A MIXED METHODS STUDY EVALUATING THE IMPACT OF A REDESIGNED BIOLOGY COURSE ON STUDENTS AND FACULTY

A Dissertation
by
JASMIN D. FEIMSTER

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APPROVED BY:

Jennifer McGee, Ed.D.
Chairperson, Dissertation Committee

Vachel Miller, Ed.D
Member, Dissertation Committee

Andrew Koricich, Ph.D.
Member, Dissertation Committee

Vachel Miller, Ed.D.
Director, Educational Leadership Doctoral Program

Ashley Colquitt, Ph.D.
Associate Vice Provost and Dean, Cratis D. Williams School of Graduate Studies

Abstract

A MIXED METHODS STUDY EVALUATING THE IMPACT OF A REDESIGNED BIOLOGY COURSE ON STUDENTS AND FACULTY

Jasmin D. Feimster
B.S., North Carolina A&T State University
M.S., University of North Carolina Greensboro
Ed.S., Appalachian State University
Ed.D., Appalachian State University

Dissertation Committee Chairperson: Dr. Jennifer McGee

Community colleges serve a diverse student population and enroll about half of all college matriculating students (Zeindenberg, 2008). Therefore, it is important that careful attention is given to the manner in which those students are taught and their unique learning needs. This study explores a course redesign effort in a non-majors biology course at South City Community College. With the support of a grant from the Bill and Melinda Gates Foundation, the Principles of Biology course (Bio-110) was redesigned using a backward course design framework (Wiggins & McTighe, 2005), a gaming simulation platform, *BioBeyond,* and supplemental Open Educational Resources (OER). Using a mixed methods approach, this study compared the performance of students who took Bio-110 in the redesigned and non-redesigned format to determine if the strategies implemented did lead to improved student outcomes. Additionally, this study analyzed if the Biology faculty's pedagogy changed based on their experiences during the redesign process. The results indicated that students were more successful

in the non-redesigned course in Spring 2017, and there was no significant difference in success between students who took the redesigned and non-redesigned course in the Fall 2017 or Spring 2018 semesters. Furthermore, students were more successful in the non-redesigned course taught by part-time faculty. Additionally, semi-structured interviews with Biology faculty members that participated in the course redesign were conducted. They revealed that their pedagogy did change after their experience, and four themes emerged that centered on curriculum alignment, learning outcomes, assessment, and use of technology in the classroom. Collectively, results from this study provided useful information for community college stakeholders regarding the impact of intentional redesign efforts on both students and faculty.

Acknowledgments

I would like to acknowledge my Dissertation Committee Chair, Dr. McGee for her guidance, expertise, and patience as both an instructor and an advisor. I would also like to thank Dr. Miller and Dr. Koricich for their guidance and support during this process. Additionally, the staff in the Educational Leadership program, my cohort members, the Writing Center staff, Skyler Prowten, Research Design and Analysis Consultant, and the instructors at Appalachian State University have all been instrumental in my progress up to this point, and I am sincerely grateful for their work. And, to the incredible faculty and staff at South City Community College for their commitment to innovation, change, and student success in the sciences; your hard work is the reason I was able to do this dissertation and I am so proud of the team we have built.

Dedication

I would like to dedicate this dissertation to the Feimster, Cherry, Brown, and Wilson families for their unwavering encouragement and blind confidence in my abilities. But this belongs to Fleet and Emerson.

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Chapter I: Introduction

Community Colleges are challenged by low retention and completion rates (Causey et al., 2022). Along with the issue of quantity, there is also an issue with quality, that is, ensuring students receive exceptional learning experiences that can help them be successful (Campbell & Blankenship, 2020). Among the concomitant strategies to tackle this effort is course redesign, particularly in high demand gateway courses (Twigg, 2009).

The American Association for the Advancement of Science (AAAS) (2009) describes calls for rethinking undergraduate biology education. The undercurrent in much of the reform literature is students' ability to adequately comprehend complex concepts in science and technology. Efforts have been made to promote inquiry-based and experiential learning, the importance of effective teaching practices, integration of cutting-edge technology, varied assessment methods, the interdisciplinary nature of sciences, and competency-based approaches (AAAS, 2009). The intentional design of biology courses is influential in addressing the institutional challenges of retention and completion and also improving student learning by revising teaching strategies and renewing focus on alignment of key outcomes (Twigg, 2009).

The focus of this study was to examine the effectiveness of an instructional redesign effort in a community college non-majors Biology course. The redesign effort centered on principles of instructional design using frameworks that served to lay out the steps in creating learning experiences that were meaningful, well organized, and engaging while remaining mindful of the learner, the objectives, the instructional methodology, and the assessment strategies (Heaster-Ekholm, 2020). This chapter will contextualize the study, outline the rationale for the redesign of the non-majors Biology course at South City Community College, discuss the

general redesign strategy, and describe the methodology that will be used to address the research questions.

Protection of Institutional Identity

To protect the identity of the institution where this research occurred, a pseudonym, South City Community College, is used in this dissertation. The researcher received the permission of the External Research Review Committee at South City to conduct this research study contingent upon using pseudonyms for the College, as well as any College students and employees, and making no identifiable references to the College, its students, or its employees in any published document. In protecting the College's confidentiality, the researcher has followed the College's requests in not identifying the College name in the research, including in any citations, of the dissertation. The researcher provided the external research approval letter in Appendix A, and any questions about the veracity of the study or authenticity of College as the research site should contact the party who shared approval of the request.

Study Context: South City Community College

Upon the award of a small grant from the Bill and Melinda Gates Foundation, the Principles of Biology course (Bio-110) was redesigned at South City Community College. South City is a large 2-year institution in an urban metropolis. It is the second largest community college in the state (NC Community Colleges, 2022a). According to an internal report from South City, the college has eight campuses across the county, and offers 300 programs of study. South City enrolls 43,000 students annually including 12,500 students in continuing education programs, and 900 high school students at four middle colleges. South City transfers 1,000 students to institutions within the state's system each.

Student Enrollment and Demographics at South City

According to NC Community Colleges (2022a), in the fall of 2021, the student population of South City consisted of 17,559 curriculum students enrolled in college level or transfer courses, including dually enrolled high school students. Of these curriculum students, 6,842 (39%) were full time and 10,717 (61%) were part time. The college's programs span Arts and Sciences (8,739, 50%), Career and Technical Education (8,416, 48%), and other special programs (404, 2%). Table 1 indicates the demographic information for curriculum students at South City compared to that of those in the state's Community College system.

Table 1

Curriculum Student Demographics

	Black				Hispanic				White				Other/Unknown			
	Female		Male		Female		Male		Female		Male		Female		Male	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
SCC	3,283	19	1,777	10	1,695	9.6	1,093	6.1	4,082	23	3,347	19	1,291	7.3	992	5.6
NCCCS	30,144	14	13,057	6	17,730	8	10,639	5	66,166	33	46,734	22	14,980	7	9,467	4

Note. SCC stands for South City Community College. NCCCS stands for North Carolina Community College System.

In the 2021-2022 academic year, South City awarded 3,364 credentials, including 1,418 transfer degrees (Associate in Science, Associate in Arts, Associate Fine Arts, and Associate in Engineering), 810 Associate in Applied Science degrees, 1,003 certificates, and 133 diplomas (NC Community Colleges, 2022a).

Mission, Vision, and Values

According to South City's website, the college's work is intentional, transformational, and impactful for its students and the surrounding community. The vision is "to be a champion of students, a catalyst for opportunity, and an exceptional provider of learning experiences that

transform lives and strengthen our community". Its mission statement is "to facilitate student learning, success, and completion, South City provides exceptional education and globally competitive training in an engaging, supportive environment". Its values are: "student centered, collaboration, excellence, accountability, equity, and courage".

According to its Strategic Plan, South City's strategic goals are centered on the mission, vision and values; thus, the work to improve the student learning experience through innovative course design is an effort to support student learning and facilitate persistence and completion. Careful course design serves as one of the efforts by faculty to ensure that instruction remains aligned with the college's mission, vision, and values. This allows faculty to pursue opportunities for improvement in teaching and learning.

Faculty Demographics at South City

As of October 2021, South City employed 781 curriculum faculty, with 435 (56%) in an adjunct capacity and 346 (44%) in a full-time capacity (NC Community Colleges, 2022a). Table 2 indicates the demographic information relative to curriculum faculty headcount by race, ethnicity, and employment status.

Table 2

South City Faculty Demographics

Faculty status	Black				Hispanic				White				Other/Unknown			
	Female		Male		Female		Male		Female		Male		Female		Male	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Full-time	37	11	16	5	11	3	5	1	134	39	120	35	16	5	7	2
Adjunct	73	17	31	7	8	2	5	1	164	38	137	31	10	2	7	2

Natural Sciences Division and the Biology Department at South City

Situated in the Academic Affairs Unit, the Natural Sciences Division is home to Biology, Chemistry, Anatomy & Physiology, Physics, Astronomy, Geology, and Geography. It offers these courses on six of the college's area campuses and supports lab and lecture facilities both in person and online. As of fall 2022, the Natural Sciences Division had 38 full-time faculty members, 38 part-time faculty members, three full-time support staff, and four part-time support staff.

The Biology Department is the largest of all of the disciplines within the Natural Sciences Division. As of fall 2022, it had 14 full-time faculty and 8 part-time faculty members. According to South City's College Catalog, in a given fall and/or spring term, the department offers approximately 75 sections of Biology courses, which consist of Principles of Biology (Bio-110), General Biology I and II (Bio-111 and 112), and Microbiology (Bio-175 and 275).

Principles of Biology (Bio-110)

Beginning in the fall of 2015, the Biology faculty embarked upon the redesign of the Bio-110 course. Bio-110 is a 6-contact hour, 4-credit non-science majors course targeted to students who wish to complete their transfer degree (Associate in Arts). The course description and state learning outcomes describe Bio-110 as:

> a survey of fundamental biological principles for non-science majors. Emphasis is placed on basic chemistry, cell biology, metabolism, genetics, evolution, ecology, diversity, and other related topics. Upon completion, students should be able to demonstrate increased knowledge and better understanding of biology as it applies to everyday life. (NC Community Colleges, 2022b)

The Department offers roughly 30 sections of Bio-110 in a given fall and/or spring semester at four area campuses in traditional (100% in-person instruction), blended/hybrid (a portion of virtual instruction), and fully online (100% virtual, asynchronous instruction) formats.

Rationale for Bio-110 Redesign at South City

The diverse student population at institutions like South City requires educators to consider student's learning needs and to account for the unique challenges they face in the community college setting. To address this challenge, the college partnered with Smart Sparrow and the Institute for Education through eXploration (ETX) to develop a Bio-110 Smart Course. Smart Courses are interactive and adaptive and teach students concepts using narratives centered on big questions (Inspark, 2022). The Bio-110 Smart Course was developed through collaboration between several higher education institutions including the University of Arizona (Inspark, 2022).

