delivery method is constantly debated. The authors mention that community college students have negative experiences in online courses due to the lack of resources, support services, and connections with the faculty. The authors are also concerned about how online education could hinder community college student success.

Health career educational programs are structured slightly differently from other similar academic programs. As pre-licensure programs, the students in health career programs are expected to hold higher academic performance standards throughout the program. The majority of health career programs require students to earn a final course grade of “C” or better in all program courses to continue in the program. Wilbeck et al. (2019) explained how Nursing programs expect students to master complex course contents and think critically. The academic rigor in health career courses is comparatively higher compared to other disciplines. Academic rigor is defined as the challenge or comprehensiveness of a course (Karsten & DiCicco-Bloom, 2014).

Student attrition, retention, and completion rates in health careers programs depend on several factors. Higher than average academic performance expectations along with higher academic rigorous course content and other personal reasons, are some of the factors in the list. Roush and Tesoro (2018) explained how the rigorous Nursing curriculum is often the reason for higher attrition and lower completion rates in Nursing programs. Social structures such as gender roles, gender identity, and work-life balance influence student retention. Hamshire et al. (2013) mentioned how students who have issues balancing schoolwork with family and other personal

issues struggle in clinical courses. The authors explain how the lack of proper mentorship and help managing academic stress is also a factor.

Admission to health career programs is often competitive and different. Prerequisite courses are generally implemented as part of preadmission requirements for these programs. Abou-Sayf and Miari (2007) explained that prerequisite courses are implemented to increase student success in a target course. The author mentioned how the number of prerequisites required for programs is on the rise. Introductory psychology, Chemistry, and biology courses are often implemented as gatekeeper courses or prerequisites to health careers programs. Some of these requirements for health career programs are based on the knowledge and skill requirements in the medical field (Jeschofnig & Jeschofnig, 2011). According to the authors, professionals in the medical field have to make rational and informed decisions every day at their work.

Anatomy and Physiology courses are challenging prerequisites for admission into Health career programs. These advanced-level science courses are considered gatekeeper courses for all health sciences programs, including Nursing and Allied health (Harris et al., 2004). The authors explain how success in these courses correlates with overall success in undergraduate health sciences programs. Anatomy and Physiology courses act as foundational courses, and a thorough grasp of the course contents from these classes is required for almost all health careers programs. A study done by Brown et al. (2017) found how Anatomy and Physiology courses can predict academic success in health career programs.

The course content for Anatomy and Physiology courses is often challenging for students. Sturges and Maurer (2013) reported that approximately 30% to 50 % of students fail Anatomy and Physiology courses. However, 89% of the students intended to continue with their chosen major in health careers. The authors explain how the students describe Anatomy and Physiology

as the most challenging gateway courses. Community colleges offer several sections of Anatomy and Physiology courses in a fully online format. Hughes (2008) explains how flexibility in online courses assists students in overcoming family and work barriers. Despite the growth of online education, Jeschofnig and Jeschofnig (2011) found several barriers to offering online science courses. The authors explain the hesitancy of educators to develop experimental activities and effective strategies in an online format. Even though the COVID pandemic forced institutions to switch all face-to-face courses to an online design, the actual impact and effectiveness of these course delivery methods need to be explored further.

Summary of Literature Review

Online education's flexibility, convenience, and independence made it popular in health career programs. Community colleges and higher educational institutions embraced online instructional delivery before the COVID pandemic. Despite its increased popularity, the impact of fully online gateway science courses on student academic performance in Health career programs is unclear. One of the studies by Brown et al. (2017) compared the achievements of Nursing students in their final semester with their success in the prerequisite Anatomy and Physiology course. The study found that students with higher grades in the prerequisite Anatomy and Physiology courses were more likely to achieve higher grades in Nursing courses. According to the researchers' students who achieved higher grades in Nursing courses tend to transfer their knowledge better into the clinical world. While there has been some research regarding the efficiency of prerequisite courses in general, such research has not explicitly focused on the impact of online gateway science courses in health career programs.

Conceptual Framework

This study is based on Rovai's (2003) Composite Persistence Model (CPM). The CPM model was derived from Tinto's (1975) theory on student retention and Bean and Metzner's (1985) theory on student attrition. Tinto's student integration model explained how factors such as personal characteristics, experience prior to college, and experiences at the college determine successful persistence in higher education (Tinto, 1975). He theorized that student experiences or integration following college admission is dependent on the student's academic and social experiences in college. The model measured academic integration using grade point average (GPA) and social integration by development and frequency of positive interactions at the college. The model also explains how the lack of interactions and community feeling likely results in students dropping out. In his recent works, Tinto mentioned the importance of building learning communities and collaborative work in classrooms (Tinto, 2012). Even though the model was considered influential in explaining persistence and attrition, it focused more on traditional undergraduate students.

Nontraditional students make up a large portion of the community college student population. This category includes a broad spectrum of students, and researchers often vary their definitions for this group. Bean and Metzner (1985) defined nontraditional students as full-time or part-time students older than twenty-four who do not live in a campus residence. Community college students enrolled in fully online courses are likely to be nontraditional. Nontraditional students are often influenced by academic experiences such as degrees, diplomas, and certificates rather than social interactions and experiences on campus. Bean and Metzner's model was grounded on Tinto's model, however focused on explaining how the factors of attrition rate varied between traditional and nontraditional students (Bean & Metzner, 1985). The model

predicted persistence similar to Tinto's model; however, it analyzed attrition factors using academic variables such as study habits and geographic variables such as age and ethnicity. Environmental variables such as finances, family responsibilities, and hours of employment were also analyzed in this model. Hence, Bean and Metzner's model is more valid in examining persistence among nontraditional online students.

Although Tinto's student integration model and Bean and Metzner's student attrition model helped to predict persistence and attrition, the models tend to focus more on traditional and non-traditional students in on-campus programs. An online learning environment differs from an on-campus environment (Rovai, 2003). Students taking fully online courses have different characteristics and needs than traditional students. Rovai came up with a composite model that combined Tinto's model and Bean and Metzner's model (Rovai, 2003). The CPM focuses on the attrition and retention rates of online learners. As the CPM was derived from Tinto's theory and Bean and Metzner's theory and focuses on online learners, the model is a more appropriate option for explaining persistence and retention in students that enroll in fully online courses.

The Composite Persistence Model developed by Rovai, as indicated in Figure 1 below, pays attention to student characteristics and skills prior to admission and external and internal factors affecting students after admission. According to the theory, student characteristics such as age, ethnicity, gender, intellectual development, and academic performance affect student persistence before admission (Rovai, 2003). Studies have found that differences in student demographics such as age, gender, and ethnicity play a role in student persistence. For example, in a study containing 500,000 courses among 40,000 community and technical college students in Washington state, the researchers found performance gaps between online and face-to-face

courses (Xu & Jaggars, 2014). The most substantial declines were noticed among younger students, males, Black students, and students with lower grade point averages. Academic GPA in previous courses predicts student persistence in online courses. Hachey et al. (2015) reported that students with prior experience in online courses and those with higher GPAs were more likely to complete online courses successfully.

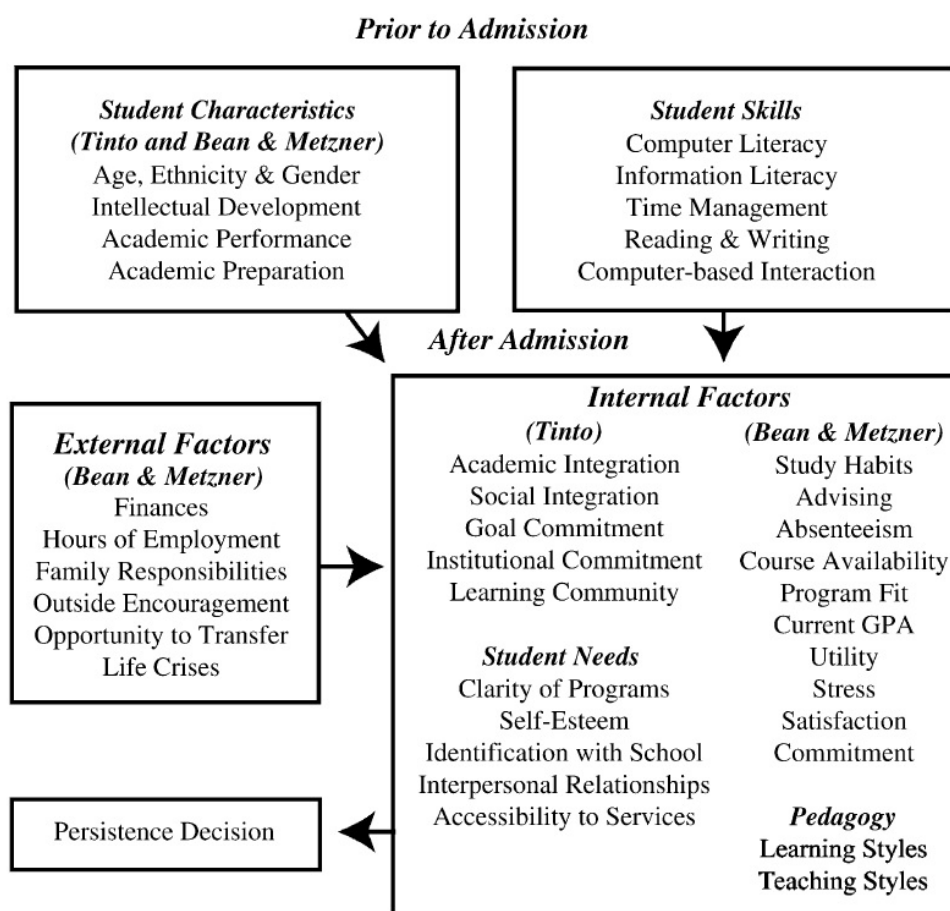


Figure 1: Composite Persistence Model explaining student persistence (Rovai, 2003).

Factors influencing student persistence in online courses after admissions can be internal and external (Rovai, 2003). Some of the external factors included finances, family

responsibilities, and employment. Additional demands on these factors adversely affect student persistence in the courses. Internal factors included social integration, satisfaction, and study habits. However, the students enrolled in fully online courses have additional factors affecting their persistence and retention. For example, the sense of community and communication in an online setting differs from a physical campus. Better awareness of online communities and communication results in better persistence among online students (Rovai, 2003). A student's learning style in an online course can also affect their persistence. A disconnect in learning style and the nature of the environment could negatively affect student persistence in online courses (Hart, 2012).

Student academic success can be subjective and is often explained differently by different researchers. According to York et al. (2015), student academic success relies on factors such as academic achievement, satisfaction, persistence, learning objectives, skills acquisition, and career success. Tinto (1975) measured students' academic integration using GPA. Bean and Metzner's (1985) model that focused on non-traditional students found that GPA directly correlates with student persistence. The CPM model, constructed on the concepts of Tinto's and Bean and Metzner's model, emphasizes the importance of GPA in pre- and post-admission. The relationship between GPA, persistence, and retention rates was compared in several other studies. Students with higher GPAs tend to persist and complete programs more successfully than those with lower GPAs (Schlosser & Anderson, 1994). For example, a student with a higher GPA in prerequisite courses tends to have a better chance of succeeding in future programs.

The Composite Persistence Model is widely used by researchers in predicting persistence and retention in online courses and programs (Rovai, 2003). According to the author, online course enrollment is dominated by non-traditional students over 24 years old, with a family and

full-time jobs. The CPM model assists in identifying student persistence and retention in online programs based on factors that affect students before and after admission. The relationship between fully online gateway science courses on student academic performance in HCAD programs in this study will be assessed through CPM lenses. Based on Rovai's Composite Persistence Model and other supporting literature, it can be hypothesized that fully online gateway science courses impact student academic performance in HCAD programs.

Research Design

The study will be conducted in a quantitative form using a non-experimental design. Quantitative research focuses on hypothesis testing, and researchers choose this method due to its objectivity and capacity to investigate social and human problems (Creswell & Creswell, 2018). This approach often relies philosophically on post-positivism which challenges the traditional notion of the absolute truth of knowledge and identifies that researchers cannot be optimistic about their knowledge claims.

Research Site

The setting chosen for this study is a large public community college in the Southeastern region of the United States. The college is one of the largest community colleges in the State and hosts around 70,000 students on its eight campuses. This multi-campus community college offers approximately 43 Associate Degree programs, 96 certifications, and six Baccalaureate degree programs and has received recognition for being the nation's top community college. The college has a history of maintaining affordable costs for its students and has the second lowest tuition and fees compared to other high-enrollment colleges in the State.

The college offers a variety of associate degrees, and they fall under two major categories, Associates in Arts (A.A.) and Associates in Science (A.S.). The number of students

earning an associate degree doubled between 2001 and 2013, and the number of students of color earning an AS degree during that time has tripled in this college. The persistence rates among students enrolled between 2011-2017 were reported to be relatively stable in 2019. The college also reported an increase in graduation rates in the same year. The institution has steadily increased enrollment among AS degrees for three consecutive years as of 2021 reporting. However, a consistent decline trend was noticed among the A.A. enrollment rates. The data correlates with the nationwide decline in visual and liberal arts disciplines.