South City's faculty led the development of the Bio-110 Smart Course. Their work served as the driving force behind the selection of outcomes, sequence of lessons, and supporting lab activities. South City's work on Bio-110 was supported by funding from the Bill and Melinda Gates Foundation. Their focus, in part, is dedicated to the success of disadvantaged students in entry-level post-secondary education science courses (Gates Foundation, 2022). Bio-110 was specifically selected for redesign because the college offers such a large volume of sections in a

variety of delivery methods. Thus, the course was primed for targeted review of the required course materials, cost, strategic alignment of learning outcomes to assessments, as well as integration of innovative instructional technology.

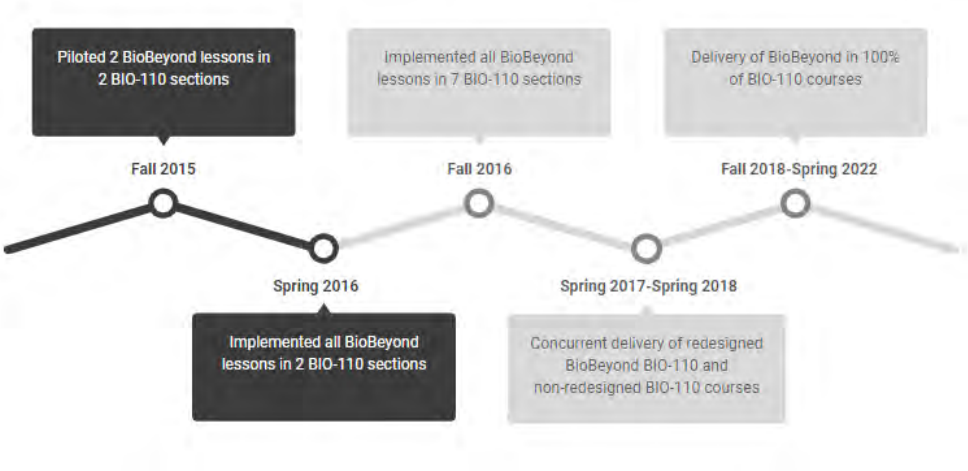
Redesign of Bio-110

Beginning in the fall of 2015, a small cadre of full-time Biology faculty members embarked upon redesigning the Bio-110 course. In addition to the inclusion of the Smart Course, a gaming simulation platform called *BioBeyond* (https://inspark.education/biobeyond/) was integrated as a part of the redesign. The *BioBeyond* platform was centered around the profound central question "Are we alone?", and led students through a virtual biological experience. With guidance from faculty, the interactive and adaptive lessons in *BioBeyond* were developed. The lessons were aligned with the AAAS (2009) Vision and Change in Undergraduate Biology Education and were mapped to the course's state description and learning outcomes (NC Community Colleges, 2022b). Additionally, in lieu of a traditional textbook, an Open Educational Resource (OER) from OpenStax (https://openstax.org/) was used to supplement the *BioBeyond* platform.

Figure 1 illustrates the timeline and tasks involved in the piloting, scaling, and implementation of the redesigned course.

Figure 1

Timeline, Bio-110 Course Redesign



This purposeful work resulted in a reimagined course with a different approach to course delivery, sequencing of topics, and more intentional use of class and lab time. The primary goal of this study was to compare the success rate in Bio-110 sections that were taught using the redesigned components and instructional technologies, to those that were taught using the traditional lab/lecture format and standard course materials. The results were further delineated to compare student success in course sections taught by either part-time or full-time faculty during the redesign. Second, this study explored the impact of the redesign on faculty in the Biology Department to determine how their teaching changed based on their experience in the redesign process. In order to address these questions, it was necessary to understand the significance of course redesign. Next, I will describe why redesign is important and rationalize it with some of the reasons institutions embark on such a task for science courses in particular.

Elements of Course Redesign

Oftentimes, institutions are faced with internal and external pressures to review the quality of their courses. Accreditation standards precipitate questions that probe if students are learning, how well they are learning, and what information they should be learning (Lammers &

Murphy, 2002; NCAT, 2014). These questions require faculty to carefully rethink how courses are delivered and, if necessary, embark upon an often-daunting redesign process. The National Center for Academic Transformation (NCAT) (2014) describes course redesign in undergraduate courses as a process to improve student success while decreasing instructional costs. Although cost is an overwhelming rationale for redesign, achievement of outcomes, mission-centered learning, and access and equity efforts prompt institutions to embark upon large-scale course redesign efforts (NCAT, 2014). These concomitant issues converge and create a challenge for practitioners who desire to provide a high-quality experience for their students.

Fink (2013) describes course design as planning a course's curriculum to ensure that students achieve and are appropriately assessed on the learning outcomes. Recent efforts to cut costs have forced community colleges to rethink how their courses are delivered (Twigg, 2009). Cho et al. (2022) describe course redesign as improving a course by restructuring its delivery and components, resulting in improved student engagement and ultimately, an improved instructional environment. They assert that because some students face challenges with academic motivation and higher-level thinking, it is imperative that institutions create a student-centered environment that can address their needs with nuanced and supportive resources. To do this involves students taking the lead in their learning, carefully guided by instructors who understand the uniqueness of the student population. The diverse student population at institutions like South City requires educators to reimagine course delivery.

The Problem(s) with Introductory Courses

Bio-110 is considered an introductory biology course. There are specific challenges with introductory biology courses. Marcus (1993) describes a typical community college non-majors biology course as survey in nature that focuses on general biology or anatomy and physiology

concepts. Although the learning outcomes would imply otherwise, these types of courses do little to promote scientific understanding or a greater appreciation of science. Because they are meant to be generic in nature, there are limitations to the depth of the content that is delivered. Thus, an instructor must diversify the lessons enough to ensure student attention is captured and that learning happens (Lysne et al., 2013).

There are a few issues that can plague educators, specifically those who teach introductory courses in the science disciplines. These issues can prohibit student success, so they are significant considerations for redesign. Introductory courses are especially challenged in this way, so careful attention is necessary to ensure student needs are met while still maintaining quality.

Another problem with introductory science courses is the traditional nature in which the content is delivered. In most community college courses, the predominant form of instruction is didactic lecture, and research has overwhelmingly indicated that students cannot meaningfully engage with the content when lecture is the primary mode of instruction (Twigg, 2009). Lecture precludes individualized learning, as each student is treated as though they bring the same set of skills, academic preparedness, and motivation to learn (Twigg, 2009). Specifically, in science courses, student engagement and the complexity of the content can make learning in these courses that much more difficult.

Student Engagement in Introductory Courses

Exeter et al. (2010) define student engagement as "the time, energy, and resources [students] spend on activities designed to enhance learning" (p. 762). If a student is appropriately engaged, then they must be involved, use a variety of skills, and recognize that something significant is at stake (Lysne et al., 2013). According to Lysne et al. (2013), science students are

often taught within the four walls of a classroom or laboratory, so they may not be able to understand the importance of connecting to their environment or the scientific problems that persist. Engagement and place are inextricably linked; therefore, both student learning and success are contingent on them (Lysne et al., 2013).

New teaching strategies have emerged to address the challenge of getting students to connect and engage with course material (Cobb, 2016). Orr (2004) asserts that the concept of place is key and holds particular irony in the context of science education. The *way* that learning occurs, process, and *where* learning occurs, place, can both elicit some passivity. In a biology class, this becomes even more apparent. The learning typically occurs inside a classroom or lab, whereas the outcomes addressed reference events that require connection to the outside world. Hence, process and place, both seminal in the learning, become passive afterthoughts, thus impacting the students' ability to acquire knowledge.

Perceived Value to Students

Institutions recognize that students are challenged with motivation, preparedness, and engagement (Zhao, 2016). These factors serve as the impetus for embarking upon course redesign. According to Eccles and Wigfield (2020), in order for a student to achieve academically, they must perceive that the tasks completed will add value. Students will ask themselves why a task should be completed and may reconcile this by assigning a type of value — either intrinsic, attainment, or utility. They will then adjust the manner in which they engage with course content based on how they balance one of those values with cost. This cost does not refer to the financial investment, rather to the effort or sacrifice required to complete the task. Students' expectations for success and the value they assign to tasks can have a positive impact

on outcomes. Collectively, these factors will determine if students remain engaged and if other similar topics they encounter will continue to spark their interest.

Cost

In addition to students' perceived value serving as a barrier to success, the financial cost of a science course can also be burdensome for both the student and the institution. Instruction, course materials, and lab fees are all required components, and they drive costs for both the student and the institution (Lloyd & Eckhardt, 2010). Cost-cutting measures, both for institutions and for students, have been a primary focus for reform (AAAS, 2009). Almost 80% of the overhead cost for colleges and universities is attributed to personnel, so there is a direct correlation with controlling cost and providing staffing interventions (van Dusen, 2000). By taking advantage of instructional technology, institutions can not only reduce the need for faculty intervention, but they can also provide more accessible materials for students and reduce the cost of instruction (van Dusen, 2000). It is necessary, however, to balance both to ensure a quality experience for all students.

How Biology is Taught to Non-Biology Majors

Teaching non-majors biology courses to unique and diverse student populations remains an area of concern, particularly because they are in high demand at community colleges (Lloyd & Eckhardt, 2010). Large schools like South City offer many sections. Therefore, it is challenging to ensure that students receive a similar experience across the various sections. Twigg (2003) asserts that faculty are allowed a fair amount of latitude in course development and delivery, but the student experience — their needs, learning styles, and interests — are standardized. Educators, however, should do the opposite; they should provide more consistency in the faculty practice and individualize the student experience (Lloyd & Eckhardt, 2010).

Often, the course text provides the framework for which the outcomes are delivered. Wandersee (1985) surveyed course texts for non-science majors courses and revealed that many have a similar structure and format. Textbooks selected for non-science major biology courses are simply paired down versions of those used in majors courses. Primarily, they begin with an introduction to chemistry and take a cellular and molecular approach. They then transition to biological principles with emphasis on biochemistry and energy. Thus, they are ineffective for students in community colleges, many of whom have challenges with college readiness (Marcus, 1993; Zeindenberg, 2008). Educators must look beyond the traditional course textbook and find innovative strategies to deliver the content in ways that keep students engaged and foster their appreciation for science (Wandersee, 1985).

Models for Redesigning Biology Courses

Marcus (1993) asserts that in order to best serve non-science major biology students, it is not necessary to expose them to every concept in biology; rather, it is imperative that the uniqueness of their needs be recognized. There is too much complex information to learn, and much of it will do little to develop their scientific literacy. Thus, students must engage with content by focusing on contemporary issues in the field, rather than rote memorization of terminology and pathways (Lysne et al., 2013). Many of the large-scale redesign efforts focus on this ideological shift to re-envision how biology is taught. There are several models of redesign that will be discussed in the next few sections, including Big Ideas; Biology Systems Thinking Framework; technology and gamification; and Backward Course Design.

Big Ideas

The standard approach to science learning wherein curriculum breadth is the focus does not allow students to build a framework upon which they can gain knowledge (National

Research Council, 2012). Recently, according to Allred et al. (2022), there has been increased emphasis on learning initiatives that focus on what students learn, and they center on big ideas. These ideas are widely agreed upon (Momsen et al., 2022) and highlight the most essential concepts, as well as what students should be able to do with this knowledge (Allred et al., 2022). This is key to building connections between ideas across disciplines and at various levels. AAAS Vision and Change reform efforts outlined a strategy to incorporate core concepts throughout biology curriculum; however, a plan for specific institutions that is nuanced enough for their student populations remains up to the faculty to devise (AAAS, 2009).

Biology Systems Thinking Framework

Momsen et al. (2022) describes systems thinking in general terms as a group of related units that can function efficiently as a whole. In the context of biology, this term is applied to living organisms, organs, or ecosystems. It is understood that the system consists of its individual entities that form the collective and the rules that determine how these entities engage. Most specifically, it is important to understand the components of a system, how they are organized, how they interact, and what controls the interaction. When a student is learning using a systems approach, they must understand the core concepts or big ideas as indicated above, and they must also conceptualize how these concepts relate to one another. Thus, they must develop a skill set that allows them to recognize and interpret complex systems and be able to understand how an action or malfunction in one component could impact the entire system.

Momsen et al (2022) derives the Biology Systems Thinking (BST) framework from traditional systems thinking, using it to describe a set of skills germane to biology instruction and assessment. There are four hierarchies: (1) identification and description of the system, (2) analysis and reason around relationships, (3) analysis and reason around a system, and (4)

reasoning across multiple systems. This framework serves as a central paradigm to help students organize their knowledge because biology is rooted in the interconnectedness of living systems.

Technology and Gamification

One of the primary goals of course redesign is to improve the outcomes, success, and completion rates for students (AAAS, 2009). Because of the multitude of considerations — cost reduction, access/equity, and quality — instructional technology is increasingly relied upon to achieve these goals (van Dusen, 2000). McDaniel and Fraser (2016) revealed that technology use in the classroom yielded positive effects. They found that adapting the course content to the instructional technology required careful review of goals and anticipated outcomes; this process alone proved beneficial for improving instruction. This type of careful consideration of outcomes and assessment serves as the crux of many redesign efforts. Thus, it is important that educators take care to not mistake simple technology integration with course redesign.

Gamification uses game design and techniques to engage individuals with non-game activities (Kalogiannakis et al., 2021). In gamification, learning can be improved upon because there is no consequence in failure (Hartt et al., 2020). Beaulieu and Petit-Turcotte (2018) indicate that biology is particularly ripe for gamification because students can encounter vast amounts of visual materials like images, pathways, processes, and diagrams that are well suited for integration into the gaming environment.

Backward Course Design

The integration of Big Ideas, Biology Systems Thinking Framework, and technology with gamification into redesign efforts can improve a course by eliciting student engagement and better conceptualization of key ideas. While these serve as addendums to an already existing course structure, backward course design involves intentionally designing a course with a clear

understanding of what is most important for the students to learn (Covey, 1989). According to Wiggins and McTighe (2005), backward course design challenges traditional instructional design in that educators must begin with the goals first, develop assessments based on those goals, and then plan their teaching accordingly. Using this strategy at a dynamic institution like South City allows the faculty to remain focused on developing their lessons intentionally in order to achieve the expected results. For these important reasons, key elements of backward design were used to reimagine the way the Bio-110 course was delivered at South City.

Purpose of the Study

The purpose of this study was to evaluate the impact of the redesign of a Principles of Biology (Bio-110) course at South City Community College. This study employed a mixed-methods approach. Quantitative methods were used to compare the success rate in sections of the course that were taught using the redesign components to those that were taught using the traditional lab/lecture format. Additionally, success in the course during the redesign period was further analyzed based on faculty status (part-time vs. full-time). Using qualitative means, I also analyzed how the redesign impacted Biology faculty members' attitudes about their pedagogy. The following research questions guided this study:

1. Did students who took the redesigned Bio-110 course have higher success rates (measured as ABC course letter grades) than students in the non-redesigned course?
2. Did faculty status (measured as part-time vs. full-time) impact student success rates (measured as ABC course letter grades) for those who took either Bio-110 course type (non-redesigned vs. redesigned course)?
3. How did faculty members' experiences of the Bio-110 course redesign influence their pedagogy?

Significance of the Study

As community colleges face a variety of challenges, particularly in science education, careful course design is imperative (Lloyd & Eckhardt, 2010). Because faculty's training and learning experiences are often limited to their professional expertise (Amey, 1999), instructional design remains an area wherein faculty could benefit from the support of institutional development programs. Additionally, according to Zeindenberg (2008), community colleges have the unique responsibility of educating a diverse population of students with nuanced needs and learning styles. As such, the manner in which their courses are delivered must be intentional, mission-driven, and remain student-centered. This study was significant because non-majors science courses have been the focus of redesign efforts (AAAS, 2009); however, it is important to draw parallels between students' success after redesign implementation and the impact the process had on faculty pedagogy. Exploring these two factors is significant in determining if the efforts are meaningful and the potential implications for other learning environments. The typical success metrics at a community college, such as grade data and graduation and transfer rates, are hugely important to the college's stakeholders. However, making the connection between traditional success and impact on faculty is sometimes lost. This study will strive to connect both the traditional quantitative course success metrics with qualitative data regarding the orientation of faculty to their teaching and future redesign endeavors.

Summary of the Methodology

In order to address the research questions, this study used a mixed-methods approach. The goal of mixing methods was to effectively use qualitative and quantitative means to strengthen the study (Schoonenboom & Johnson, 2017). Greene et al. (1989) delineated the purposes for mixing methods. They include complementarity to clarify the results of one method

with the results of another, development of where the results of one method inform the other, revealing paradox or contradiction, and expansion of the depth of range of inquiry. Bryman (2006) further supplemented these categories into other aspects including credibility, context, illustration, utility, confirmation and discovery, and diversity of views (Schoonenboom & Johnson, 2017). In this study specifically, the purpose of using mixed methods was to combine both qualitative and quantitative approaches to broaden the depth of understanding of the impact of this course redesign on both student success and faculty's orientation to course design.

Quantitative Methods to Address Success in a Redesigned Bio-110 Course

In order to address Research Questions 1 and 2, an ex-post-facto quasi experimental design using mixed methods was used to determine if there was a relationship between the type of Bio-110 course a student took (non-redesigned or redesigned), faculty status (part-time vs. full-time) and their success in the course, determined by the letter grade earned. In a quasi-experimental study, the researcher is unable to control for external variables (Maciejewski et al., 2013). However, these types of studies are effective because they allow the researcher to compare the effectiveness of the treatment, in this case, course type, and tend to have higher external validity (Maciejewski et al., 2013). Quantitative research was selected because it is systematic in nature, and allows for relationships between variables to be examined (Ellis & Levy, 2009). Additionally, a quantitative methodology will allow for characteristics of the groups to be observed and the potential identification of relationships between the type of course completed and the earned grade.

The research design used comparison groups that consisted of students who took Bio-110 and were instructed by faculty members (part-time or full-time) that taught the course in either the redesigned format or the non-redesigned format. The sample consisted of students who took

Bio-110 in the Spring 2017, Fall 2017, and Spring 2018 semesters. Summer terms were excluded because only the non-redesigned Bio-110 course was taught in summer 2017 and 2018. Instruction of the Bio-110 course was delivered in three formats that included traditional (100% of instruction in person), blended (50% of instruction in person), and fully online (100% of instruction online, asynchronous) in both the redesigned and non-redesigned courses.

In order to analyze the data, analysis of variance (ANOVA) was utilized as well as *t*-tests. ANOVAs are commonly used to test for statistical differences among the means of two or more groups (Coladarci & Cobb, 2014). To address Research Question 1, a one-way ANOVA was performed to analyze the impact of Bio-110 course type (redesigned vs. non-redesigned) on the students' final course grade. To explore Research Question 2, a 2 x 2 ANOVA was used to analyze the impact of Bio-110 course type (redesigned vs. non-redesigned) and faculty status (part-time vs. full-time) on the students' final course grade.

Qualitative Methods to Analyze Faculty's Pedagogy After the Redesign

In order to address Research Question 3, interviews were used to analyze the changes in faculty's pedagogy after participating in the Bio-110 redesign process. The goal was to determine if their attitudes about course redesign were impacted and what, if any, impact that had on how they approach their pedagogy as a result of their experience. According to Ryan et al. (2013), interviews are valuable tools because they allow the researcher to gain insight into the participant's perceptions, understanding, and experiences.

The sample consisted of full-time faculty members in the Biology Department at South City. Full-time faculty members were sampled because, by virtue of their role in course design and textbook selection in the department, they made significant contributions to the Bio-110

redesign process and, thus, were a part of the pilot, phasing, scaling, and full implementation of the redesign.

This data regarding teaching decisions was collected by conducting interviews that queried the Biology faculty regarding their orientation to course redesign after their experience with the Bio-110 course. The questions, according to internal documents at South City, were grounded in the college's Teaching and Learning Excellence Framework that consists of eight faculty competencies: pedagogical content knowledge, feedback and assessment, inclusive pedagogy, curriculum alignment, classroom climate, instructional strategies, faculty engagement, and educational technology. The faculty's perspectives about the redesign were collected via responses to interview questions. The data was analyzed by open coding which allowed for the comparing and contrasting analysis of similarities in themes, and aiding in removing preconceived notions and biases regarding the responses (Creswell, 2014). Then, axial coding was conducted to make meaning from the phenomena revealed in open coding (Creswell, 2014).

Delimitations, Research Questions 1 and 2

As it relates to Research Questions 1 and 2, this study was delimited to students who took Bio-110 in the Spring 2017, Fall 2017, and Spring 2018 semesters. These semesters were selected because they were the terms in which the Department was offering the course in both the non-redesigned and redesigned formats. Success rates during Summer 2017 and 2018 were not analyzed because the Department taught Bio-110 in the non-redesigned method exclusively.

Delimitations, Research Question 3

As it relates to Research Question 3, this study was delimited to full-time faculty members who taught the Bio-110 course in the Spring 2017, Fall 2017, and Spring 2018 semesters. Full time faculty were selected by virtue of their required role in course design and

textbook selection in the department; they also made significant contributions to the Bio-110 redesign. According to the Public Agenda and Achieving the Dream (2011), there has been a longstanding challenge with integrating adjunct faculty into reform efforts that are critical to student success. Additionally, colleges are often unable to develop the appropriate infrastructure to effectively communicate with adjunct faculty. In terms of course redesign, as a cost saving measure, institutions may employ a design approach wherein full-time faculty do the course design work and adjunct faculty implement the strategy (Felber, 2020).