The college serves a diverse population of students by maintaining a steady enrollment ratio. According to the 2021 report, the median age and ethnicity of the students enrolled have remained consistent. The median age of students reported by the institution in 2021 is 21. About 60 % of the students enrolled in the college are between the ages of 18 to 24, and 28% of the student population is 25 and older. The racial/ethnic breakdown of enrolled students in the college was 41% Hispanic/Latinx, 24% White, 17 % Black or African American, and 5% Asian.

Gender-specific enrollment trends were reported to be consistent for the past three years at this college. Gender was listed as a binary in the RCC database, and the student characteristic was redefined with biological sex for this study. Female students were consistently higher among the enrolled students for the 2018-19, 2018-20, and 2020-21 academic years. However, the gap between male and female student enrollment rates grew during specific years. The percentage gap between male-female student enrollment was 15.8 % in the fiscal year 2018-19, and the percentage gap was recorded at 20 % by the fiscal year 2020-2021. The gap in male and female student enrollment rates correlates with the low nationwide enrollment among male students.

The institution allows students to take college-credit courses through several instructional delivery methods. The modes of delivery used at this institution are online, real-time virtual

(RTV), mixed mode, and the face-to-face approach. The online and RTV strategies are both fully online courses; however, the RTV mode requires students and instructors to meet online during assigned dates and times. Face-to-face delivery refers to traditional on-campus courses, and the mixed method includes a blend of face-to-face with a minimum of 30 % of online delivery. Approximately 66% of the students are enrolled in 2021 part-time status, 34 % in full-time status and the average class size is 21.7.

The health careers division at this college offers a variety of Baccalaureate degrees, Associate degrees, and certificate programs in Allied health and Nursing. These programs help students develop the skills and expertise to succeed in a high-demand health career such as Nursing, Radiography, and Respiratory therapy. The student demographics for HCAD programs at the college are slightly different from general college demographics. Approximately 60% of the students enrolled in HCAD programs for the 2020-21 academic year are over 25 years of age, and among them, about 33% were reported to be over 30 years of age. These programs' racial/ethnic breakdown was 34% White, 33% Hispanic/Latinx, 16 % Black or African American, and 7% Asian. Female student enrollment is much higher in the programs, with an 80 % enrollment compared to 18% male and 2% unreported.

All HCAD programs in this college are limited access programs, and admission to these programs is based on overall GPA and successful completion of prerequisite courses. The Six HCAD programs selected for the study are Nursing, Radiography, Diagnostic Sonography, Dental Hygiene, Cardiovascular Technology, and Respiratory Care. Despite program accreditation requirements, all these HCADs have very similar course structures and curricula. Gatekeeper courses such as Anatomy and Physiology are traditionally offered face-to-face. Delivery modes such as online and mixed-mode approaches are also used for these courses. As a

result of the COVID pandemic, Regional Community College (Pseudonym), referred to as RCC in this study, flipped all face-to-face and mixed-mode courses into a fully online environment.

Data Source and sample

This quantitative case study examines whether completing fully online gateway science courses is related to student academic performance in HCAD programs. A sample of students enrolled in the fall, spring, and summer semesters between 2018 and 2021 will be utilized for the study. Institutional data will be retrieved for the specific academic year. Each semester the institution offers approximately 40 sections of A&P I and 30 sections of A&P II courses, adding to around 8000 students (duplicated headcount) in three years. The six HCAD programs selected for the study enroll an average of 800 students per academic year adding to around 2400 students in three years. A&P I and II courses are prerequisites for all of them.

All information will be retrospectively retrieved from the institution. Rovai (2003) emphasizes the importance of evaluating persistence and retention based on student characteristics before and after admission. Data collected will include course grades from A&P courses taught in all formats for the specific years. Data will be separated based on fully online and other format categories. The modes of course delivery for other formats include real-time virtual (RTV), mixed mode, and the face-to-face approach.

Data for Student academic performance after admission to HCAD programs include each student's program retention rates and cumulative GPA. The retention data will provide information on student academic performance in HCAD programs. The course GPA information will help identify the academic performance of students who attend A&P courses in a fully online format and other course delivery formats. In addition to these data, student demographic information such as age, sex, and ethnicity/race backgrounds will also be collected. Participant

names or other identifying information will not be retrieved for confidentiality purposes. The study variables and codes are summarized in Table 1.

Table 1

Proposed Variables and Coding

Research Questions		Variables and Coding	Data analysis
RQ1:	Is there a difference in final course grades among students who completed A&P courses in a fully online format and other course delivery formats?	Independent Variable	Fully online A&P course participation. Yes = 1 No = 0
		Dependent Variable	Mean course grades A=4.0; B=3.0; C=2.0; D=1.0 and F=0 Continuous from 0 to 4.0
RQ2:	Is there a difference in first-year retention among HCAD program students who completed A&P courses in a fully online format and other course delivery formats?	Independent Variable	Fully online A&P course participation. Yes = 1 No = 0
		Dependent Variable	Student Retention Retained 1 Not Retained 0
RQ3:	Is there a difference in cumulative GPA among HCAD program students who completed A&P courses in a fully online format and other course delivery formats?	Independent Variable	Fully online A&P course participation. Yes = 1 No = 0
		Dependent Variable	Mean Cumulative GPA Continuous from 0 to 4.0

Data Analysis Methods

Descriptive analysis will be used to describe the student population of the study in a logical and meaningful way, based on students' demographic characteristics (e.g., age, sex, and race/ethnicity). An independent t-test of two means will be used to evaluate the difference in final course grades among students who took A&P courses fully online and in other formats. An Independent t-test or two-sample t-test is a statistical test used to compare the means of two groups (Pyrzczak & Oh, 2018). A chi-square test will be used to determine the relationship between student retention in HCAD programs and their completion of A&P courses in face-to-face format and fully online format. Chava Frankfort-Nachmias et al. (2021) defined the chi-square test as an inferential statistical technique designed to test relationships between two nominal or ordinal variables. The difference in cumulative GPA among students in HACD programs will also be analyzed using an independent t-test.

The first research question was to determine whether there is a difference in final course grades among students who completed A&P courses fully online and other course delivery formats. An independent t-test will be used for data analysis. Students with letter grades A, B, C, D, and F will be only included in the study. The following points system will be assigned to course grades: A=4.0; B=3.0; C=2.0, D=1.0, and F=0. The dependent or test variable will be the mean course grades, and the independent or grouping variable will be the students who completed A&P course entirely online or in other formats.

The second research question will determine whether there is a difference between the probability of first-year retention among HCAD program students who completed A&P courses fully online and other course delivery formats. A chi-square analysis will be conducted to evaluate if there is a difference in retention among HCAD program students who completed A&P

courses in a fully online format and other course delivery formats. The two variables will be the retention status of the student with two levels, retained and not retained in the program, and the format of the class, fully online and other formats.

Finally, the last research question is to identify whether there is a mean difference in cumulative GPA between HCAD program students who completed A&P courses fully online and other course delivery formats. An independent t-test will be used to evaluate the difference in academic performance of students in HACD programs who completed A&P courses in a fully online format and other course delivery formats measured by GPA. The dependent or test variable will be the mean cumulative GPA, and the independent or grouping variable will be the students who completed A&P course entirely online or in other formats.

Limitations

The following are some of the limitations anticipated in the study. One of the main limitations is the difficulty generalizing the analysis as all the data is retrieved from one institution. HCAD programs at RCC only accept a limited number of students per cohort year due to the selective admission process. In addition, the institution only had one whole year of fully online instruction due to the COVID pandemic. Next, participants might have unique challenges or strengths since the fully online instructions were offered during the COVID pandemic. These unique strengths or weaknesses could affect the reliability of the study negatively. Additionally, since each HCAD programs are unique program culture and demographics of students, gathering all the program data together could create some validity issues.

Significance of the study

The need for health career programs has increased significantly due to the increased demand for healthcare professionals. Community colleges all over the United States are forced to increase the number of course sections for gateway science courses to accommodate the prerequisite needs of students in health career programs. Technology innovations and advancements encourage these colleges to shift some of the gateway course delivery into fully online formats. Even though fully online course delivery is getting popular in community colleges, research gaps exist regarding the impact of these courses in health career programs.

The research is intended to identify the relationship between fully online gateway science courses and student academic performance in Health Career programs at RCC. The study builds on existing literature that shows the importance of Anatomy and Physiology courses in the overall success of health career programs. There is an increased need for colleges to collaborate to improve student retention and completion in health career programs. Though this study is specific to RCC, results could be transferable, and it can be easily replicated in similar health career programs at other institutions across the United States. The results from the study could help community colleges and similar institutions to identify the populations that are struggling in health career programs.

Students enrolled in health career program courses at a community college have characteristics and needs that differ from those in other programs. The selective admission process, clinical education, academic rigor, and licensure requirements make health career programs unique and different from other programs. Students taking health career courses are required to earn a final course grade of “C” or better in all program courses to continue in the program. The results from the study could eliminate the concern of academic rigor and integrity

while offering these courses in different delivery formats. This study is based on the guided principles of Rovai's Composite Persistence Model. The conceptual framework could lead the study to identify student persistence, retention, and academic performance, specifically among the unique student population in health career programs.

Gateway courses such as Anatomy and Physiology are considered foundational courses for almost all health career programs. The popularity of online delivery for these courses is on the rise, so the importance of online teaching and learning awareness is also on the rise. The findings of the study can shed light on current perceptions and practices of community college faculty members regarding online teaching and learning. The results from the study could help faculty determine the types of interventions they want to utilize for their online courses. Program chairs and directors could use these study results while creating or revising their curricula and making recommendations to the college administration. They could also use the results while providing a rationale for their programmatic accreditation for choosing or not choosing the delivery method.

The college administration could use the study results in creating, maintaining, and eliminating online courses. Knowledge from this study could help guide colleges in developing high-quality, effective online courses and programs. The study findings could enhance knowledge among administrators regarding the relation between course delivery formats, student academic performance, retention, and completion in health career programs. Additionally, administrators might use the results to allocate funding toward online course development and training sessions and thus help the students and the community.

CHAPTER 2

THE RELATIONSHIP BETWEEN FULLY ONLINE GATEWAY SCIENCE COURSES AND STUDENT ACADEMIC PERFORMANCE IN HEALTH CAREER ASSOCIATE DEGREE PROGRAMS AT REGIONAL COMMUNITY COLLEGE

Introduction

The shortage of Allied health and Nursing professionals is a growing concern in the United States. Healthcare facilities across the United States must hire at least 200,000 new nurses annually to meet the demand and replace the retiring nurses (American Hospital Association, 2021). The workforce report also indicated critical shortages in other Allied health professions. The higher education system must be able to supply additional graduates to meet the demand in the healthcare workforce. One of the solutions to meet the increased demand for health career professionals is the creation of online courses and programs (Chan et al., 2012). Unlike traditional face-to-face courses, online learning allows students to access course materials anytime. The global COVID pandemic in 2020 forced faculty and administrators to transition all face-to-face courses, including gateway science courses, into an online environment. Transitioning from a face-to-face course into a fully online environment has raised questions regarding the effectiveness of the delivery system in the past (Bell & Federman, 2013).

Healthcare professions are one of the fastest-growing job sectors in the United States. The Bureau of Labor statistics projected healthcare occupations to grow approximately 13%, adding about 2 million new jobs from 2021 to 2031 (U.S. Bureau of Labor Statistics, 2022). The Federal Code and Affordable Care Act (ACA) requires all Allied health professionals to complete

a professional degree or certificate from a higher education institution to work in the field (Affordable Care Act, 2009). Community colleges serve a vital role in preparing students for health careers by offering various Health Careers Associate Degree (HCAD) programs. Some of the common HCAD programs include but are not limited to, Nursing, Radiography, Dental Hygiene, Diagnostic Sonography, Cardiovascular Technology, and Respiratory Therapy. These associate degree programs are structured to offer students the opportunity to earn national certifications and or state licensures within their specific medical profession.

Associate degree programs in health careers are vocational and geared toward specific roles in healthcare. The admission process to health career degree programs are highly competitive and generally different from other associate degree programs (Salvatori, 2001). Programmatic accreditation and professional regulatory requirements vary depending on the type of program. Curriculum and program outcomes are chosen based on the specific program (Ingrassia, 2016). Despite the differences, associate degrees in health careers aim to prepare their students to draw on evidence-based practices and focus on delivering compassionate patient care. The prerequisite science course requirements are similar or the same for these programs. In addition, the HCAD programs are structured with didactic and clinical courses. Didactic courses enhance conceptual learning and promote hands-on skills in a simulated environment (Adler & Carlton, 2019). Clinical courses allow students to observe and perform procedures and activities in a real-world clinical setting.

Anatomy and Physiology (A&P) courses are generally identified as gateway science courses to health career programs. Completing gatekeeper courses such as A&P is often considered predictive of student success in Allied health and Nursing programs (Newton et al., 2007). A&P courses have been traditionally taught face-to-face, predominantly due to the

psychomotor nature of these courses (Johnston et al., 2015). Technological advancements and societal changes have made community colleges shift some gateway science courses into a fully online format well before the COVID pandemic. The global pandemic forced institutions to offer all the courses in a fully online format. Despite its increased popularity, the impact of fully online gateway courses on student academic performance in HCAD programs is unclear. While there has been some research regarding student success in online science courses (Garman, 2012), such research has yet to explicitly focus on students in health careers programs.