Limitations, Research Questions 1 and 2

There were some important limitations to consider in the quantitative portion of this study. Because of the uniqueness of community colleges and the students they serve, traditional metrics such as grade data do not accurately reflect what success may mean in this nuanced setting (Zeindenberg, 2008). Community college students typically are non-traditional; as the average age of a community college student in the state where South City is located is 28 years old (NC Community Colleges, 2022a). Zeindenberg (2008) asserts that their needs reach far beyond academics, so a holistic approach to serve and assess their success is necessary. Community colleges are much more diverse in their student composition; therefore, traditional metrics like course grades may not accurately capture the ways these institutions serve their students. Thus, otherwise non-conventional metrics can also be touted as student successes.

Further, the selection of the Bio-110 sections that were taught using the redesigned pedagogy was not randomized. The decision was made by Biology Department leadership based on the instructors' willingness to participate in the redesign project and experience with course development. These instructors were stationed at specific satellite campuses at South City;

therefore, it cannot be assumed that there was a random sampling of the student population who would otherwise take the Bio-110 course.

Limitations, Research Question 3

Alcoff (1988) describes the particular benefit of positionality as a fluid concept that can be used to create and critique different interpretations of meaning. During the time of the Bio-110 course redesign, my position at South City as the Division's leader included the Biology Department and its faculty and staff. Additionally, I have prior experience as a Biology faculty member at South City and another community college in the region. Therefore, care was taken to not overemphasize my authority as an agency of interpretation (Alcoff, 1988).

Information retrieval and recall for faculty that were queried also served as a limitation. Lavrakas (2008) describes the memory processes that participants use to respond to questions. One of those is retrieval, which is the recovery of prior information from long term memory into working memory. Long term memory includes memory for facts and from events. Respondents may have been challenged when the retrieval process was unaided without cues related to the situation queried. Typical cues related to time (i.e.: Spring 17 or Fall 17) or a repetitive action (i.e.: teaching the Bio-110 course for several semesters) may have elicited error-prone responses as the memories associated with the Bio-110 redesign process were encoded several years ago.

Assumptions

There are a few assumptions associated with this study. First, educators assume that student success is measured by grade data alone, and that pass rates associated with transferability of a course within the community college setting (i.e.: A/B/C) indicates success with students meeting the course level learning outcomes. Similarly, it is assumed that unsuccessful students (D/F/W) did not achieve the learning objectives. Secondly, a part of the

course redesign involved efforts to reduce the cost of required course materials, as the leadership and faculty assumed that cost was a significant priority for students. Integration of OERs and other low-cost materials was an integral part of the redesign. Finally, it is assumed that students desired a less traditional classroom experience that incorporated more technology and integrated approaches that deviated from the typical didactic lecture.

Definitions

The purpose of this study was to determine the effectiveness of a redesign effort in a community college Principles of Biology course (Bio- 110) and explore the impact of the redesign on faculty members. To this end, several terms are operationally defined by the following:

- Success/Pass rate: an earned grade of A, B, or C in a course.
- Redesigned course: a Bio-110 course that has been restructured using a flipped classroom approach wherein students have their first interaction with the content before the class using the *BioBeyond* gaming platform, and then use class time for in-depth engagement with the material (Abeysekera & Dawson, 2015).
- Non-redesigned course: a Bio-110 course that uses typical didactic lecture and lab instructional strategies.
- Bio-110: a survey biology course that emphasizes "basic chemistry, cell biology, metabolism, genetics, evolution, ecology, diversity, and other related topics" (NC Community Colleges, 2022b). It does not have a prerequisite and is approved for transfer under the state's comprehensive articulation agreement.
- Transfer: If a student receives credit for a course by virtue of an earned grade of A, B, or C, the individual course will transfer and the student will receive credit towards

requirements for the completion of a degree or credit for it at the four-year institution to which they will attend after matriculation at a community college.

- Degree/Completion: In the context of an Associate's degree, (two-year degree designed for transfer to baccalaureate institutions) it is the fulfillment of the required college transfer courses, to total a minimum of 60 credits.
- Curriculum student: a student enrolled in a college level course for transfer or degree completion credits.
- Enrolled student: a student who is officially registered for a Bio-110 course.
- Blended (instruction): <=50% of the instruction occurs virtually via the learning management system. In the context of Bio-110, blended delivery means the lecture occurs online and the lab occurs in person.
- Traditional (instruction): 100% of the instruction occurs in person. In the context of Bio-110, traditional delivery means both the lecture and lab instruction occurs in person.
- Online (instruction): 100% of the instruction is asynchronous and occurs virtually via the learning management system. In the context of Bio-110, online delivery means both the lecture and lab instruction occurs online.
- Part-time student: a student attempting fewer than nine credit hours of coursework in a fall or spring term.
- Full-time student: a student attempting 12 or more credit hours of coursework in a fall or spring term.
- Part-time (adjunct) faculty: a faculty member assigned up to 50% of a full-time teaching load in a given semester, or up to two curriculum courses.

- Full-time faculty: a faculty member, in addition to professional development, college service, and office hour commitments, that is assigned to teach between 15-18 contact hours per semester.

Summary

The purpose of this study was to determine the effectiveness of a redesign effort in the Principles of Biology course at South City Community College. To do so, the success rate in sections of the course that were taught using redesign components and new instructional technologies to those that were taught using the non-redesigned traditional lab/lecture format were compared. Success in the Bio-110 course during the redesign period was further delineated by faculty status (part-time faculty vs. full-time). Additionally, I explored the impact of the redesign on faculty in the Biology Department to determine how their teaching changed based on their experience in the redesign process. This analysis is significant because it is necessary for faculty to thoughtfully design courses tailored to the student population that they serve (Fink, 2013). The course redesign occurred at South City Community College, a large two-year institution in an urban metropolis. The diverse student population requires educators to consider students' needs and learning styles and to account for the unique challenges they face in the community college setting. Furthermore, by redesigning courses in community colleges, particularly those in high demand, faculty can have a significant impact on student success (Twigg, 2009).

In order to address the specific research questions, an *ex-post facto* quasi-experimental design that utilized mixed methods was used. The first goal was to determine if there was a relationship between the type of Bio-110 course a student took (redesigned vs. non-redesigned), faculty status (part-time vs. full time), and their success in the course, as determined by the grade

earned. Additionally, Biology faculty members' attitudes about course redesign after their experience with Bio-110 were explored using semi-structured interviews. Collectively, this data is impactful because the redesign efforts could precipitate similar strategies for students with unique learning needs and in a nuanced learning environment. Further, understanding the impact of a redesign project from the faculty's perspective can influence how they approach their pedagogical philosophy.

Chapter II: Review of Literature

The focus of this chapter is to discuss the primary framework, Understanding by Design (UbD), used in the redesign of the Principles of Biology course (Bio-110) at South City Community College. To do so, the key principles and assumptions of instructional design theories of seminal theorists Merrill, Gagné, Wiggins and McTighe, and Tyler will be discussed. UbD will be compared with other instructional models and critiqued in relation to education inquiry. Then, the foundations, origins, and history of UbD will be engaged under the backdrop of course design for non-majors biology courses. Further, full-time and part-time faculty will be characterized, and their approaches to instruction and curriculum will be discussed. Additionally, this chapter will discuss how course redesign influences faculty's orientation towards teaching decisions. This orientation will be examined through South City's Teaching and Learning Excellence Framework, which provides the competencies faculty use to gauge student success at the college. Finally, the manner in which course redesign influences teaching choices will be used as the basis for rationalizing the potential impact of redesign efforts in community college biology courses.

Instructional Design

Instructional design has roots in psychology but has been influenced by constructivism (Heaster-Ekholm, 2020; Richey, 1996). Educators assert that at its core, teaching should be guided by learning objectives through accounting for desired behaviors, the environment in which learning occurs, and the manner in which learning is assessed (Mager, 1997). Several theorists have identified key tenets of instructional design, all of which have the goal of providing quality learning experiences for students. In the next few sections, I will explore instructional design approaches by key theorists, such as Merrill, Gagné, Wiggins and McTighe,

and Tyler. It is essential to compare and contrast these theories in order to understand how they work in the community college setting.

Merrill's Theory of Instructional Design

According to Merrill (2001), instructional design requires two activities: deciding what to teach and deciding how information should be taught. Determining the "what" is complicated because it requires a series of small, but important decisions (p. 294). Specific components of knowledge should be selected from a wide body of curriculum, and the sequence in which that knowledge should be delivered is determined. The "how" is also important because it involves deciding which instructional strategy is best suited for the "what" and the context in which it is taught (p. 294).

Merrill's (2001) assertion of the two activities necessary for instructional design requires educators to process knowledge analysis and develop a keen instructional strategy. The knowledge analysis involves "micro decisions" (p. 294) that include selecting relevant components of the content and deciding on the order in which they should be presented so instructional materials can be adequately developed. This work reaches far beyond that of a subject matter expert because course design includes being versed in the approach that best achieves the goal of instruction. Determining the knowledge components is a key part of the design process and lends itself to the instructional strategy. The instructional strategy, or the *how to teach*, requires decisions that include selecting the resources and contexts for instruction.

Pebble in the Pond. Merrill's emphasis on the process required to develop instruction reaches far beyond a particular technology or a singular implementation (Merrill, 2002). There should be an emphasis on quality and specific guidance around what each step is supposed to accomplish. Based on his instructional principles, Merrill (2002) describes the Pebble-in-the-

Pond design model, which consists "of a series of expanding activities initiated by first casting in a pebble, that is, a whole task or problem of the type that learners will be taught to accomplish by the instruction" (p. 43). After identifying the problem, the second ripple in the pond requires further development of the problems with increasing complexity. If a learner can master these tasks, then they have mastered the knowledge. The third ripple in the pond involves identifying the knowledge or skill required to complete the learning tasks. The fourth ripple compels the teacher to specify the most appropriate instructional strategy that will sufficiently engage the learner. The fifth ripple necessitates adapting the strategy to the learning environment, delivery method, or situation. Pebble-in-the-Pond is based on Merrill's first principle of instruction with its content-first approach; tasks are centered on real-world activities that form the crux of the curriculum (Merrill, 2007).

Significance, Advantages, and Disadvantages of Merrill's Theory. Merrill is known for his design theory because it is a systematic way to design instruction. Using a number of previously established theories, he was able to develop these principles that focus on problem-centered learning. Here, learners use constructivism to build their own knowledge by activating prior knowledge and experiences (Bayat & Tarmizi, 2012).