The purpose of this quantitative study was to determine the relationship between fully online gateway science courses and student academic performance in HCAD programs at Regional Community College (RCC). The study identified student demographic characteristics such as age, sex, and race/ethnicity to get a broader picture of the specific student population. The findings demonstrate the relationship between fully online learning in gateway science courses and student academic performances in HCAD programs. The research also analyzed the relationship between the mode of delivery and student academic performances in gateway science courses through a pre- and post-COVID pandemic lens. The following questions guided the research:

1. Is there a difference in final course grades among students who completed A&P courses in a fully online format and other course delivery formats?
2. Is there a difference in first-year retention among HCAD program students who completed A&P courses in a fully online format and other course delivery formats?
3. Is there a difference in cumulative GPA among HCAD program students who completed A&P courses in a fully online format and other course delivery formats?

Review of Literature

The demand for healthcare professionals continues to increase rapidly in the United States. American Hospital Association reported a 30 % increase in job vacancies for various Nursing personnel and a 31% increase in Respiratory therapists between 2019 and 2020 (American Hospital Association, 2021). The nationwide staffing shortage created the need for more newly graduated healthcare professionals. A study by Mercer, a consulting firm, projected a critical shortage of Nursing and Allied health professionals, leading to a shortage of 3.2 million healthcare workers by 2026 (U.S. Healthcare Labor Market, 2021). Higher educational institutions are faced with the goal of promoting practical strategies for graduating additional healthcare professionals. Community colleges embraced fully online instructional delivery before the COVID pandemic (Ortagus, 2017). However, the global pandemic has shifted several gateway science courses that have been traditionally taught face-to-face to a fully online setting.

Online Education and Student Success

Online teaching and learning have become widely accepted educational practices in higher education. The current online education was evolved from distance education methodology, which utilized correspondence, audio, and video tools to provide and assist instruction in the past (Kentnor, 2015). Southern Association of Colleges and Schools Commission on Colleges (2020) identifies online education as one of the many instructional methodologies used in distance learning. Online course delivery methods include fully online, blended or hybrid and traditional course formats (Montelongo, 2019). Fully online courses are offered entirely online in synchronous or asynchronous formats with no physical in-person interaction. Blended or hybrid courses consist of online and face-to-face sessions, and the amount of time allotted for each session varies depending on the curricula (Ruiz et al., 2006).

Traditional formats require students to meet face -to face; however, these courses often use online technology to deliver supplemental materials for the course.

The advancement of the internet and the accessibility of technology created a surge in demand for online teaching and learning. Even before the COVID pandemic, more than 60% of postsecondary educational leaders welcomed online learning as a part of their long-term strategies (Gering et al.,2018). Among the higher education students enrolled in 2012, 32.5% were enrolled in online courses (Allen & Seaman, 2013). Crawford and Persaud (2012) mentioned how online enrollment in community colleges grew by 8.2% in 2011 while overall enrollment remained somewhat stagnant. While online learning was in use before the global pandemic, as COVID pandemic gripped the nation, forcing educational institutions to shutter their doors, online learning became one of the only methods of instruction. The rapid shift from face-to-face to online course delivery opened a new perspective on digital pedagogy.

Advantages of Online Education

Online course delivery has several advantages over face-to-face and other course delivery methods. Flexibility is one of the significant benefits of online learning (Francescussi & Rohani, 2019). Online courses allow students to participate in the course from their convenient locations using their laptops or computers. Nontraditional students such as adult learners and working parents make up most community college students. These community college students often juggle their careers and personal life commitments while achieving their academic goals (Bourdeaux & Schoenack, 2016). The asynchronous online course format offers flexibility and accessibility to students by allowing them to take classes anywhere and anytime. As open-access institutions, accessibility and flexibility are vital for community colleges.

Course delivery in an online format allows a multi-modal approach to teaching and learning. Soffer and Nachmias (2017) explained how students enjoy online videos and activities better than the activities in face-to-face courses. Technological advancements have paved the road to improving the learning experience for online learners. In addition to flexibility, accessibility, and multi-modal learning, online course delivery also benefits the learner and the institution with affordability. Choe et al. (2019) have explained the advantage of online education in accommodating more students in classrooms without needing additional physical space. According to the author, online courses help institutions cut the cost of staffing and space, making them more affordable to students and administrative perspective.

Disadvantages of Online Education

While online education has become an accepted practice in higher education, the method of course delivery has been criticized by several researchers. McKenzie (2017) reported that students question the quality of online education even when they accept its value. Research by Hart et al. (2016) states that students have poorer outcomes online than in face-to-face courses. According to the study, students completing online courses tend to receive lower passing grades and are more likely to repeat the courses. Academic performance among low-income or underrepresented students enrolled in online courses is also an issue. Low-income, Black or African American, and Hispanic/Latinx students tend to need help with academic performance in online courses (Johnson & Mejia, 2014).

Human interaction, classroom engagement, and collaboration are some concerns in online courses. Herman (2020) identified significant issues in immediate interactions with students in his online courses. The author found out that most of his students who had taken courses in the face-to-face format disliked the online version of the course. The article mentioned that most

students disappointed with online courses missed human interaction. The author also noted how some students in his online courses were concerned about the increased chances of distractions in online learning. Positive human interactions and collaborative learning are vital for students to become active learners. Higher education students who take more online courses tend to engage less in collaborative learning and student-faculty interactions (Dumford & Miller, 2018). The study also reported that these students tend to have less exposure to effective teaching practices and lower quality of interactions.

As the demand for online courses increased, higher education institutions focused on developing online courses. The COVID pandemic forced community colleges to shift all their face-to-face courses online. Transforming traditional courses to the online environment requires adequate time and effort. Switching face-to-face courses to an online format quickly is like conducting conventional courses at a distance. Hart et al. (2016) explained how underqualified and underprepared faculty affect online programs' quality. According to Lopez (2020), some experienced professors at Glendale community college needed more experience teaching online. Almost half of the faculty who taught in the college requested additional time to switch from face-to-face courses to online. According to the author, several students, including single parents, expressed concerns about the switch. Students who needed additional academic help, counseling, and face-to-face support also needed help catching up with their semesters.

Student Academic Success in Online Courses

Student academic success is generally measured using Grade Point Averages (GPA), persistence, retention, completion, and time to graduation rates. Researchers focus on grades or GPA to measure academic success (York et al., 2015). Factors such as affordability, student demographics, and Institutional characteristics are often ignored. Online courses differ from

traditional face-to-face courses. Kauffman (2015) explains how students in traditional face-to-face courses prefer active learning strategies, whereas online learners prefer a reflective learning style. According to the study, successful online students tend to be self-motivated and self-directed, with above-average communication and interaction skills. Adequate course and instructional design is also a critical success factor for students in online courses.

Community colleges across the nation face several challenges in promoting academic success. A drop-in retention rate affects the student's ability to attain education and career goals, whereas it will also affect the institution financially due to the loss of revenue (Sternberg, 2013). Students receiving proper support were more likely to retain in the online courses. Technology skills, self-motivation, and time management are challenges among community college students taking online courses (Johnson et al., 2014). The researchers added academic preparation, reading, and writing skills to the challenge list. Student persistence and completion in online courses depend on several factors. Shelton et al. (2017) found that students who demonstrate higher levels of engagement through a social presence in online courses had better persistence and completion rates than others.

Health Career Program Student Success and Gateway Science Courses

Healthcare have historically demonstrated staffing shortages in the United States. The study performed by U.S. Healthcare Labor Market (2021), predicted that the demand for healthcare workers will beat the supply by 2025. Research in the past has also identified similar shortages in healthcare professionals, including nurses and Allied health professionals (Levit et al., 2009). Several factors contribute to the severe healthcare professional shortage in the United States. Factors such as the aging population, increasing healthcare needs, and the massive shift in

healthcare due to the COVID pandemic contribute to the shortage. Higher education institutions such as community colleges play a huge role in creating the healthcare workforce.

Health career academic programs include a broad range of highly competitive programs under the Nursing and Allied health categories. These academic programs are highly competitive and structured differently from other similar programs. The academic rigor in health career courses is comparatively higher compared to other disciplines. Academic rigor is defined as the challenge or comprehensiveness of a course (Karsten & DiCicco-Bloom, 2014). As pre-licensure programs, the students in health career programs are expected to hold higher academic performance standards throughout the program. The majority of health career programs require students to earn a final course grade of "C" or better in all program courses to continue in the program. Wilbeck et al. (2019) explained how Nursing programs expect students to master complex course contents and think critically.

Student academic success in health career programs is often linked with attrition, retention, and completion rates. Attrition and retention rates have been identified as significant issues in Nursing programs for the past 50 years (Merkley, 2015). Higher academic performance expectations and academic rigor are responsible for high attrition rates in health career academic programs. Roush and Tesoro (2018) explained how the rigorous Nursing curriculum is often the reason for higher attrition and lower completion rates in Nursing programs. Social structures such as gender roles, gender identity, and work-life balance influence student retention. Hamshire et al. (2013) mentioned how students who have issues balancing schoolwork with family and other personal issues struggle in clinical courses. The authors explain how the lack of proper mentorship and help in managing academic stress is also a factor.

The admission criteria to health career programs often differ from other similar programs. These limited seat capacity programs require students to have a specified minimum GPA and prerequisite courses completed prior to getting admitted. Program admission criteria are selected to assess students' academic readiness for a rigorous curriculum. Abou-Sayf and Miari (2007) explained that prerequisite courses are implemented to increase student success in a target course. The author mentioned how the number of prerequisites required for programs is rising. Introductory psychology, Chemistry, and biology courses are often implemented as gatekeeper courses or prerequisites to health careers programs. Some of these requirements for health career programs are based on the knowledge, skill, and critical thinking requirements in the medical field (Jeschofnig & Jeschofnig, 2011). According to the authors, professionals in the medical field have to make rational and informed decisions every day at their work.

Student academic performance in gateway science courses strongly predicts academic success in health career programs. Wambuguh et al. (2016) found that students who completed gateway science courses with a higher grade had a better chance of graduating from the Nursing program than those who scored less in those courses. Anatomy and Physiology courses are challenging prerequisites for admission into Health career programs. These advanced-level science courses are considered the gatekeeper for all health sciences programs, including Nursing and Allied health (Harris et al., 2004). The authors explain how success in these courses correlates with overall success in undergraduate health sciences programs. Anatomy and Physiology courses act as foundational courses, and a thorough grasp of the course contents from these classes is required for almost all health careers programs. A study done by Brown et al. (2017) found how Anatomy and Physiology courses can predict academic success in health career programs.

The course content for Anatomy and Physiology courses is often heavy and challenging for students. These gateway science courses are difficult for students as they require them to comprehend vast and complex information utilizing higher-order thinking strategies. Entezari and Javdan (2016) noticed a 30- 40% dropout rate within Anatomy and Physiology courses at LaGuardia Community College. The student failure rate in A&P courses is also higher than in other similar science courses. Sturges and Maurer (2013) reported that approximately 30% to 50 % of students who enroll in Anatomy and Physiology fail these courses. However, 89% of the students in these courses intended to continue with their chosen major in health careers. The authors explain how the students describe Anatomy and Physiology as the most challenging gateway science courses.

As the need for online courses has significantly increased, community colleges offer several sections of Anatomy and Physiology courses in a fully online format. Hughes (2008) explains how flexibility in online courses assists students in overcoming family and work barriers. Despite the growth of online education, Jeschofnig and Jeschofnig (2011) found several barriers to offering online science courses. The authors explain the hesitancy of educators to develop experimental activities and effective strategies in an online format. Even though the COVID pandemic forced institutions to switch all face-to-face courses to an online design, these course delivery methods' actual impact and effectiveness need to be explored further.

Conceptual Framework

This study was driven based on Rovai's (2003) Composite Persistence Model (CPM). The model focused on critical factors affecting online learners' persistence and student success. The CPM was developed from Tinto's (1975) theory on student retention and Bean and Metzner's (1985) theory on student attrition. Tinto's student integration model explained how factors such

as personal characteristics, experience prior to college, and experiences at the college determine successful persistence in higher education (Tinto, 1975). Bean and Metzner's model was grounded on Tinto's model; however, it focused on explaining how the factors of attrition rate varied between traditional and nontraditional students (Bean & Metzner, 1985). Even though both Bean and Metzner's and Tinto's model was considered influential in explaining persistence and attrition, they focused more on on-campus and face-to-face learning environment.

Nontraditional students make up a large portion of the community college student population. Bean and Metzner (1985) defined nontraditional students as full-time or part-time students older than twenty-four who do not live in a campus residence. Nontraditional students are often influenced by academic experiences such as degrees, diplomas, and certificates rather than social interactions and experiences on campus. Although Tinto's student integration model and Bean and Metzner's student attrition model helped predict persistence and attrition, the models focus more on traditional and nontraditional students on campus. Students taking fully online courses have different characteristics and needs than traditional students as their environment differs from an on-campus environment (Rovai, 2003). The composite model combined Bean and Metzner's with Tinto's models in explaining online learners' persistence and retention rates.

Rovai (2003), as indicated in Figure 2 below, incorporated pre- and post-admission elements as predictors for student persistence in online courses. According to the theory, student characteristics such as age, ethnicity, gender, intellectual development, and academic performance affect student persistence before admission. A study containing 500,000 courses among 40,000 community and technical college students in Washington State reported significant performance gaps between online and face-to-face courses based on student

demographics (Xu & Jaggars, 2014). The CPM identified student finances, family responsibilities, and employment as external factors affecting student persistence after admission. Student studying habits, social integration, and GPA were listed as internal factors under post-admission. Better awareness of online communities and communication results in better persistence among online students. Hachey et al. (2015) reported that students with higher GPAs were likelier to complete online courses successfully.

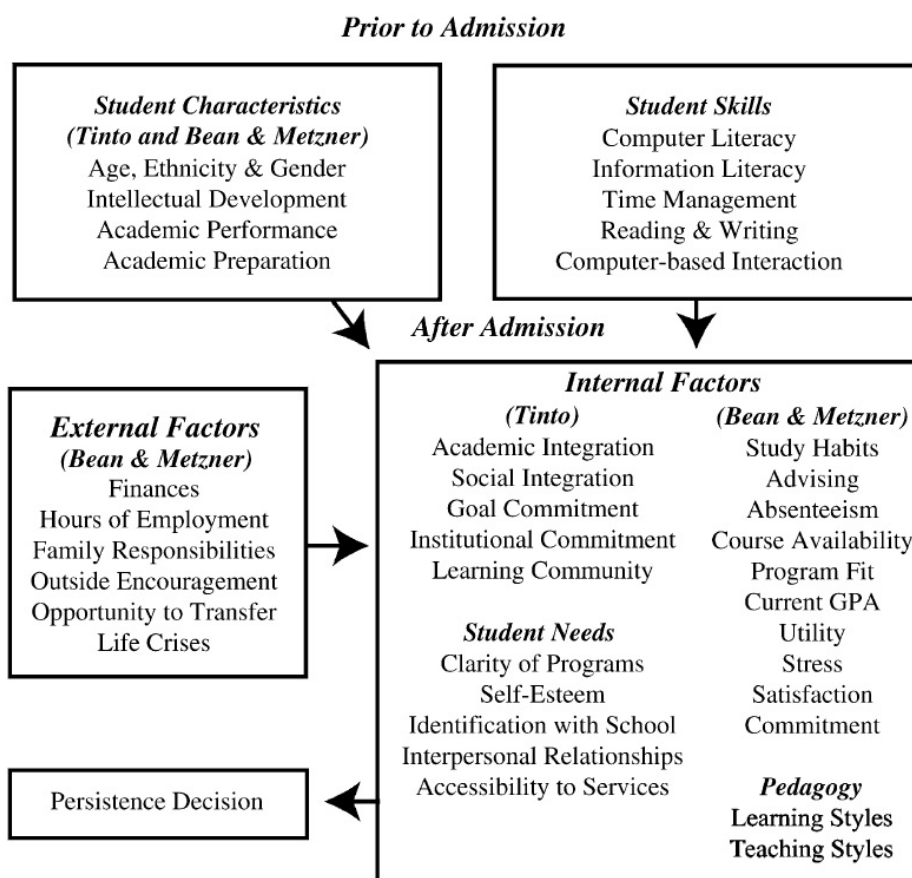


Figure 2: Composite Persistence Model explaining student persistence (Rovai, 2003).

The CPM serves as the conceptual framework for this study as some of the predictors for student persistence mentioned in the model align well with the study. Student Characteristics prior to admission, such as age, sex, and ethnicity information, were included in the data analysis. The study evaluated internal factors by analyzing the student academic performance in HACD programs using GPA. The relationship between online gateway science courses and student retention in HCAD programs was also evaluated in the study. Furthermore, the study evaluated primarily nontraditional community college students enrolled in fully online courses. As CPM assists in identifying nontraditional student persistence and retention in an online environment, the framework was a perfect fit for this current study.

Research Design

The study was performed using a quantitative non-experimental research design. Quantitative research focuses on hypothesis testing, and researchers choose this method due to its objectivity and capacity to investigate social and human problems (Creswell & Creswell, 2018). The study used existing institutional data to analyze the relationship between fully online gateway science courses and student academic performance in HCAD programs at RCC.

Research Site

The research site selected for this study was a large public community college in the Southeastern region of the United States. The Regional Community College (Pseudonym), referred to as RCC in this study, is one of the largest community colleges in the State and hosts around 70,000 students on its eight campuses. This multi-campus community college offers approximately 43 associate degree programs, 96 certifications, and six Baccalaureate degree programs and has received recognition for being the nation's top community college. The college

has a history of maintaining affordable costs for its students and has the second lowest tuition and fees compared to other high-enrollment colleges in the State.

The college serves a diverse population of students by maintaining a steady enrollment ratio. The median age of students reported by the institution in 2021 is 21. About 60 % of the students enrolled in the college are between the ages of 18 to 24, and 28% of the student population is 25 and older. The racial/ethnic breakdown of enrolled students in the college was 41% Hispanic/Latinx, 24% White, 17 % Black or African American, and 5% Asian. Gender was listed as a binary in the RCC database, and the student characteristic was redefined with biological sex for this study. Female students were consistently higher among the enrolled students for the 2018-19, 2019-20, and 2020-21 academic years. However, the gap between male and female student enrollment rates grew during the specific years. The percentage gap between male-female student enrollment was 15.8 % in the fiscal year 2018-19, and the percentage gap was recorded at 20 % by the fiscal year 2020-2021.

The health careers division at this college offers a variety of Baccalaureate degrees, associate degrees, and certificate programs in Allied health and Nursing. These programs help students develop the skills and expertise to succeed in a high-demand health career such as Nursing, Radiography, and Respiratory therapy. The student demographics for HCAD programs at the college differ slightly from the overall student demographics at RCC. Approximately 60% of the students enrolled in HCAD programs for the 2020-21 academic year are over 25 years of age; among them, about 33% were reported to be over 30. These programs' racial/ethnic breakdown as reported by the institution was 34% White, 33% Hispanic/Latinx, 16 % Black or African American, and 7% Asian. Female student enrollment is much higher in the programs, with an 80 % enrollment compared to 18% male and 2% unreported.

Data Source and sample

The study used existing institutional data from RCC. The primary data consisted of three sets, and the first one includes students enrolled in A&P II courses (BSC2094C) from the academic year 2017-18 to 2021-22 ($n = 11,138$). Students could complete A&P II courses at different institutions and transfer to RCC. One sub-sample included first-year HCAD students who completed A&P II, specifically at RCC, from 2017-18 to 2021-22 ($n = 741$). The other sub-sample included HCAD program graduates who completed A&P II, specifically at RCC, from 2018 to 2022 ($n = 1,426$). The Six HCAD programs selected for the study are Nursing, Radiography, Diagnostic Sonography, Dental Hygiene, Cardiovascular Technology, and Respiratory Care. Despite program accreditation differences, all these HCADs have very similar course structures and curricula. Gateway science courses such as A&P II are the prerequisite courses for all HCAD programs used in this study. This quantitative study examined whether completing fully online gateway science courses was in any way related to student academic performance in HCAD programs.

All the data were retrospectively retrieved from the institution. Data collection was performed after obtaining Institutional Review Board (IRB) approval from Northern Illinois University and RCC. The composite model emphasizes the importance of evaluating persistence and retention based on student characteristics before and after admission (Rovai, 2003). Data collected included course grades from A&P II courses taught in all formats for the specific years. Data were separated based on fully online and other format categories. The modes of course delivery for other formats include Real-Time Virtual (RTV), mixed mode, and the face-to-face approach.

Data for student academic performance after admission to HCAD programs included each student's first-year program retention rates and cumulative GPA. The retention data collected for the study evaluated the relationship between course delivery methods in gateway science courses and student retention in HCAD. The graduation GPA information was used to analyze the relationship between course delivery methods in gateway science courses and overall student academic performance in HCAD programs. In addition to these data, student demographic information such as age, sex, and ethnicity/race backgrounds were also collected. The data was retrieved as password-protected Microsoft Excel tables. The only student identification information was coded for confidentiality purposes.

Variables

The study addressed questions to analyze the relationship between fully online gateway science courses and student academic performance in HCAD programs at RCC. Guided by the Composite Persistence model (Rovai, 2003), student retention and academic performance in HCAD programs were analyzed. The three dependent variables for this study were: 1) Mean course grade points for A&P II continuous from 0 to 4.0, 2) First-year student retention in HCAD programs with the dichotomous outcome (retained = 1, not retained = 0), and 3) Mean Cumulative GPA for HCAD program graduates continuous from 0 to 4.0. Mean course grade points were calculated as continuous variable values 0 to 4 based on the quality points per credit assigned by RCC for each letter grade, A = 4; B = 3; C = 2; D = 1, F = 0, and W = 0. A unique withdrawal option put in place by the institution for students who struggled with natural disasters and the COVID pandemic was recorded as R20 equals 0. Information on the sample, variables and coding utilized for this study are listed in Table 2.

Table 2

Study Variables and Coding

Research Questions	Sample	Variables and Coding		Analysis
RQ1: Is there a difference in final course grades among students who completed A&P courses in a fully online format and other course delivery formats?	Students enrolled in A&P II courses (BSC2094C), academic year 2017-18 to 2021-22 (<i>n</i> = 11,138)	Independent Variable	A&P course completion format 1 = pre-COVID in-person 2 = post-COVID in-person 3 = post-COVID online	ANOVA
		Dependent Variable	Mean course grade points. Continuous 0 to 4.0	
RQ2: Is there a difference in first-year retention among HCAD program students who completed A&P courses in a fully online format and other course delivery formats?	First-year HCAD students who completed A&P II at RCC, academic year 2017-18 to 2021-22 (<i>n</i> = 741)	Independent Variable	A&P course completion format 1 = pre-COVID in-person 2 = post-COVID in-person 3 = post-COVID online	Chi - Square
		Dependent Variable	First-year student retention Retained 1 Not Retained 0	
RQ3: Is there a difference in cumulative GPA among HCAD program students who completed A&P courses in a fully online format and other course delivery formats?	HCAD program graduates who completed A&P II at RCC, academic year 2017-18 to 2021-22 (<i>n</i> = 1,426)	Independent Variable	A&P course completion 1 = pre-COVID in-person 2 = post-COVID in-person 3 = post-COVID online	ANOVA
		Dependent Variable	Mean Cumulative GPA Continuous 0 to 4.0	

Independent Variable for this study A&P II course completion, has multiple levels with three possible values, 1 = pre-COVID in-person, 2 = post-COVID in-person, 3 = post-COVID online as indicated above in Table 2. The rationale for using multiple levels of the independent variable was because of the unexpected switch in course delivery formats due to the pandemic. Fully online courses in A&P II were only offered at RCC after the Summer of 2020 in Post-COVID courses. The online category includes fully online courses in delivered synchronous or asynchronous formats. The in-person category included mixed-mode and face-to-face formats that required some form of physical presence on the campus.

Based on the data retrieved from the institution and the guided conceptual framework of the study, the sociodemographic information of the participants is relevant to the study. Participant characteristics such as age, Sex, Race/Ethnicity, and First-Generation status were identified and compared with pre- and post-admission HCAD groups. As Gender was listed as a binary in the RCC database, the student characteristic was redefined as Sex for this study. The college is working on updating its database to be more Gender inclusive.

Analytic Strategy

Descriptive and Inferential statistics were used in this study to explore the relationship between fully online gateway science courses and student academic performance in HCAD programs at RCC. The data for the analysis were retrieved from the institution as Excel worksheets. An IBM® SPSS® software was used to run the statistical tests. Descriptive analysis was used to describe the student's sociodemographic information among students who enrolled in A&P II courses and HCAD programs. Characteristics such as student age, sex, race/ethnicity, and first-generation status were used to understand the population better.

Inferential statistics were used to analyze the three guiding questions for the research. The first research question was to determine whether there is a difference in final course grades among students who completed A&P II courses entirely online and in other course delivery formats. A One-way ANOVA test was used to address the question. A One-way ANOVA test is a statistical test used to compare the means of two or more groups (Tabachnick & Fidell, 2018). The dependent or test variable was the mean course grade points. The independent variable was the student A&P II course completion format in three levels, pre-COVID in-person, post-COVID in-person, and post-COVID online. Statistical significance was determined based on p -value set at 0.05 (Kirk, 2013). Considering the homogeneity of variances, Welch's ANOVA was used along with the Games-Howell post hoc test to interpret the results.

The second research question focused on first-year student retention among HCAD programs. A chi-square analysis was conducted to evaluate the relationship between retention among HCAD program students and A&P II course completion format. Chava Frankfort-Nachmias et al. (2021) defined the chi-square test as an inferential statistical technique designed to test relationships between two nominal or ordinal variables. The significance level value p -value was set at 0.05 (Agresti, 2007). The two variables used for the test were the retention status of the student with two levels, retained and not retained in the program, and the student A&P II course completion format in three levels, pre-COVID in-person, post-COVID in-person, and post-COVID online.