Merrill's work has been lauded for its clarity in creating a learning solution. It focuses on finding solutions to problems, and this often helps learners transfer knowledge more effectively. The result is added value to instructional design and student learning experiences (Bayat & Tarmizi, 2012). A criticism of Merrill's approach is that it does not include how to determine the learning needs of the students or a manner in which to evaluate the design for improvement (Amir-teimury et al., 2014). Other approaches, like Backward Design, underscore the

significance of identifying learning outcomes first in order to drive the nature of assessments used.

Gagné's Theory of Instructional Design

As opposed to Merrill's focus on solving real world problems (Merrill, 2002), Robert Gagné emphasized the fundamental nature of learning as an internal process. Gagné was influential in instructional design, as he was central in incorporating psychology into the field (Richey, 1996). Khadjooi et al. (2011) assert that this process depends on past learning, or internal conditions, and is controlled by external events. These conditions of learning differ depending on the outcomes and benefit from the use of varied and well sequenced instructional strategies. Strategies should include direction, practice, feedback, and reinforcement.

Gagné's theory of instructional design requires educators to carefully analyze the content of their curriculum (Gagné & Merrill, 1990). This ensures that the sequence of the lessons can be well established and educators can determine what prior knowledge students bring to the learning environment (Gagné, 1968). Thus, the focus of the instructional design is on learning outcomes and how to structure activities to achieve those outcomes. Then, the learning tasks can be developed with an emphasis on the *students* who are receiving the instruction, and not on the *material* being taught (Richey, 1996).

Gagné (1968) outlines nine events in instruction. These events are:

1. Gain the attention of the students.
2. Inform students of the objectives.
3. Stimulate recall of prior learning.
4. Present new material.
5. Provide guidance for learning.

6. Elicit learner performance.
7. Provide feedback.
8. Assess performance.
9. Enhance learning retention and transfer.

Gagné's steps are significant because they reference actions of both the teacher and the learner that are seminal in instruction (Miner et al., 2015). Additionally, the conditions of learning—those internal factors that address prior knowledge and external factors such as instructions from the teacher—are essential to effective instruction (Khadjooi et al., 2011). For students as unique and diverse as those in a community college, taking a holistic approach that accounts for the environment, the teacher, and the learner will ensure effective instruction.

Backward Course Design

Whereas Gagné and Merrill addressed activation of prior knowledge, demonstration of application, and integration of new knowledge, backward course design emphasizes assessment centered on achievement of learning outcomes. Although it has its origins at the K-12 level, the tenets of backward design can be applied at the community college level. The concept was first introduced by Ralph Tyler. In what became known as the Tyler Rationale, four basic principles of curriculum and instruction were outlined: defining learning objectives, developing meaningful learning experiences, organizing those experiences to have an optimal effect, and evaluating and revising experiences that were not effective (Tyler, 1949; Wraga, 2017). Tyler encountered challenges that educators face today: student enrollment, new emphasis on curriculum development, and assessment (Wraga, 2017). He used extensive field work to design a course that engaged his students with meaningful curriculum development and with a novel emphasis on "assessment as evaluation rather than a measurement" (Wraga, 2017, p. 228). Wraga (2017)

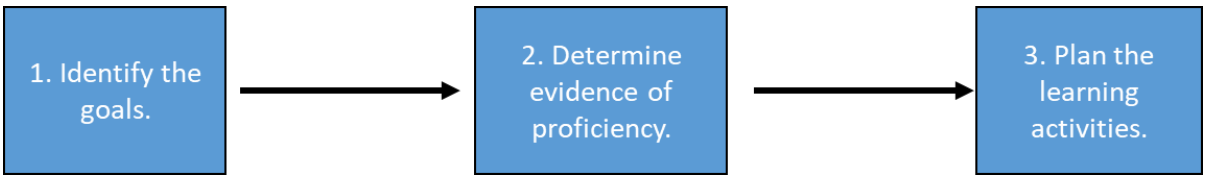
asserts that Tyler was seminal in identifying the difference between measurement and evaluation, an unconventional notion at that time. Measurement was historically focused on serving the institution and sought to standardize local situations. Tyler wanted to evaluate students based on their behaviors in relation to educational objectives that were developed. Some renowned theorists such as Kliebard (1970 & 1995) refuted Tyler's claims as stepwise, narrow, and trivial. However, others attempted to redirect these criticisms. The focus on objectives served as the backdrop for Wiggins and McTighe's work on UbD.

UbD Framework

Backward course design serves as the foundation of UbD (Wiggins & McTighe, 2005). According to Covey (1989), the crux of backward course design is "to begin with the end in mind" (p. 98). This means there must be a clear understanding of the endpoint so the route best suited for the students can be determined. This ensures that the direction is appropriate for the content delivered. Educators must carefully consider all aspects of design when crafting their courses. According to Wiggins and McTighe (2005), backward course design challenges the traditional instructional design model in that educators must begin with the goals first, develop assessments based on those goals, and then plan their teaching accordingly. Thus, the lessons must be derived from the results they hope to achieve. Figure 2 outlines the three steps in the backward design process.

Figure 2

Steps of Backward Design



Note. The steps of backward design, adapted from Wiggins and McTighe (2005).

Wiggins and McTighe (2005) outline these steps in relation to designing for understanding. Step 1, likely the most important, requires educators to examine the goals and focus on the big ideas. Because time constraints will not allow all of the content in a course to be addressed, the first step requires the educator to prioritize the concepts they want students to understand. This is different from traditional approaches because oftentimes, students stumble upon mastery, instead of there being an explicit focus on the intention of the learning. Additionally, without having the end in mind, students will traverse the curriculum in a survey manner without a specific learning purpose. In Step 2, faculty must decide how the student will be assessed to determine if proficiency has been achieved. This evidence will validate student learning with a variety of methods such as discussions, projects, or exams, rather than just covering the content through a collection of activities. Step 3 requires educators to decide what teaching methods and learning activities are most appropriate. What knowledge and skills must students have in order to achieve the desired outcomes? How will mastery be demonstrated on assessments? What materials and resources are needed to teach this information to accomplish these goals? Backward design is akin to a travel itinerary; the traveler selects their destination first, and then does the work to plan how to reach that destination. Using this framework, the educator first decides what the students should know, determines what mastery will look like, and then decides what resources will be used to demonstrate mastery.

Unconventional Nature of UbD. Wiggins and McTighe (2008) describes the departure of UbD from traditional teaching. First, there is an emphasis on the assessment piece from the outset. Typical teaching has instructors creating assessments at the end of a unit of study. The intention of backward design requires mastery to be demonstrated by evidence of the big ideas identified in Step 1. Second, the faculty member must always ensure that the teaching remains aligned with the established goals. This recursive process is at the forefront and allows the items in the assessment to serve as teaching targets. The plan can be re-assessed and revised based on what the students master and serves to guide decision making regarding essential knowledge and skills. Additionally, a particular teaching method does not drive the process. Traditional approaches rely on a specific strategy like experiential learning, maybe because it is favored by the instructor. UbD requires faculty to ask: In order for students to achieve the outlined goal, what instructional strategy is best suited? Thus, the teacher remains focused on the concepts to be learned, and then selects the most appropriate approach.

UbD Design Standards and Processes. Wiggins and McTighe (2005) also outlined specific principles that ensure quality control in course design. Analogous to a grading rubric, these standards exist in three stages and provide targets so educators can work toward these instructional ideals in their development. In Stage 1, the standards ask questions to center design on the big ideas. Essential questions that allow students to make connections, incite deep thought, and probe inquiry should be framed. In Stage 2, standards focus on assessment to ensure they are fair, valid, and authentic. The assessment formats should vary and allow for sufficient evidence of learning. In Stage 3, the learning plan is developed, so design considerations should include opportunities for students to understand what is required of them, why they are learning the material, and how to engage in the big ideas. These standards also ensure that faculty will

vary the activities to address different learning styles with opportunities for inquiry, experimentation, and reflection.

Ultimately, there should be a synergy in the overall course design, with clear alignment between all three UbD stages (McTighe & Brown, 2021). This, however, does not necessarily mean the process is linear. A well-crafted plan is necessary, but faculty should take liberties to play with ideas and test those ideas with different groups of students (Wiggins & McTighe, 2005). There is a recursive nature to UbD, and faculty should self-assess, adjust, and utilize peer feedback to seek alternate teaching strategies (Wiggins & McTighe, 2005).

The "Understanding" in UbD. Along with ensuring that a course's design is sound, it is necessary that faculty members are clear on what they want students to *understand*, as this is different from simple knowledge acquisition (Reynolds & Kearns, 2017). Evidence of understanding includes the ability to develop questions independently, apply basic concepts to more complicated topics, and perform investigations (Wiggins & McTighe, 2005). In other words, "If students *understand*, then they can provide evidence of that understanding by showing that they know and can do certain specific things" (Wiggins & McTighe, 2005, p. 37).

Bloom's taxonomy is a commonly used resource to delineate the range of educational learning objectives (Anderson & Krathwohl, 2001). It consists of six levels: remember, understand, apply, analyze, evaluate, and create (Bloom et al., 1956). According to Wiggins and McTighe (2005), educators assert that they want their students to understand the content but need clarity on what that means. UbD requires educators to explicitly determine, through its framework, what exactly they want their students to understand. More importantly, they must design the curriculum so that understanding can be demonstrated via carefully crafted assessments. These assessments must not only demonstrate that a task was done correctly, but

that the student can explain their approach, how they used particular skills, and why their method was or was not appropriate. Further, Wiggins and McTighe (2005) assert that understanding means grasping big ideas that allow for effective transfer of knowledge. They developed a six-sided view of the concept; when students understand, they "can explain, can interpret, can apply, have perspective, can empathize, and have self-knowledge" (p. 84). Collectively, these concepts must be fully developed in order to judge understanding.

The difference between knowledge and understanding is also a key component of UbD. Students acquire knowledge through facts, claims, assertion of right or wrong, and what they know to be true (Wiggins & McTighe, 2008). This is different from understanding, as this requires meaning making, applying theory to facts, knowing why things happen, and illustrating careful discernment (Wiggins & McTighe, 2008).