Finally, the last research question was to identify whether there is a mean difference in cumulative GPA between HCAD program students who completed A&P II courses fully online and other course delivery formats. A One-way ANOVA test was used to evaluate the difference in academic performance of students in HACD programs who completed A&P II courses in a

fully online format and other course delivery formats measured by GPA. The dependent or test variable was the mean cumulative GPA, and the independent or grouping variable was the student A&P II course completion format in three levels, pre-COVID in-person, post-COVID in-person, and post-COVID online. Just as the first research question, statistical significance was determined based on *p*-value set at 0.05, and Welch's ANOVA was used along with Games-Howell post hoc test to interpret the results.

Limitations

One of the limitations of this study was in the data retrieval, as RCC only started offering fully online A&P II courses after the COVID pandemic. There was no pre-pandemic data on students completing A&P II online at RCC. In addition, the institution had one whole year of complete online instruction in gateway science courses due to the COVID pandemic. Participants who took A&P II courses online might have faced unique challenges or strengths as the courses were offered during or past the COVID pandemic. Limitation in resources and lack of adequate training among faculty were some other limitations of the study.

HCAD programs at RCC only accept a limited number of students per cohort year due to the selective admission process. Since each HCAD programs are unique program culture and demographics of students, gathering all the program data together could create some disparities. Also, as all the information was retrieved from one institution, there is some difficulty in generalizing the analysis.

Results

Descriptive statistics

The sample groups were selected based on the three research questions for this study. The sample for the primary group included students enrolled in the A&P II course at RCC ($n =$

11,138) during the research period of the study. The second group had first-year HCAD students who completed A&P II at RCC ($n = 741$), and the third group included HCAD graduates who completed A&P II at RCC ($n = 1,426$) during the research period. The sociodemographic information of both groups is presented in Table 3.

Table 3

Descriptive summary of A&P II students and HCAD program graduates

Student Characteristics	Students enrolled in A&P II course	First-year HCAD students who completed A&P II at RCC	HCAD program graduates who completed A&P II at RCC
Age (Mean)	24.34	28.80	28.97
Sex (Percentage)			
Female	78.3%	78%	82.8%
Male	19.1%	20%	16.8%
Nonreported	2.6%	2%	0.4%
Race/Ethnicity (Percentage)			
White	25.1%	37.8%	36.0%
Black or African American	19.6%	19.8%	13.0%
Hispanic/Latinx	36.0%	27.7%	33.7%
Asian	6.4%	6.7%	7.4%
Mixed-Race	2.9%	2.6%	2.5%
Native American	0.3%	0.4%	0.3%
Hawaiian	0.3%	0	0.3%
Nonreported	9.5%	5.0%	6.7%
First-Generation Status (Percentage)			
First Gen	35%	33.6%	52.7%
Non-First Gen	65%	66.4%	47.3%
Number of observations	11,138	741	1,426

The descriptive information includes student age, sex, race/ethnicity, and first-generation status. The mean age of first-year HCAD students (28.80) and HCAD program graduates (28.97) was higher than those enrolled in A&P II courses (24.34), as shown above in Table 3. The average student age range reported by the college was 18 to 24. The female student population increased from 78.3% in A&P II courses to 82.8 % among HCAD graduates. The percentage gap between male and female in all these groups are almost three times higher than the college average of 15.8% in 2018-19 and 20% in the 2020-21 academic year. White, and Asian students had an increase in percentage going from A&P II group to HCAD programs graduates group, whereas Black or African American and Hispanic/Latinx students demonstrated a decline. Most of the students in HCAD graduates group were first-generation students, in contrast to those enrolled in the A&P II course.

Research Question #1: Student academic performance in A&P courses

Is there a difference in final course grades among students who completed A&P II courses in a fully online format and other course delivery formats?

A one-way ANOVA was conducted to determine if the final course grades among students who completed A&P II course fully online was different for groups who completed the course in other course delivery formats. Participants were classified into three groups: pre-COVID in-person ($n = 5,057$), post-COVID in-person ($n = 1,454$), post-COVID online ($n = 4,627$). The descriptive data for students completing A&P II courses fully online and other course delivery formats is presented in Table 4. There were no outliers in the data, as assessed by inspection of a boxplot and the sampling distribution of the mean is normal considering the sample size. Based on Central Limit Theorem the sampling distribution of the mean is normal for larger sample sizes ($n > 30$), regardless of the distribution (Tabachnick & Fidell, 2018). The

assumption of homogeneity of variances was violated, as assessed by Levene's test for equality of variances ($p = .001$) indicating that the variances are not equal.

Table 4

Descriptive Statistics for student performance in A&P II courses

Students enrolled in A&P II	N	Mean Grade points.	SD	SE	95% CI of M		Min	max
					Lower Bound	Upper Bound		
Pre-COVID in-person	5,057	2.57	1.4	0.02	2.53	2.61	0	4
Post-COVID in-person	1,454	2.77	1.4	0.04	2.70	2.84	0	4
Post-COVID Online	4,627	2.57	1.4	0.02	2.53	2.61	0	4
Total	11,138	2.60	1.4	0.01	2.57	2.62	0	4

One-way ANOVA compares the means between different groups and determines whether the results are statistically different. As an omnibus test statistic, the one-way analysis cannot identify which specific group is different from another (Kirk, 2013). A modified version of the test known as Welch's ANOVA was used to test the statistical significance. A&P II final course mean grade points was statistically significantly different for different levels of course completion formats, Welch's $F(2, 4095) = 13.30, p < .001$. The group means were statistically significantly different ($p < .05$). Therefore, we can reject the null hypothesis and accept the

alternative hypothesis that there is an association between A&P II course completion format and the mean course grade points. Welch's ANOVA analysis is presented in Table 5.

Table 5

Welch's ANOVA analysis of student performance in A&P II courses.

	Statistic ^a	df1	df2	Sig
Welch	13.30	2	4095	.000

As the results indicated a statistically significant difference among the group means, a multiple comparison test was performed to identify the differences between the specific groups (Kirk, 2013). Games-Howell post hoc analysis revealed a difference in A&P II final course grade points among pre-COVID and post-COVID in-person groups. A difference in grade points was also noticed among post-COVID in-person and post-COVID online groups. The results showed that the difference between the mean course grade points among the pre-COVID in-person group, 2.6 ± 1.4 , and the post-COVID in-person group, 2.8 ± 1.4 , a difference of 0.2 (95% CI, -0.1 to 0.3) was statistically significant ($p < .005$). The difference between post-COVID in-person group, 2.8 ± 1.4 , and the post-COVID online group, 2.6 ± 1.4 , a difference of -0.2 (95% CI, -0.3 to -0.1) was also statistically significant ($p < .005$).

Research Question #2: Student first-year retention in HCAD programs

Is there a difference in first-year retention among HCAD program students who completed A&P courses in a fully online format and other course delivery formats?

A chi-square test of independence was conducted between A&P II course completion format and first-year student retention in same HCAD program. All expected cell frequencies were greater than five. Chi-Square analysis is presented in Table 6. There was a statistically significant association between A&P course completion format and first year student retention in same HCAD program, $X^2(2) = 13.70, p < .001$. There was a statistically significant association between the two variables. Therefore, we can reject the null hypothesis and accept the alternative hypothesis that there is an association between A&P course completion format and first-year retention among HCAD students.

Table 6

Chi-Square Analysis of first-year retention in HCAD programs

	Value	df	Asymptotic Significance (2-Sided)
Pearson Chi-Square	13.70 ^a	2	0.001
Likelihood Ratio	13.23	2	0.001
N of Valid Cases	741		

First-year student retention in HCAD programs was 16.1% for students who completed pre-COVID in-person A&P II courses. An overall drop in retention was noticed among HCAD program students from pre-COVID to post-COVID. Students who completed post-COVID online A&P II courses were the least to retain in HCAD programs after first year. The first-year retention rate was 9.4% for students who completed post-COVID in-person A&P II courses and 7% for students who completed post-COVID online A&P II courses.

Research Question #3: Student academic performance in HCAD programs

Is there a difference in cumulative GPA among HCAD program students who completed A&P courses in a fully online format and other course delivery formats?

A one-way ANOVA was conducted to determine if the HCAD graduating cumulative GPA among students who completed A&P II course fully online was different for groups who completed the course in other course delivery formats. Participants were classified into three groups: pre-COVID in-person ($n = 1,045$), post-COVID in-person ($n = 318$), post-COVID online ($n = 63$). The descriptive data is presented in Table 7.

Table 7

Descriptive Statistics for student performance among HCAD graduates

Students enrolled in A&P	N	Mean Cumulative GPA	SD	SE	95% CI of M		Min	max
					Lower Bound	Upper Bound		
Pre-COVID in-person	1,045	3.20	0.3	0.01	3.22	2.54	2.54	4.0
Post-COVID in-person	318	3.20	0.3	0.02	3.24	2.58	2.58	4.0
Post-COVID Online	63	3.32	0.03	0.03	3.38	2.92	2.92	4.0
Total	1,426	3.21	0.3	0.01	3.22	2.54	2.54	4.0

There were no outliers in the data, as assessed by inspection of a boxplot for values greater than 1.5 box-lengths from the edge of the box. The sampling distribution of the mean was

normal considering the sample size. The sampling distribution of the mean is normal as the sample sizes ($n > 30$), regardless of the distribution. The assumption of homogeneity of variances was violated, as assessed by Levene's test for equality of variances ($p = .02$) indicating that the variances are not equal. A Welch's ANOVA was used to test the statistical significance as presented in analysis in Table 8. HCAD graduating cumulative GPA was statistically significantly different for different levels of course completion formats, Welch's $F(2, 166.59) = 7.01, p < .001$. The group means were statistically significantly different ($p < .05$) and, therefore, we can reject the null hypothesis and accept the alternative hypothesis that there is an association between A&P course completion format and cumulative GPA among HCAD graduates.

Table 8

Welch's ANOVA analysis of student academic performance among HCAD graduates

	Statistic ^a	df1	df2	Sig
Welch	7.01	2	166.59	.001

Games-Howell post hoc test was performed to identify the differences between the specific groups among HCAD program graduates. The analysis revealed a difference in cumulative GPA between pre-COVID in-person and post-COVID online groups. A difference in cumulative GPA was also noticed between post-COVID in-person and post-COVID online groups. The results showed that the difference between the cumulative GPA among the pre-COVID in-person group, 3.2 ± 0.3 , and the post-COVID online group, 3.3 ± 0.2 , a difference of

0.2 (95% CI, -0.1 to 0.3), was statistically significant ($p < .005$). The difference between post-COVID in-person group, 3.2 ± 0.3 , and the post-COVID online group, 3.3 ± 0.2 , a difference of -0.11 (95% CI, 0.04 -0.19) was also statistically significant ($p < .005$).

Summary of Findings

The study's results addressed the relationship between online gateway science courses and student academic performance in HCAD programs. The descriptive statistics on socioeconomic background showed an increase in mean age (28.97) and a higher percentage gap between male and female among HCAD graduates and A&P II students. There was an increase in first-generation students (52.7%) and a decrease in Black or African American and Hispanic/Latinx student percentages among HCAD graduates compared to A&P II students. The results from the Welch's ANOVA study indicated an association between the A&P course completion format and the mean course grade points. Games-Howell post hoc analysis found that the post-COVID in-person group had higher mean course grade points than the post-COVID online group, showing a difference of -0.2 (95% CI, -0.3 to -0.1). The results also showed that the post-COVID in-person group had higher mean course grade points than the pre-COVID in-person group, demonstrating a difference of 0.2 (95% CI, -0.1 to 0.3).

The Chi-Square Analysis showed an association in first-year retention among HCAD program students who completed A&P courses fully online and in other course delivery formats. The retention rates were recorded as 16.1% for pre-COVID in-person, 9.4% for post-COVID in-person, and 7% for the post-COVID online group. The results from the second Welch's ANOVA study indicated an association between the A&P II course completion format and cumulative GPA among HCAD graduates. Unlike the first research question analysis, the Games-Howell post hoc test results found that the post-COVID online group had a higher cumulative GPA than

the post-COVID in-person group, showing a difference of -0.11(95% CI, 0.04 -0.19). The results also showed that the post-COVID online group had a higher cumulative GPA than the pre-COVID in-person group, showing a difference of 0.2 (95% CI, -0.1 to 0.3).

Discussion

Healthcare facilities across the United States are experiencing a significant shortage of Allied health and Nursing professionals. As the demand for these professionals is rising, higher educational institutions are looking into developing new health career programs and increasing enrollments in current programs. Student academic success in gateway science courses such as A&P predicts success in health career programs (Harris et al., 2014). The sudden need for online course delivery due to the COVID pandemic has forced several higher educational institutions to offer gateway science courses online. While existing research has information regarding student success in online science courses, such research has yet to explicitly focus on the impact of fully online gateway courses on student academic performance in HCAD programs (Garman, 2012). Information regarding the relationship between gateway science courses and student academic performance in HCAD programs could help institutions improve student retention and completion rates among these programs. The purpose of this quantitative study was to determine the relationship between fully online gateway science courses and student academic performance in HCAD programs at RCC.

The sociodemographic information gathered from the study provides a snapshot of the student characteristics in A&P II courses and HCAD programs. The mean age of students in HCAD programs was higher than that of students enrolled in A&P II courses, and the RCC average student age range of 18 to 24. Students older than twenty-four are often classified as nontraditional students (Bean & Metzner, 1985). The findings confirm that nontraditional

students comprise most of the population in HCAD programs. The data from the study also confirmed that the number of male students enrolling and graduating HCAD programs is significantly lower than female students. The percentage gap between male and female among HCAD program graduates was recorded 66% compared to the college average of 15.8% in 2018-19 and 20% in 2020-21. Adult female students taking classes at community colleges have unique challenges compared to other groups. Nontraditional female learners often have family responsibilities that might hinder their school and graduation (Henriksen, 2019). The author also mentions how motherhood and family responsibilities create time management issues among female students.

The study's conceptual framework emphasizes the importance of preadmission student characteristics while analyzing student persistence (Rovai, 2003). Students' sociodemographic characteristics, including age, sex, and ethnicity, in A&P II courses fall under the preadmission student characteristics category in the CPM model. The descriptive findings of this study indicate that nontraditional first-generation White female students aged 24 or above are more likely to enroll and graduate from HCAD programs. Furthermore, comparing the race/ethnicity of students enrolled in A&P II courses and HCAD graduates revealed a decrease in minority representation, particularly among Black or African American and Hispanic/Latinx students. The data aligned with previous literature on persistence and achievement gaps for Black or African American community college students (Johnson et al., 2014). The socio-demographic information provides an overview of the distinctive student traits in HCAD programs. Academic institutions can benefit from this information in order to design personalized learning support systems for this specific group.

Gateway science courses such as A&P II are common prerequisites for HCAD programs. Students are required to complete prerequisite courses prior to getting admitted into HCAD programs. As community college students complete prerequisite courses at their pace, the student social engagement and academic performance for these courses are often different from program courses. These A&P II courses lay the essential foundation for skills and clinical application of knowledge for students in Allied health and Nursing programs. All students enrolled in A&P II are not seeking admission to HCAD programs. RCC started offering these courses fully online after the COVID pandemic. Previous literature raises concerns about the efficacy of online education science courses (Crawford & Persaud, 2013). The first research question results show an association between the A&P II course completion format and the mean course grade points. The result from the first research question gives a general picture of the academic performance in gateway science courses and preadmission student characteristics among HCAD students.

One of the key insights from the first research question results was the difference in course grades among students who took the course prior to and past the COVID pandemic. The multiple comparison test results indicated that the post-COVID in-person group had better mean course grade points compared to pre-COVID in-person group. The results might be an indicator of the resilience the students developed because of the COVID pandemic. Resilience is often seen as a result of behavior or actions that help individuals develop skills to overcome challenges and thrive after difficult experiences (Thompson et al., 2018). A statistically significant difference in mean final course grade points was also demonstrated between the post-COVID online group and the post-COVID in-person group. The observed differences could be attributed to the aftermath of the COVID pandemic, particularly among students. The pandemic presented unique mental, health, and academic challenges among community college students. According

to (Huckins et al., 2020), college students were more depressed and anxious during the Spring of 2020.

The first-year retention rate predicts student academic success in HCAD programs. Retention rates remain a problem in HCAD programs such as Allied Health and Nursing. According to the National Center for Education Statistics, the retention rate for two-year public institutions in the fall of 2020 was 61 % (National Center for Education Statistics-NCES, 2022). This second research question results show that the first-year retention rates in HCAD programs were well below the national average. Students could complete gateway science courses at different institutions and transfer to RCC. The results for the second research question are based on students who completed the A&P II course, specifically at RCC. The disparity in retention rates is often due to multiple factors such as rigorous curriculum, higher academic performance expectations, and other personal student issues (Roush & Tesoro, 2018). The study's findings indicate a statistically significant association between A&P course completion format at RCC and first-year student retention in HCAD programs.

There was a statistically significant decrease in first-year student retention among HCAD students who completed A&P fully online at RCC compared to other formats. The COVID pandemic created some notable changes in how courses were offered at RCC. All courses at the institution were forced to switch to a fully online format for one semester immediately after the pandemic. Even though in-person and other options in gateway science courses returned to the college in a semester, the newly implemented fully online options continued. First-year retention rates in HCAD programs at RCC varied for students who took the A&P course prior to and past the COVID pandemic. The retention rates were recorded as 16.1% for pre-COVID in-person, 9.4% for post-COVID in-person, and 7% for the post-COVID online group. The results

contradict the Billings and Halsted (2020) study indicating no difference in the outcome of face-to-face versus online courses.

This study also identified student academic performance by evaluating graduating GPA of students in HCAD programs. Cumulative GPA is one of the best measures of student success in community colleges (Nakajima et al., 2012). The third research question result show an association between A&P course completion format and cumulative GPA among HCAD graduates. One of the interesting findings was that even though the first-year HCAD program retention rates were lower among the post-COVID online group, the ones who survived and graduated in the group had a higher cumulative GPA than the pre-COVID and post-COVID in-person groups. The results align with the literature that reported on the quality of online learning. According to Allen et al. (2016), more than 41% of academic leaders believed that the outcomes of online instruction are superior to face-to-face instruction. Even though an association was identified in the results, it is not clear whether the online course modality was more effective than other delivery options. The results could be influenced by the pre-admission and post-admission factors mentioned in the conceptual framework and the unique strengths and challenges of the pandemic.

Overall, the results of this study evaluated the relationship between fully online gateway science courses and student academic performance in HCAD programs at RCC. The study's descriptive findings examined several preadmission and post-admission factors outlined in the CPM model. The study findings demonstrated that the post-COVID in-person group had higher course mean grade points in A&P II courses than other groups. The study results also showed that the post-COVID online group had the least first-year student retention rates in HCAD programs. Among the students who retained in the HCAD programs, the fully online group was

more academically successful, indicated by the mean cumulative GPA. Considering the wide range of reasons, it is unclear whether one course delivery modality is better than another for improving student academic performance in HCAD programs. However, the results of this study indicate that online modality could be a viable course delivery option for instructing gateway science courses.

Implications for Future Research and Practices

The study identified the relationship between fully online gateway science courses and student academic performance in Health Career programs at RCC. Academic leaders and administrative staff could use the study results to improve student retention and academic performance in Health Career Associate Degree programs. This study aligns with the existing literature that showed the importance of the gateway science course delivery format in HCAD programs. However, the study had limitations in identifying online learners in pre-COVID A&P courses, as the college only offered an online delivery format for A&P after the pandemic. In addition, the post-COVID pandemic has created unprecedented changes and unique challenges to community college education after the spring of 2020 (Center for Community College Student Engagement, 2021). Also, students in HCAD programs could complete gateway science courses at different institutions and transfer to RCC. The result of this study is based on students who completed the A&P II course, specifically at RCC. Further research is needed to explore the post-pandemic aspect of gateway science course delivery methods.

The result of this study gives a general picture of the preadmission student characteristics and academic performance in gateway science courses. Academic performance was similar among students who took the course in-person and online. The post-COVID difference noticed among the in-person and fully online groups needs to be explored further to see whether it is a

temporary issue. The study also found that nontraditional first-generation White female students aged 24 or above are more likely to enroll and graduate from HCAD programs. The sociodemographic information shows the uniqueness of the student population in HCAD programs. Students have their unique strengths and challenges based on their sociocultural background. For example, first-generation students often struggle with persistence, motivation, and self-efficacy (Jeffreys, 2012). Academic institutions could use this information while creating support systems for their students. Additional research could investigate how sociodemographic factors impact the academic achievement of HCAD students.

These findings demonstrated the relationship between gateway science course completion format and first-year student retention in HCAD Programs at RCC. Students could complete gateway science courses at different institutions and transfer to RCC. The results are based on students who completed the A&P II course, specifically at RCC. Retention in HCAD programs such as Nursing is considered continuous enrollment and completing program courses sequentially (Jeffreys, 2014). Retention rates in the HCAD program indicate student persistence in the program. This study showed a lower retention rate among students who completed their prerequisite A&P courses online. The lower retention rate could be due to multiple factors. However, college leaders and administrators need to see if a fully online modality is an appropriate choice for conceptual learning for all students (Kauffman, 2015).

The shortage of healthcare professionals is adding pressure on community colleges to develop new health career programs and expand the current ones. The results from this study shed light on the current perceptions and practices of community college faculty members. The findings from this study showed that the students who completed A&P courses in a fully online format had higher mean cumulative GPAs in the graduating semester than others. Health career

programs nationwide could provide this information to their accreditation agencies as a rationale for choosing fully online delivery methods.

In summary, the results of this study evaluated the relationship between fully online gateway science courses and student academic performance in HCAD programs at RCC. The descriptive findings of the study explored some of the preadmission and post-admission factors mentioned in the CPM model (Rovai, 2003). The study findings demonstrated higher course mean grade points among the post-COVID in-person group compared to pre-COVID in-person and post-COVID online groups. Academic institutions could conduct more research to determine if the trend is only temporary and related to the COVID-19 pandemic. The study results indicated that first-year student retention in HCAD programs was lower among students who completed the gateway science courses in a fully online format compared to the in-person groups. However, among the students who survived the first year and graduated from the HCAD programs, the fully online group was more academically successful, indicated by the mean cumulative GPA. Academic leaders and administrative staff can effectively employ the findings of this study to optimize the performance and retention rates of students enrolled in Health Career Associate Degree programs.

CHAPTER 3

SCHOLARLY REFLECTION

Reflection on the Dissertation Process

My experience with online teaching in Community college and Health career programs started in 2009 when I first taught my fully online course. During my tenure as a full-time faculty and clinical coordinator in the Radiologic Technology program, all the courses I taught included an online component. After completing my ION online teaching certification in 2014, I had the opportunity to develop several Allied Health online courses and serve on the college distance education committee. My expertise in online teaching and passion for health Careers guided me through transitioning into my current role as a full-time online educator in 2017. As a full-time faculty in health careers for the past fourteen years, I was always interested in assessing and exploring academic student success in Allied Health Programs. Starting my doctoral program in the summer of 2020 and taking online courses during the peak of the COVID pandemic inspired me to derive my topic for research.

The COVID pandemic created several unique challenges for faculty and students in teaching and learning. I had firsthand experience with some of these pandemic-specific challenges in my doctoral student and Health Career faculty role. Academic performance and student retention rates were often discussed in all our Health career departmental and advisory meetings. However, the topic of transitioning gateway science courses from a face-to-face into a

fully online environment raised more questions during our post-pandemic meetings. As I explored the literature, I found several studies on the association between student performance in gateway science courses and academic success in health career programs. Some of these studies even mentioned how Anatomy and Physiology courses could predict academic success in health career programs (Brown et al., 2017). However, there needed to be more information on the impact of fully online gateway courses on student academic performance in HCAD programs.

The aim of my research was to examine the relationship between fully online gateway science courses and student academic performance in HCAD programs at RCC. Previously, as a Clinical Coordinator, I had the opportunity to collect, analyze, and report data for programmatic accreditation purposes. Some of the data collected for these reports included student demographics, enrollment, attrition, retention, completion, and employment rates. Also, as a part of my tenure process, I collected student data from my courses to investigate and reflect on teaching and learning practices. However, data collection for this research was slightly different from my previous experience as data collection for this quantitative study required Institutional research Board (IRB) approval from two institutions. The data were retrospectively retrieved from the institution by the institutional analytics department. I experienced some delay with the data retrieval as the research site analytics team was backlogged with some institutional requests. After a virtual meeting with the team, the second time, I was able to retrieve the data.

One of the major challenges I faced with my data was that the college chosen for this study never offered A&P II courses in a fully online format before the COVID pandemic. Due to the nature and complexity, Anatomy and Physiology courses were always offered in an in-person format prior to the pandemic. Davis (2010) explains how A&P courses can often be content-heavy and conceptually challenging for students. As the pre-pandemic data on fully online A&P

courses did not exist, my initially proposed plan comparing fully online and other format delivery had to be modified. In addition, the institution offered one year of fully online instruction for gateway science courses following the COVID pandemic. Per my dissertation chair's advice, I relied on a pre-pandemic and post-pandemic approach for my study. Independent variables for the study were revised to three levels, including a pre-COVID in-person group, a post-COVID in-person group, and a post-COVID fully online group. My initial analytic strategies in the dissertation proposal were altered to fit the retrieved data.

Health career students in community colleges are a population with unique challenges and needs. As a community college Alumni in an Allied health program, I was familiar with some of the challenges faced by the students. Students within these programs face additional hurdles due to the academic rigor and strict clinical requirements. One of the reasons why I chose to teach in a health career program was my firm belief that I could make some positive changes in the field. The socio-demographic information retrieved for this study gave me an overall picture of the health career programs at the research site. One of the factors that surprised me was the percentage drop in Black or African American and Hispanic/Latinx students graduating from HCAD programs compared to A&P courses. Aligning with the conceptual framework of Rovai (2003), the drop in enrollment among the two racial ethnicities in HCAD was noteworthy.