Wiggins and McTighe (2008) further elucidate the importance of learning for understanding, which includes information acquisition, meaning making, and transferability of knowledge. Traditional teaching methods rely on knowledge acquisition, so meaning and transfer are not achieved (McTighe et al., 2004). Thus, when a student is confronted with an unfamiliar problem, their lack of understanding precludes them from integrating their knowledge to solve it (Wiggins & McTighe, 2008). Further, teachers have a direct role in creating understanding. Their instructional approach and sequence become even more significant if the goal is meaning making and knowledge transfer (McTighe et al., 2004). UbD challenges the notion that faculty must cover all of the content and then allow students to apply skills to demonstrate mastery (Wiggins & McTighe, 2005). Changing the sequence of teaching, keeping meaning and transfer at the forefront, and then introducing instruction can ensure that students

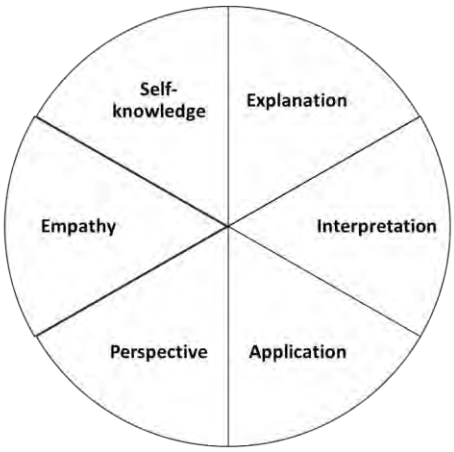
can learn for understanding as opposed to simple knowledge acquisition (Wiggins & McTighe, 2005).

UbD and Instructional Design in Science Courses. It is important that science courses at two-year colleges are intentionally designed (Twigg, 2009). These institutions serve a diverse population including first generation, non-traditional aged, and minority students (Zeindenberg, 2008). Particularly in science courses, there are marked achievement gaps in these populations (Long et al., 2020; Minbiole, 2016). However, these students tend to demonstrate enhanced understanding of concepts and academic performance when their courses are a part of improvement efforts centered on meaningful assessment (Long et al., 2020). Like in Merrill's problem-centered learning and the emphasis on understanding in UbD, making connections to the content only serves to enhance learning. The emphasis on understanding in science courses is framed by big ideas and essential questions that allow students to make connections to real world problems (Wiggins & McTighe, 2005).

Six Facets for Understanding in UbD. According to Wiggins and McTighe (2005), in order to ensure that students have attained adequate understanding, UbD uses six facets. These facets are indicated in Figure 3.

Figure 3

Six facets of Understanding in UbD



Note. The six facets of understanding, adapted from Wiggins & McTighe (2005).

In Facet 1, a student who understands can explain the big ideas using their own insights. They can integrate theories and principles to make sound arguments, but with subtle distinctions. In Facet 2, interpretation, a student must translate information. In Facet 3, application, students can use their knowledge and apply it in different situations, even if the context is novel. They can also extend their knowledge into unstructured or messy situations they would encounter in the real world. Facet 4, perspective, requires the student to be the oppositionist. They must be able to determine if an idea is biased or based in theory, but still take an affirmative stance. In Facet 5, empathy, the student must be able to appreciate views that are divergent from theirs. They must find meaning in views that could be perceived as incorrect or implausible. Finally, in Facet 6, if a student has self-knowledge, they can acknowledge their own preconceptions and concede when their own assumptions are wrong. This requires careful reflection and self-regulation.

Applying the Six Facets of UbD for Understanding in Science Education. These six facets can be implemented specifically in science education because there are various ways to

incorporate them into the learning goals. Wiggins and McTighe (2005) indicated that to explain a particular big idea, a student must be able to make predictions and develop hypotheses based on previously established principles. They should be able to provide reasons why their hypothesis is reasonable. In the context of science education, Facet 2, interpretation, is important because students must be keen at analysis, which requires interpreting patterns to make sense of data. Application allows students to extend their knowledge into real world situations; this could include taking a previously established protocol and adjusting its parameters to fit a new context. According to Wiggins and McTighe, (2008), understanding with empathy in science education would enable students to, for example, study theories with which they disagree or that have been widely disputed and still have an appreciation for the point of view. Self-knowledge would allow students to assess their own thinking. This could include reviewing pre- and post-assessment questions to critique their work and gain insight into their learning.

Understanding and Constructivism. Instructional design theories, such as UbD, require students to use prior knowledge and experiences to build their own knowledge (Bayat & Tarmizi, 2012). The integration of constructivism into UbD is demonstrated when students are given the opportunity to make connections between the content and their own experiences. Constructivism involves the social construction of knowledge from human interactions and relationships (Raskin, 2002). This is different from objectivism which asserts that knowledge is scientific, singularly methodical, and measured with a fair degree of accuracy and validity (Richey, 1996). Humans must assemble knowledge and their minds work to make meaning by creating systems for understanding the world around them (Raskin, 2002). Constructivism rejects objective reality and emphasizes the individual's ability to internally process information (Richey, 1996). Thus, the learner takes an active role in shaping the learning tasks. Using a

constructivist framework, the student can engage in a learning activity from which they can make meaning and build mental models (Merrill et al., 1990). Some theorists, such as Gagné, rely heavily on constructivism to situate learning. The focus is on the learning objectives, the environment, and knowledge transfer across contexts (Richey, 1996). This is key to understanding, as the goal is deep learning that is transferable by the learner in different situations (Richie, 1996).

Active Learning and Constructivism. Exposure to Levels 1 and 2 in Bloom's taxonomy is common for students entering introductory STEM courses, but many are not practiced in Levels 3 or above (Anderson & Krathwohl, 2001). Well-designed courses that incorporate active learning strategies allow students to apply and comprehend concepts. Haak et al. (2011) describes a constructivist phenomenon wherein students are able to integrate new information with prior knowledge but "only change ideas when new information conflicts with their previous understanding, creating cognitive dissonance" (p. 1216). Thus, activities that extend beyond recall and challenge students to explain their thinking are most beneficial to their learning.

Assessment in UbD. The use of meaning, transfer, and knowledge acquisition in UbD is critical to understanding course content (Wiggins & McTighe, 2008). Careful examination of assessment tools used in classrooms revealed that faculty often fail to assess for understanding, and even fewer require transfer of knowledge (Wiggins & McTighe, 2008). Backward course design demands that assessment ask these questions: "What is evidence of the desired results?" and "In particular, what is appropriate evidence of desired understanding?" (Wiggins & McTighe, 2005, p.147). According to Wiggins and McTighe (2005), faculty are challenged by the assessment piece, and even more so in UbD, because the sequence of traditional course design deviates here more than in any other stage. The thinking must shift from assessing for a

grade to assessing for achievement of outcomes and understanding. To do so, faculty must transition from the role of an activity designer to the role of an assessor, an uncomfortable position for some. Conventional habits include teaching to a target, so faculty begin by creating the assessment without considering how it aligns with the desired outcomes. As assessors, faculty must consider these standards: sufficient demonstration of understanding, tasks that will anchor the work, desired results, and criteria for judging quality work. Collectively, these standards will allow the assessor to clearly understand how the learner made mistakes and ultimately guide the students towards a greater understanding of the content.

WHERE Approach for Assessment in UbD. In the UbD approach, assessment can be challenging because it is difficult to develop an assessment before elucidating the specific learning activities (Wiggins & McTighe, 2005). Wiggins and McTighe (2008) explain the "WHERE" approach for assessment as follows: "W" asks questions such as where are students going, why they are going there, and what might go wrong along the way. "H" requires faculty to "hook" students with a real-world scenario or application question. "E" allows for students to explore and experience concepts while being well equipped to master the particular outcome. "R" provides students space to enhance their learning through revision, refinement, and reflection. Finally, students are evaluated in the last stage, "E" or evaluation.

Authentic Evidence of Understanding. Wiggins and McTighe (2005) explain the idea of authentic assessment as being rooted in UbD's notion of understanding. In order to ensure students truly understand, educators have to know the students' thought process. Traditional assessment requires students to provide answers to questions without contextualizing with rationale or support, so it is difficult to ensure the student has attained understanding. Further, Wiggins and McTighe (2005) suggest that assessment must occur on a continuum in order for

evidence of understanding to be demonstrated. Traditional assessments, like tests and quizzes, can still be useful in ensuring students have fundamental knowledge. However, they should be accompanied by a range of activities, such as open-ended prompts, observations, oral questions, and they should vary in scope, time, structure, and setting. Additionally, the tasks must be authentic with contextualized innovation. The student must use their knowledge to replicate a task set in the real world. Usually, these types of problems lack structure, so the student must independently develop a unique plan to attack the issue. Rote memorization, although important, is not sufficient. Rather, the student is tested with real life situations that are messy and unstructured. Additionally, students must assemble their knowledge from a variety of units or chapters to navigate a complex or scaffolded task. Unlike taking traditional tests or quizzes that simply drill them, students should be allowed to consult resources, get feedback, and tailor their work to guide their understanding, as this cycle mimics how they will be asked to work in the real world.

The History of Course Redesign and Redesign Trends

In order to understand the significance of course redesign in science courses, it is necessary to review some key contributors and their efforts to guide educators in improving student learning. The next section will outline a series of redesign efforts that occurred at both research universities and community colleges and spanned various disciplines. There are commonalities among each, however, the nuances germane to biology education will be elucidated.

Vision and Change (V&C)

John Moore (1984) was a prominent contributor to science education initiatives. He asserted that in order to improve student learning in science, educators should take a dynamic

approach that mimics the evolving nature of the science disciplines. Heavily influenced by his work, a series of publications and conventions, called Vision and Change (V&C), was developed. It included core concepts that outlined the reform required to improve how students learn in undergraduate biology (AAAS, 2009). This series of documents was published by the American Association for the Advancement of Science (AAAS) and described the need for improvement and various strategies experts could use to achieve the learning goals for students. V&C serves as the guiding framework for many reform efforts in biology education, and it also includes a chronology that outlines how these changes can be implemented within institutions (AAAS, 2009).

The V&C movement is seminal because it not only outlines the need for change, but it also provides a roadmap for how educators, professionals, and administrators can embark on enacting change in biology education. The Call to Action document had the following aims: "integrate core concepts and competencies throughout the curriculum, focus on student centered learning, promote a campus wide commitment to change, and engage the biology community in the implementation of change" (AAAS, 2009, p. xii-xiii). These aims were teased out to identify the problem, implementation strategies, and action items. Though this framework provided guiding principles for reform efforts, there was a significant gap in translating theory to practice. The challenges included how could educators apply this framework and how could they measure its success (AAAS, 2009). Although V&C provided the structure or guiding principles, it was up to individual institutions and educators to develop a plan germane to their student populations, faculty landscape, and institution's mission.

Non-majors and introductory biology courses are primed for reform using the competencies in the V&C framework. These efforts are significant because institutions have

nuanced student populations that require engagement to foster meaningful learning (Kakarougkas & Abdellatif, 2022). In the next few sections, examples of biology redesign efforts at various institutions will be described and contextualized within the V&C framework.