Student academic success in health career programs is measured using a variety of factors, including retention, attrition, and completion rates. Based on my experience, students leave health career programs for academic or nonacademic reasons. Academic failure among health career programs is a growing concern on a national level, as this could be one of the reasons for the overwhelming shortage of healthcare professionals. One of the reasons for student academic failure in health career programs such as Nursing is that students often

underestimate the academic rigor associated with the program (Kirsten & DiCicco-Bloom, 2014). The COVID pandemic made some unprecedented changes to the situation as well. In my study, a significant difference in retention rate was noticed among students who completed A&P II face-to-face and in full online format. The drop was partially because of the aftereffects of the pandemic, as several students were battling with personal challenges during that time. However, it could also be an indication that a fully online format may not be the best option for all student groups.

I firmly believe that cumulative GPA is one of the indicators of student academic performance in HCAD programs. Studies have identified cumulative GPA as an indicator of student success in Nursing programs (Patzner et al., 2017). One of the interesting findings I made in this study was that students who completed A&P II courses in a fully online format had higher cumulative GPAs than students who completed the course in other formats. Even though the students who completed A&P II in a fully online format had difficulty retaining in HCAD programs, the ones who completed the program performed better academically. I believe the finding was a turning point to my conclusion, confirming that even though a fully online format might not be the best option for all students, the modality effectively delivers gateway science courses.

Application to Professional Practice

The experience and knowledge I gained through this study have several applications in my professional practice. The practical implication of this study will help RCC administrators and leaders design and develop effective gateway science courses and HCAD programs. This study will also help health career educators and program advisors at RCC in identifying the best course delivery options for students to be successful. As a full-time faculty at RCC I plan to

share the results with the six HCAD program chairs, the advising department, and the academic deans for Allied Health and Nursing departments in the institution.

I started my role as a full-time professor and clinical coordinator in Radiologic Sciences at my current institution six years back. One of the factors that motivated me to pursue my doctoral degree is from inspiration I received from the institution in data collection and research during my tenure process at RCC. Students from two of the six HCAD programs selected for this study are fed into our Baccalaureate program. I work closely with the HCAD programs at RCC and even more closely with the two programs that provide students to our program. Student performance, retention, and completion are critical discussion topics in our routine departmental meetings. However, student performance and retention concerns have gone to different levels after the COVID pandemic. The results from the study will help me identify some of the root causes of our student performance and retention concerns.

The extreme shortage of healthcare professionals is forcing community college administrators and leaders to increase enrollment and graduate more students. To graduate additional healthcare professionals, leaders at RCC must focus on designing and developing effective gateway science courses and HCAD programs. Colleges offer professional development opportunities to train and retain their educators in online teaching. I plan to recommend our college leaders evaluate the effectiveness of professional development courses offered at the college. I also recommend the evaluation of instructor presence, faculty-student interaction, and equity-minded practices in fully online courses. Transforming traditional courses to the online environment requires adequate time and effort. Switching face-to-face courses to a fully online format in a short time is more like conducting traditional courses at a distance. My

goal is to encourage college leaders to focus on humanizing, redesigning, and reinventing effective online pedagogy.

Program chairs and advisors at RCC can also use my study results to identify the best course delivery options for students to be successful. The results from the study indicated that students who completed A&P II online had a lower first-year retention rate in HCAD programs but a higher cumulative graduating GPA. The course development team should reevaluate the post-pandemic trend of offering most A&P II courses online. I suggest program chairs and academic deans at RCC in HCAD programs work with the science department in offering A&P courses in fully online and in-person formats. In addition, the team should make sure that adequate training and support are provided to full-time and part-time faculty to maintain academic rigor and effectiveness while delivering the courses in a fully online format. Program advisors play a huge role in advising prospective students about HACD programs and guiding them to succeed. I anticipate informing the program advisors in advising each prospective student regarding their best choice of course modalities.

There are several actionable recommendations to share with RCC. The research findings indicate that the student demographics in HCAD programs are distinct and divergent from those observed in comparable programs. The needs and challenges experienced by this unique population are constantly changing, especially in these post-pandemic times. One of the recommendations for the RCC administrators and leaders is to update the support system for the current and prospective HCAD students based on their changing needs. Simplifying the admission process and providing easy access to program advising is one of the recommendations for the institution. Mixed messages and recommendations from different sources could create

additional challenges and confusion for students. A faculty-collaborated advising plan for current and prospective students might be a good idea to guide the students on the right track.

Some of the results noticed in this study could be temporary or a sign of a new norm. The COVID pandemic has forced academic deans and program chairs to create and revise several new options for course delivery. Another recommendation for RCC is to conduct additional research and data analysis to look deeper into the effectiveness of course delivery. While scheduling courses, academic deans and program chairs need to evaluate if a fully online delivery option is appropriate for that specific course. Offering interdisciplinary meetings and collaboration among science faculty teaching A&P courses and HCAD faculty teaching program courses is also a recommendation to create consistency across the disciplines.

Application to Research Practice

The experience I gained through conducting this research has made me a better researcher. As I was new to the process of writing and publishing research, I had to dig deep into choosing the appropriate publisher and carefully follow their requirements and guidelines. Some challenges I faced in the research process included performing an extensive literature review, interpreting data, analyzing the results, and balancing work-life balance. The peer-reviewed publication I chose for my research was online learning, a publisher focused on online and blended learning research. After exploring the publication process, I understand my opportunity to share my ideas publicly. I plan to work with my dissertation chair to submit my work for publication sometime next year.

The Research course I completed during the doctoral program at NIU introduced me to the nature and purpose of educational research. The course helped me understand the relationship between research design, methodological approaches and methods, and ethical research

practices. The seminar course I completed in Quantitative foundations was beneficial in building my confidence to use statistical methods and quantitative techniques in my work. The course taught me new concepts and refreshed my descriptive and inferential statistics knowledge. The course also gave me a good refresher on SPSS software use which helped me analyze my study results. Even though I was familiar with institutional data retrieval on a programmatic level, this research process gave me clarity in retrieving data on a broader level.

Through this experience, I have developed a profound passion for research and data collection. As online teaching and learning have evolved into a new phase after the pandemic, I would like to explore more research and literature regarding the latest changes and the future of digital pedagogy. Several pieces of literature I have referred to for this research identified that students often miss human interaction in online courses (Herman, 2020). I always believed in the relevancy of faculty presence and humanized online teaching approach in fully online courses. I would like to keep reviewing post-pandemic research and literature to grasp the latest trends better. In addition, the study findings made me realize how it does not explain any causal relationships between the variables. Even though the results demonstrated some association between fully online gateway science courses and student academic performance in HCAD programs, a direct influence could not be established. Further research will shed more light on this topic.

As a faculty in Health careers for several years, I am always interested in assessing student success in our programs at multiple levels. I believe that student success in health careers is a continuum that goes way beyond academic success in individual courses and programs. One of the biggest blessings of my job is the longer-term commitment to our students. I get to connect and network with several of my graduates in a healthcare facility most of the time. While

conducting my exhaustive literature review, I have found several studies and literature focusing on student success and online learning in Nursing. However, the broader picture of online learning in health career programs was under-explored. I would like to conduct additional studies on student success at multiple levels focusing on health careers in a broader picture.

Initially, the task of completing my dissertation appeared overwhelming and impossible. However, in the end, it proved to be a fulfilling and worthwhile journey. I find it valuable to gain knowledge about conducting literature reviews, utilizing different methodologies, collecting data, and interpreting the results. The entire dissertation process has given me the confidence to continue my research journey in online learning and the success of health career students. I hope my study will spark meaningful conversations about the effectiveness of delivering fully online courses for gateway science courses in health career programs. I am incredibly thankful for the support and guidance extended by my dissertation chair, committee members, and professors throughout this journey.

REFERENCES

- Abou-Sayf, F. K., & Miari, S. (2007). How to determine course prerequisites: An IR perspective on what to do and what not to do. *IR Applications, 14*.
<https://files.eric.ed.gov/fulltext/ED504326.pdf>
- Adler, A.M., & Carlton, R. R. (2019). *Introduction to radiologic & imaging sciences & patient care*. Elsevier.
- Affordable Care Act, 5002 (2009). <https://www.hhs.gov/sites/default/files/v-healthcare-workforce.pdf>
- Agresti, A. (2007). *An introduction to categorical data analysis* (2nd ed.). Hoboken, NJ: Wiley.
- Allen, I. E, & Seaman, J. (2013). *Changing course: Ten years of tracking online education in the United States*. The Online Learning Consortium.
<https://files.eric.ed.gov/fulltext/ED541571.pdf>
- Allen, I., Seaman, J., Poulin, R., & Straut, T. (2016). *Online Report Card: Tracking Online Education in the United states*. <https://files.eric.ed.gov/fulltext/ED572777.pdf>
- American Hospital Association. (2021). *Strengthening the Health Care Workforce*
<https://www.aha.org/system/files/media/file/2021/11/strengthening-the-health-care-workforce-II.pdf>
- Bean, J., & Metzner, B. (1985). A conceptual model of nontraditional undergraduate student attrition. *Review of Educational Research, 55*, 485–650.
<http://dx.doi.org/10.3102/00346543055004485>
- Bell, B., & Federman, J. (2013). E-learning in postsecondary education. *The Future of Children, 23*(1). 165-185
- Bernard, R. M., Abrami, P. C., Lou, Y., Borokovski, E., Wade, A., Wozney, L., & Huang, B. (2004). How does distance education compare with classroom instruction? A meta-analysis of the empirical literature. *Review of Educational Research, 74*(3), 379–439.
- Billings, D., & Halstead, J. A. (2020). *Teaching in nursing: A guide for faculty* (6th ed.). Elsevier
- Bourdeaux, R., & Shoenack, L. (2016). Adult student expectation and experiences in an online learning environment. *Journal of Continuing Higher Education, 64*(3), 152–161. <https://doi.org/10.1080/07377363.2016.1229072>

- Bower, B. L., & Hardy, K. P. (2004). From correspondence to cyberspace: Changes and challenges in distance education. In B. L. Bower & K. P. Hardy (Eds.), *From distance education to e-learning: Lessons along the way*, 5-12. San Francisco: Jossey-Bass.
- Brown, S. J., White, S., Power, N. (2017). Introductory anatomy and physiology in an undergraduate nursing curriculum. *Advances in Psychology Education* 41(1),56-61. <https://doi.org/10.1152/advan.00112.2016>
- Bulger, S., & Watson, D. (2006). Broadening the definition of at-risk students. *The Community College Enterprise*, 12(2), 23–32. <http://schoolcraft.edu/pdfs/cce/12.2.23-32.pdf>
- Chan, Z. C., Tam, W. S., Lung, M. K., Wong, W. Y., & Chau, C. W. (2012). A systematic literature review of nurse shortage and the intention to leave. *Journal of Nursing Management*, 21(4), 605-613. <https://doi.org/10.1111/j.1365-2834.2012.01437.x>
- Chava Frankfort-Nachmias, Leon-Guerrero, A., & Davis, G. (2021). *Social statistics for a diverse society*. Sage Publications, Inc.
- Center for Community College Student Engagement. (2021). *The impact of COVID-19 on entering students in community colleges*. https://cccse.org/sites/default/files/SENSE_COVID.pdf
- Choe, R. C., Scuric, Z., Eshkol, E., Cruser, S., Arndt, a., Cox, R., Toma, S. P., Shapiro, C., Levis-Fitzgerald, M., Barnes, G., & Crosbie, R. H. (2019). Student satisfaction and learning outcomes in asynchronous online lecture videos. *CBE-Life Sciences Education*, 18, 1-14. <https://doi.org/10.1187/cbe.18-08-0171>
- Crawford, C., & Persaud, C. (2012). Community colleges online. *Journal of College Teaching & Learning*, 10(1). 75-82 <https://doi.org/10.19030/tlc.v10i1.7534>
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage.
- Davis, G. M. (2010). What is provided and what the registered nurse needs—bioscience learning through the pre-registration curriculum. *Nurse education today*, 30(8), 707-712.
- Dumford, A. D., & Miller, A. L. (2018). Online learning in higher education: exploring advantages and disadvantages for engagement. *Journal of Computing in Higher Education*, 30(3), 452–465. <https://doi.org/10.1007/s12528-018-9179-z>
- Entezari, M., & Javdan, M. (2016). Active learning and flipped classroom, hand in hand approach to improve students learning in human Anatomy and Physiology. *International Journal of Higher Education*, 5(4). <https://doi.org/10.5430/ijhe.v5n4p222>