Using V&C in a Non-Majors Biology Course at a Community College. In Gonzalez (2016), a high-enrollment online introductory biology course was redesigned at a diverse, medium-sized, two-year community college. This course was ideal for redesign because the learning outcomes were already aligned with the core concepts of V&C. Additionally, the redesign framework required emphasizing key concepts with active learning strategies and student reflection. The main focus was the redevelopment of homework projects that included hands-on exploratory activities. These activities required students to engage with their environment and their own behaviors. The assessment measures included typical strategies used in an online class like exams, quizzes, and discussion forums. Conventional quantitative success measures, such as grade distribution and final exam scores, did not indicate improved student success in the redesign course compared to the traditional course. However, the student opinion surveys were telling in their responses relative to the level of engagement. Many students reported the inclusion of family members and friends in their projects, integral alignment of outcomes and assessments, and a heightened awareness of the world around them.

UbD in Undergraduate Biology Courses. Long et al. (2020) describe the common strategy of incorporating V&C and Universal Design in undergraduate biology courses. Long et al. (2020) used the UbD framework in an undergraduate Biology course at a two-year community college. After redesign by key faculty members in the department, a statistically significant decrease in the D/F/W rates and a significant increase in students passing with a grade C was found. Additionally, it was determined that “at-risk” students—those in their first-

semester, traditional-aged students, and minority students—benefited most from the UbD redesign. Thus, these efforts were found to be effective in improving student learning and retention.

Minbiole (2016) also describes similar efforts at a four-year liberal arts college. The curriculum in a non-majors' biology course was redesigned using UbD. The results indicated higher final exam scores in the redesigned course compared to those scores earned by students in the traditionally taught course. Additionally, there were more students who earned a grade of A or B in the redesigned course than in the traditional course.

Redesign Trends

Although redesign efforts can include changing the delivery method, incorporating specific instructional technologies, or shifting the sequence in which the learning outcomes are presented, there are some trends that have emerged in the field as commonly used, specifically in science courses. Below, I will outline some of the most prevalent ones and discuss their implications for student performance.

Technology and Innovation. According to van Dusen (2000), educational reform on the basis of technology innovation has persisted and dates back almost 100 years. The expansion of computers and the internet has transformed educational practice. As these tools predominated, a cycle of reform emerged: claims about a novel and transformative technology, data indicating that the new tool was either ineffective in improving instruction or the outcomes declined, and then critique of the tool's design and implementation. Few tools have had staying power beyond the experimentation phase, and even fewer can drastically change instructional practices. Restructuring how students learn means re-envisioning how teaching looks. This type of learning

and teaching would include making aids or alternative tools readily available; however, they must be of high quality and low cost.

Technology and the Program in Course Redesign. The incorporation of technology can be effective in reducing course costs and improving the quality of the student learning experience (van Dusen, 2000). At its core, the Program in Course Redesign (PCR) has an intense focus on the use of technology to redesign courses (Twigg, 2009). The goal is to improve quality and mitigate costs for institutions. According to Twigg (2009), PCR embarked upon a large redesign effort that included 30 institutions of various types including research, private, and two-year colleges. The focus was on large-enrollment high-demand introductory courses across various disciplines that included humanities, natural sciences, and social sciences. Although each used a different design model, all projects shared six characteristics: whole course redesign, active learning, computer-based learning resources, mastery learning, on-demand help, and alternative staffing.

Instructional Technology: Gamification. According to Kalogiannakis et al. (2021), gamification uses game design and techniques to engage individuals with non-game activities. Hartt et al. (2020), assert that in education, the goal is to make otherwise mundane content more interesting to the learner. In gamification, learning can be improved because there is no consequence in failure. Unlike the typical classroom where traditional assessments are passed or failed with clear consequences, gamification allows the player to make repeated attempts without penalty. Additionally, players can pace themselves, working to achievement levels to demonstrate mastery. Students have indicated that in a gaming scenario, they experienced feeling the process of playing the game being more rewarding than the actual result, because the player

is intrinsically motivated. Thus, students associate this positive feeling with a positive learning experience.

According to Beaulieu and Petit-Turcotte (2018), biology is especially ripe for gamification because students can encounter vast amounts of visual materials within the content like images, pathways, processes, and diagrams. These are well suited for integration into the gaming environment. One of the considerations that persists in gamification is the necessity to fully and properly integrate the platform into the curriculum. Technical challenges or games that do not directly align with the content can impact students' motivation and engagement.

Flipped Classroom Approach. The flipped classroom approach has been explored for several decades. It involves the reimagining of the traditional lecture; there is an "inversion of expectations" (Berrett, 2012, p. 1). Cobb (2016) describes the approach wherein lesson content is absorbed prior to class time, and then students participate in engaging learning activities during instructional time. The in-class activities can vary from discussions, simulations, or hands-on activities. The goal is to allow students to become more active participants and make them responsible for their own learning. According to Berrett (2012), they cannot absorb the material in a simple, passive manner; rather, students must spend time outside of class engaging with the material. The in-person time is spent interacting with classmates and the instructor, and applying what they have learned. As a result, students can correct misconceptions in real-time well before high stakes assignments, like exams ensue. Thus, more learning takes place.

Kakarougkas and Abdellatif (2022) assert that STEM based courses are the breeding ground for a flipped approach, mostly because they are so heavily entrenched with lecture style teaching. They have specifically been on the forefront of teaching innovations using peer-led instruction to help students work through conceptual questions in small groups. Any flipped

approach must clearly identify the learning outcomes and have strategies to ensure they are demonstrated. Additionally, there must be alternate activities prepared in case students have not adequately completed the necessary work prior to class time (Berrett, 2012). These are often cited challenges that faculty have with implementing a flipped classroom approach (Kakarougkas & Abdellatif, 2022).

Faculty Orientation Towards Course Redesign

The efforts previously described outline strategies that are effective in improving student learning in biology. Another key component to this improvement is faculty's perspectives on course redesign. The challenges of embarking upon redesign, particularly in STEM courses, have long persisted (AAAS, 2009; Twigg, 2009). Faculty have cited "student learning, persistence, and graduation rates" (Bernstein-Sierra & Kezar, 2017, p. 408), as reasons to re-envision how courses are delivered. This means rethinking the traditional lecture format and implementing active learning strategies (Freeman et al., 2014). Some reforms are precipitated by short-term or award-based initiatives (Bernstein-Sierra & Kezar, 2017). Faculty's attitudes regarding redesign are impacted by a number of factors; these may preclude the implementation of long-range or wide-spread change. This section will outline some of these factors, including teaching choices and Systems Theory approaches. Additionally, part-time and full-time faculty's instructional practices and perspectives related to course redesign will be contrasted. Finally, South City's Teaching and Learning Excellence Framework, which provides the competencies faculty use to gauge student success at the college will be discussed.

Teaching Decisions

According to Hunter (1994), there are a number of factors that influence teaching decisions, and these choices can have a significant impact on student learning. The decisions faculty must

make occur before they meet the student, during instructional time, and after interacting with the student. When implemented correctly, these decisions can increase the probability of learning. Hunter (1994) places these teaching decisions into three categories:

1. What to teach.
2. Actions the student will take to learn and to illustrate that learning has occurred
3. Facilitation and acquisition of student learning.

Making good choices in each regard should be based on sound teaching practices, sensitivity to the students' needs, and a level of reflexivity to adjust the learning environment.

Content

The decisions regarding what to teach have already been dictated by virtue of the institution, accreditation standards, or specific discipline. Hunter (1976) asserts that the nuances to this are based on the instructor's knowledge of their students and what is presumed they bring to the classroom. Decision making should be guided by the notion that basic concepts, simple generalizations, and foundational processes must be attained before more complex connections can be made. Because students come into the learning environment with a myriad of experiences, they each assimilate knowledge uniquely. Hunter (1994) describes the dependent curriculum sequence phenomenon. An instructor must decide what information serves as a prerequisite to the learning that will occur in her classroom. It must be appropriately built upon to ensure that the more advanced concepts are acquired (not merely be presented); then, the learning can occur. In some cases, however, there may not be a specific rationale to learn information in a particular sequence; thus, the order in which knowledge is acquired is inconsequential. This is called independent sequence. Here, careful assessment is seminal in determining the students' knowledge and skills.

Student Behavior

Hunter (1994) further elucidates two factors that impact how students learn and the behavior that promotes their learning. They are input modalities and output modalities. Input modalities include the sources through which students receive information; examples include reading, discussion, and observation. Each of these can occur individually, amongst peers, or with the teacher. Aligning input modalities with learning objectives, and tailoring these inputs to the content are equally important teaching decisions. Output modalities validate if the learning occurred. These include demonstration of analysis, evaluation, and problem solving. To determine if the learning process was successful, most students must exhibit these output behaviors. Additionally, the instructor must take responsibility for the impact of the input on the demonstration of the output.

Teacher Behavior

Hunter (1994) further asserts that teachers must make decisions about their own behavior that are rooted in key learning principles. Doing so will empower students' motivation to learn, the quality of their learning, and their ability to retain the information. Most importantly, they will be able to transfer knowledge and apply it in novel situations that allow them to be creative, solve problems and make sound decisions.

Instructional Practices and Faculty Status

There are various perceptions of full-time and part-time faculty in community colleges (Banachowski, 1996). The next section will characterize these faculty members, highlight the

roles they play in their institutions, describe the advantages and disadvantages of each, and contrast their instructional practices.

Part-Time Faculty

Two-year colleges rely heavily on part-time faculty for instruction (Banachowski, 1996). According to Tuckman (1978), part-time employment in academia is vastly different than part-time employment in other areas. Part-time faculty members must be highly educated, have expertise in an academic area, and have some full-time employment experience; whereas, in other labor forces, a part-time employee is more likely to have limited education and less experience holding a full-time job.

Although this situation is unique to higher education, Banachowski (1996) describes the advantages for the institution. Part-time faculty can save the school money, as their salary and benefits are less costly. Their employment allows the institution to be more flexible to meet the changing demands of enrollment; their temporary contracts can be adjusted when there are changes in student matriculation. Part-time faculty also bring real-world experience to the community college setting, which allows students to see the value of practicing professionals in their field (Mangan, 1991).

In contrast, there are some personal and institutional disadvantages to employing part-time faculty. Often, they are marginalized in their department because they have little input in departmental affairs, are unaware of department vision or goals, and have a cursory relationship with their institution. Thus, part-time faculty are placed at a disadvantage because they have little participation in their environment. Long term, the increase of part-time faculty may threaten full-time positions, particularly as full-time faculty leave the field (Mangan, 1991). Kelly (1992) asserts that the increased number of part-time faculty could lead to a concern about the integrity

of teaching at two-year institutions. As these employees are only teaching part of the time, their commitment to the work could be questioned. Additionally, research has suggested that part-time faculty do not incorporate new teaching methods into their pedagogy (Thompson, 1992). The faculty member may become over-used, resulting in ambiguity in the role and decreased performance (Banachowski, 1996). This is exacerbated by institutions doing a poor job of integrating the faculty member into the college culture (Banachowski, 1996).