- Francescucci, A. & Rohani, L. (2019). Exclusively synchronous online (VIRI) learning: The impact on student performance and engagement outcomes. *Journal of Marketing Education, 41*(1), 60-69. <https://doi:10.1177/02734753128818864>
- Fredericksen, E. E. (2018). A national study of online learning leaders in U.S. community colleges. *Online Learning, 22*(4), 383-405. <https://doi:10.24059/olj.v22i4.1458>
- Frogner, B., & Skillman, S. (2015). *Pathways to Middle-Skill Allied Health Care Occupations*. Issues in Science and Technology. <https://issues.org/pathways-to-middle-skill-allied-health-care-occupations/>
- Garman, D. (2012). *Student Success in Face-to-Face and Online Sections of Biology Courses at a Community College in East Tennessee* [Electronic]. <https://dc.etsu.edu/cgi/viewcontent.cgi?article=2601&context=etd&httpsredir=1&referer>
- Gering, C. S., Sheppard, D. K., Adams, B. L., Renes, S. L., & Morotti, A. A. (2018). *Strengths-based analysis of student success in online courses*. *Online Learning, 22*(3), 55–85. <https://doi.org/10.24059/olj.v22i3.1464>
- Greenhalgh, T. (2001) Computer assisted learning in undergraduate medical education. *British Medical Journal, 322*(7,277), 40-44.
- Hachey, A. C., Wladis, C., & Conway, K. (2015). Prior online course experience and G.P.A. as predictors of subsequent online STEM course outcomes. *The Internet and Higher Education, 25*, 11–17. <https://doi.org/10.1016/j.iheduc.2014.10.00>
- Hamshire, C., Willgoss, T. G., & Wibberley, C. (2013). Should I stay or should I go? A study exploring why healthcare students consider leaving their program. *Nurse Education Today, 33*(8), 889-895.
- Harris, D.E., Hannum, L., & Gupta, S. (2004). Contributing factors to student success in Anatomy and Physiology: Lower outside workload and better preparation. *The American Biology Teacher, 66*(3), 168-175. <https://doi.org/10.2307/4451650>
- Harris, R., Rosenberg, L., & O'Rourke, M. (2014). Addressing the challenges of nursing student attrition. *Journal of Nursing Education, 53*(1), 31-37. <https://doi.org/10.3928/01484834-20131218-03>
- Hart, C. (2012). Factors Associated with Student Persistence in an Online Program of Study: A Review of the Literature. *Journal of Interactive Online Learning, 11*(1). <https://www.ncolr.org/jiol/issues/pdf/11.1.2.pdf>
- Hart, C. M. D., Friedmann, E., & Hill, M. (2016). Online Course-taking and Student Outcomes in California Community Colleges. *Education Finance and Policy, 13*(1), 42–71. https://doi.org/10.1162/edfp_a_00218

- Henriksen, R. (2019). Picturing identity: A visual narrative of a female nontraditional student. *Visual Communication Quarterly*, 26(3), 146-160. Retrieved from <https://doi.org/libproxy.uwyo.edu/10.1080/15551393.2019.1638787>
- Herman, P. C. (2020, June 10). *Online Learning Is Not the Future*. The Chronicle of Higher Education. Retrieved July 3, 2020, from <https://www.insidehighered.com/digital-learning/views/2020/06/10/online-learning-not-future-higher-education-opinion>
- Huckins, J. F., DaSilva, A. W., Wang, W., Hedlund, E., Rogers, C., Nepal, S. K., Wu, J., Obuchi, M., Murphy, E. I., Meyer, M. L., Wagner, D. D., Holtzheimer, P. E., & Campbell, A. T. (2020). Mental health and behavior during the early phases of the COVID-19 pandemic: a longitudinal mobile smartphone and ecological momentary assessment study in college students (Preprint). *Journal of Medical Internet Research*, 22(6). <https://doi.org/10.2196/20185>
- Hughes, L. (2008). Construction and evaluation of an online microbiology course for nonscience majors. *Journal of Microbiology & Biology Education*, 9(1), 30–37. <https://journals.asm.org/doi/10.1128/jmbe.v9.92>
- Ingrassia, J. M. (2016). Successful admission criteria to predict academic and clinical success in entry-level radiography programs. *Radiologic Technology*, 87(5).
- Jeffreys, M. (2012). *Nursing student retention: Understanding the process and making a difference*. (2nd ed.). New York, NY: Springer Publishing Company.
- Jeffreys, M. (2014). Jeffries's nursing universal retention and success model: Overview and action ideas for optimizing outcomes A-Z. *Nurse Education Today* 35, 425-431.
- Jeschofnig, L., & Jeschofnig, P. (2011). *Teaching Lab Science Courses Online*. John Wiley & Sons.
- Johnson, H., Mejia, M. C., & Cook, K. (2014). *Online Learning and Student Outcomes in California's Community Colleges*. Public Policy Institute of California. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.432.6575&rep=rep1&type=pdf>
- Johnston, A. N. B., Hamill, J., Barton, M. J., Baldwin, S., Percival, J., Williams-Pritchard, G., Salvage-Jones, J., & Todorovic, M. (2015). Student learning styles in anatomy and physiology courses: Meeting the needs of nursing students. *Nurse Education in Practice*, 15(6), 415–420. <https://doi.org/10.1016/j.nepr.2015.05.001>
- Kauffman, H. (2015). A review of predictive factors of student success in and satisfaction with online learning. *Research in Learning Technology*, 23. <https://doi.org/10.3402/rlt.v23.26507>

- Kentnor, H. (2015). Distance education and the evolution of online learning in the United States. *Curriculum and Teaching Dialogue*, 17(1 & 2), 21–34. https://digitalcommons.du.edu/cgi/viewcontent.cgi?article=1026&context=law_facpub
- Karsten, K., & DiCicco-Bloom, B. (2014). Acknowledging the academic rigor of associate degree nursing education: A grounded theory study of overcoming failure. *Teaching and Learning in Nursing*, 9(4), 153–163. <https://doi.org/10.1016/j.teln.2014.04.003>
- Kirk, R. E. (2013). *Experimental design: Procedures for the behavioral sciences* (4th ed.). Thousand Oaks, CA: Sage.
- Levit, L., Smith, A. P., Benz, E. J., & Ferrell, B. (2009). Ensuring quality cancer care through the oncology workforce. *Journal of Oncology Practice*, 6(1). <https://doi.org/10.1200/jop.091067>
- Lopez, A. G. (2020, March 30). *Community College Leaders Worry COVID-19 Crisis Will Push Students to Drop Out*. Laist. Retrieved July 4, 2020, from https://laist.com/2020/03/30/community_college_coronavirus_crisis_students_teaching_remote_learning_drop_out.php
- Marcus, S. (2004). Leadership in Distance Education: Is it a unique type of leadership - a literature review. *Online Journal of Distance Learning Administration*, 7(1). <http://www.westga.edu/~distance/ojdl/spring71/marcus71.html>
- McKenzie, L. (2017). *Questions on Quality of Online Learning*. Inside Higher Ed. <https://www.insidehighered.com/digital-learning/article/2017/10/18/faculty-analysis-criticizes-online-education-george-washington>
- Merkley, B. R. (2015). Student nurse attrition: A half century of research. *Journal of Nursing Education and Practice*, 6(3). <https://doi.org/10.5430/jnep.v6n3p71>
- Montelongo, R. (2019). Less than/more than: Issues associated with high impact online teaching and learning. *Administrative Issues Journal: Education, Practice & Research*, 9(1), 68–79. <https://doi.org/10.5929/9.1.5>
- Nakajima, M. A., Dembo, M. H., & Mossler, R. (2012). Student persistence in community colleges. *Community College Journal of Research and Practice*, 36(8), 591 – 613
- National Center for Education Statistics-NCES. (2019). Table 311.15. *Number and percentage of students enrolled in degree-granting postsecondary institutions, by distance education participation, location of student, level of enrollment, and control and level of institution: Fall 2017 and fall 2018*. https://nces.ed.gov/programs/digest/d19/tables/dt19_311.15.asp
- National Center for Education Statistics-NCES. (2022). *Undergraduate Retention and Graduation Rates*. <https://nces.ed.gov/programs/coe/indicator/ctr/undergrad-retention-graduation#:~:text=See%20Digest%20of%20Education%20Statistics>

- Newton, S. E., Smith, L. H., Moore, G., & Magnan, M. (2007). Predicting early academic achievement in a baccalaureate nursing program. *Journal of Professional Nursing*, 23(3), 144-149.
- Ortagus, J. C. (2017). From the periphery to prominence: An examination of the changing profile of online students in American higher education. *The Internet and Higher Education*, 32, 47–57. <https://doi.org/10.1016/j.iheduc.2016.09.002>
- Patzer, B., Lazzara, E. H., Keebler, J. R., Madi, M. H., Dwyer, P., Huckstadt, A. A., & Smith-Campbell, B. (2017). Predictor of nursing graduate school success. *Nursing Education Perspectives*, 38(5), 272-274. www.neponline.net
- Pyrczak, F., & Oh, D. M. (2018). *Making Sense of Statistics* (pp. 128–133). Routledge.
- Roush, K., & Tesoro, M. (2018). An examination of the rigor and value of final scholarly projects completed by DNP nursing students. *Journal of Professional Nursing*, 34(6), 437–443. <https://doi.org/10.1016/j.profnurs.2018.03.003>
- Rovai, A. P. (2003). In search of higher persistence rates in distance education online programs. *Internet & Higher Education*, 6(1), 1-16. [https://doi.org/10/1016/S1096-7516\(02\)00158-6](https://doi.org/10/1016/S1096-7516(02)00158-6)
- Ruiz, J. G., Mintzer, M. J., & Leipzig, R. M. (2006). The Impact of E-Learning in Medical Education. *Academic Medicine*, 81(3), 207–212. <https://doi.org/10.1097/00001888-200603000-00002>
- Salvatori, P. (2001). Reliability and validity of admissions tools used to select students for the health professions. *Advances in Health Sciences Education*, 6.
- Schlosser, C. A., & Anderson, M. L. (1994). *Distance education: A review of the literature*. Association for Educational Communications and Technology.
- Shelton, B. E., Hung, J.-L., & Lowenthal, P. R. (2017). Predicting student success by modeling student interaction in asynchronous online courses. *Distance Education*, 38(1), 59–69. <https://doi.org/10.1080/01587919.2017.1299562>
- Soffer, T. & Nachmias, R. (2017). Effectiveness of learning in online academic courses compared with face-to-face courses in higher education. *Journal of Computer Assisted Learning*, 34. <https://doi.org/10.1111/jcal.12258>
- Southern Association of Colleges and Schools Commission on Colleges. (2020). *Distance Education and Correspondence courses*. In SACSCOC. <https://sacscoc.org/app/uploads/2019/07/DistanceCorrespondenceEducation.pdf>
- Sternberg, R. J. (2013, February 7). Research to improve retention. *Inside Higher Ed*. <http://www.insidehighered.com/views/2013/02/07/essay-use-research-improve-student-Retention>

- Sturges, D., & Maurer, T. (2013). Allied health students' perceptions of class difficulty: The undergraduate human anatomy and physiology classes. *The Internet Journal of Allied Health Sciences and Practice*, 11(4), 1-10. https://pdfs.semanticscholar.org/b2f9/b0db826be39976e430f26073b3f39507d857.pdf?_ga=2.261756431.303748312.1663157329-695806258.1662047635
- Tabachnick, B. G., & Fidell, L. S. (2018). Using multivariate statistics (7th ed). Boston: Pearson Education.
- Thompson, G., Wrath, A., Trinder, K., & Adams, G. C. (2018). The roles of attachment and resilience in perceived stress in medical students. *Canadian Medical Education Journal*, 9(4), e69-77. <https://doi.org/10.36834/cmej.43204>
- Tinto, V. (1975). Dropout from higher education: a theoretical synthesis of recent research. *Review of Educational Research*, 45(1), 89–125. <https://doi.org/10.2307/1170024>
- Tinto, V. (2012). *Leaving college : rethinking the causes and cures of student attrition*. University Of Chicago Press ; Bristol.
- U.S. Bureau of Labor Statistics. (2022). *Healthcare Occupations*. In Bureau of Labor Statistics. <https://www.bls.gov/ooh/healthcare/home.htm#:~:text=Healthcare%20Occupations>
- U.S. Healthcare Labor Market. (2021). In Mercer. <https://www.mercer.us/content/dam/mercer/assets/content-images/north-america/United-states/us-healthcare-news/us-2021-healthcare-labor-market-whitepaper.pdf>
- Wambuguh, O., Eckfield, M., & Van Hofwegen, L. (2016). Examining the Importance of Admissions Criteria in Predicting Nursing Program Success. *International Journal of Nursing Education Scholarship*, 13(1), 87–96. <https://doi.org/10.1515/ijnes-2015-0088>
- Wilbeck, J., Evans, D. D., Hummer, K., & Staebler, S. (2019). Supporting program rigor in newly developed specialty academic programs. *Journal of the American Association of Nurse Practitioners*, 1. <https://doi.org/10.1097/JXX.0000000000000260>
- Xu, D., & Jaggars, S. (2014). Performance Gaps Between Online and Face-to-Face Courses: Differences Across Types of Students and Academic Subject Areas. *The Journal of Higher Education*, 85(5), 633–659. <https://doi.org/10.1353/jhe.2014.0028>
- York, T. T., Gibson, C., & Rankin, S. (2015). Defining and measuring academic success. *Practical Assessment, Research, and Evaluation*, 20(5). <https://doi.org/10.7275/hz5x-tx03>