Tuckman (1978) was one of the first to create a taxonomy of part-time faculty. He categorized them into seven groups: the semi-retired, students, those who wish to obtain full-time employment, those otherwise employed full-time (moon-lighters), those with family responsibilities, those otherwise employed part-time (part-mooners), and all others. The next section will discuss some differences in teaching effectiveness between part-time and full-time faculty.

Contrasting Part-Time and Full-Time Faculty

According to Williams and Wiatrek (1987), in a typical two-year institution, full-time faculty are expected to teach a full course load for a contractual period that is associated with an entire academic year. This is different from part-time faculty, who are typically only contracted to teach for one term or one class at a time. In addition to teaching, full-time faculty are also required to serve students and the college by engaging with service, committee work, and professional development. These responsibilities differ greatly from their part-time counterparts, whose primary role is instructing students (Banachowski, 1996). Further, full-time faculty are often required to attend department meetings and orientations and keep themselves availed of college-wide communication (Williams & Wiatrek, 1987). When it comes to the ability to engage with their students, part-time faculty face some distinct challenges. First, since their roles

are temporary and often transient, they have limited availability to students and may not have the time to adequately prepare for their courses (Xu, 2018). Additionally, they may not have loyalty to the institution; this likely impacts the quality of instruction and the manner in which they interact with their students (Xu, 2018). Benjamin (2002) found that part-time faculty were less available to students outside of instructional time and their exams were less rigorous, which could lead to grade inflation.

Teaching Effectiveness of Part-time and Full-time Faculty

There have been studies on the varying instructional approaches by part-time and full-time faculty. Ran and Xu (2018) conducted a quasi-experimental study on the impact of contractual status on students. They found that there was a negative influence of non-tenure track faculty on course enrollment and performance in both two-year and four-year colleges. Scheutz (2002) further delineated differences in part-time and full-time faculty. After conducting a survey from 100 community college instructors, she found that part-time faculty had less teaching experience, are less likely to incorporate collaborative teaching strategies, and are less likely to interact with college stakeholders. Based on these findings, the study concluded that there is indeed a difference in the quality of instruction received from part-time and full-time faculty.

There have been studies relating the reliance of community colleges on part-time faculty to specific types of student outcomes, such as graduation rates. Jacoby (2006), for example, used Integrated Postsecondary Data System (IPEDS) data to illustrate that as the proportion of part-time community college faculty increases, graduation rates decrease. However, more research on this particular issue has been conducted at four-year institutions. Figlio et al. (2015) explored the impact of part-time instructors on course enrollment and course success. Their findings

contrasted with prior work; they found that adjunct faculty had a positive impact on student performance. The faculty studied, however, had been with the institution for a long time and aspired to be hired as full-time; this was not typical of most part-time faculty. Bettinger and Long (2010) studied students' likelihood of taking a course with an adjunct vs. a full-time faculty member. They found that adjuncts had a small but significant positive effect on subsequent course enrollment and degree choice. The authors proposed that these results may be due to the fact that adjuncts do not have research responsibilities and can focus on teaching. Additionally, they bring industry expertise that is beneficial to the students.

The work mentioned above has contrasting conclusions in terms of the overall impact of faculty status on teaching effectiveness. However, it is clear that community colleges are nuanced. They enroll half of all post-secondary education students, and their demographics serve a large portion of low-income and other underrepresented groups (Xu, 2018). This, coupled with the disproportionate employment of part-time faculty, requires these institutions to look beyond traditional course outcomes as a measure of success; thus, course design and instructor effectiveness are important considerations.

Institutional Impacts of Course Redesign

Along with typical success metrics like grade data and degree completion, the hallmark of student success lies also in the manner in which teaching practices are done; if they are inadequate or incomplete, then the desired results will not be achieved (Campbell & Blankenship, 2020). Trogden et al., (2022) talks about high impact practices like internships and first year seminars that are influential in a student's overall experience. Oftentimes, however, these practices are not fundamental to teaching and learning and are developed in the absence of faculty input (Campbell & Blankenship, 2020). Additionally, the impetus of high impact

practices is sometimes rooted in a deficit mindset; the students lack specific characteristics to be successful and that lends itself to failure (Zhao, 2016). Thus, according to some, these characteristics, sometimes inherent in first generation or underrepresented students, need to be weeded out (Campbell & Blankenship, 2020).

However, there is evidence that these characteristics do not need to be weeded out (Martin et al., 2017); rather, these students need to be engaged in a meaningful way and this will lead to success in the classroom (Campbell & Blankenship, 2020). Intentional course redesign can help students be successful without centering on a deficit paradigm (Martin et al., 2017). Redesign can ensure the focus remains on institutional mission and values, and that ideals like student engagement, quality education, and improved access can be achieved (Campbell & Blankenship, 2020). Further, redesign efforts should center faculty's own knowledge and judgment (Campbell & Blankenship, 2020). This can facilitate shifts that become a part of the institution's culture and allows faculty to take accountability for change and improvement (Alexander & Gardner, 2009). Collaboration between faculty members, their department, and the institution increases the chances of a cultural shift occurring and an increased understanding of the relationship between high quality pedagogy and student success (McGowan et al., 2017).

Teaching and Learning Excellence Framework at South City

It is necessary to embed established teaching and learning framework concepts in course redesign efforts at institutions. Eynon and Iuzzini (2020) assert that doing so requires thoughtful and sustained effort by faculty in order to change their pedagogical approaches. Standard approaches that do not account for the institution's culture or resources will not impact student success efforts. South City uses the Teaching and Learning Excellence Framework to ground its work with faculty development. Centered around eight tenets and aligned with the college's

values, the framework emphasizes key instructor competencies that will help promote student success. The eight tenets will be outlined below.

Pedagogical Content Knowledge

To ensure the most appropriate instructional strategies are used, faculty must combine their content knowledge with best practices in pedagogy. Ultimately, the goal is for faculty to address difficult topics in the content area, allow students to make connections, and ascertain the most critical knowledge and skills necessary in the course.

Feedback and Assessment

Developing and implementing the most appropriate assessment strategies is seminal to support student learning. This helps to determine if skills are being mastered so teaching strategies can be adjusted based on student performance. Frequent, meaningful, and timely feedback are necessary for authentic assessment. Furthermore, the college must support faculty's need for data literacy in order to properly measure student performance.

Inclusive Pedagogy

Providing a learning environment where students perspectives, experiences, and learning styles are considered is important to include in classroom instruction. Faculty can enrich the student experience by providing the students with equitable access, well rounded discussions, and an environment of inclusion.

Curriculum Alignment

Connecting learning outcomes with assessments provides students the opportunity to think critically about the course content while also enabling them to apply that knowledge to a broader perspective. Aligning curriculum by careful selection of learning objectives and course materials makes instruction more effective.

Classroom Climate

Classroom climate includes the physical, virtual, social, and emotional environments in which learning takes place. This also means outlining clear expectations that are aligned with institutional policies while creating a safe and inclusive space for learning to occur.

Instructional Strategies

Diverse instructional strategies foster engagement, relationship building, and critical thinking for students. Additionally, careful selection of technology and instructional design that meets the needs of students supports knowledge building and application.

Faculty Engagement

Making meaningful connections with colleagues and community members, and prioritizing health and wellness are key to advocating for student success. This also includes identifying opportunities to strengthen these connections to continue to champion student learning.

Educational Technology

Literacy in the basic digital environment, learning management systems, and other educational tools enhances student engagement and expands access to education. This requires faculty to actively collaborate to integrate these tools into their classroom environment.

Faculty Perceptions of Redesign Efforts

There have been national efforts, such as V&C, to reform teaching and learning at the division and institutional level. However, educators recognize the necessity for faculty to effect change at the department level. Off-shoot initiatives such as the Partnership for Undergraduate Life Sciences Education (PULSE) have this focus and are also aligned with V&C competencies (Stavrianeas et al., 2022). PULSE's goal is for faculty to integrate V&C's concepts and

competencies into their curriculum, with an emphasis on student-centered learning while promoting a campus-wide commitment to change with a systems thinking approach (Stavrianeas et al., 2022). Below I will outline two approaches to redesign efforts: systems approach and enlisting a community of practice.

Systems Approach to Reform Efforts

Systems thinking involves identifying how the parts of a system, like those in a large community college, are interrelated and the complexity of the relationships among all the parts. Thus, it is necessary to consider how these parts operate individually and not "assume simple linear cause-and-effect relationships" (Stavrianeas et al., 2022, p. 5). Additionally, faculty must also prepare for the messiness of unintended consequences and delays when enacting reform within their organizations.

Stavrianeas et al. (2022) assert that in the context of higher education, the purpose of systems thinking is to understand the behavior of the system in order to anticipate the outcomes of a change initiative. Implementing a systems thinking approach is best suited for change in large organizations, like metropolitan community colleges, that have many components with often competing priorities. Leveraging resources can reveal opportunities to garner small gains in change initiatives. Ultimately, all the components of the system impact how a faculty member teaches, and their decisions can be influenced at different levels by several of these factors.

Communities of Practice (CoP)

According to Wenger et al. (2002), the community approach to change involves educators sharing a passion for what they do and a desire to interact to learn to do it more effectively. Bernstein-Sierra and Kezar (2017) describe a CoP as composed of three elements. The first is "a domain of knowledge" (p. 409) that gives members purpose, and establishes

standards for learning. The second is "a community of individuals who care about the domain" (p. 409). This community is supportive and will often convene in order to learn more about the mission they have in common. The third element is "a shared practice that they develop together in order to be effective in their domain" (p. 409). This practice refers to the resources, including ideas and materials, that members of the community share to develop knowledge. CoPs can be informal and organic; however, their value to the organization stems from the knowledge sharing that can occur. Their goal typically is to make improvements to practice or engage members of the community in which they occur.

Wenger et al. (2002) ascribed the evolution of CoPs to the lifecycle of a living organism with five stages: "Potential, Coalescing, Maturing, Stewardship, and Transformation" (p. 69). Each stage may encounter challenges because of the nuanced objectives of that stage. During the potential stage, members determine if there is common ground, similar questions, or similar challenges. In the coalescence stage, members engage in trust-building between members. The maturation stage involves proving value to the community by clarifying mission and boundaries; here, there is a marked shift from informally sharing ideas with colleagues to developing a prescribed domain that elicits more structure. As a part of the stewardship stage, CoPs work to maintain momentum as natural changes occur like new technology, and depleted energy of members sets in. Finally, during transformation, community members may dissipate unexpectedly, energy may wane, or the CoP may change forms.

Using a systems approach or a CoP in course redesign can ensure that institutional culture is shifted in a way that allows the redesign to be impactful beyond an individual course. Faculty can use the strategies implemented to further influence institutional success measures beyond the initial scope.

Rationale and Purpose for this Study

The purpose of this study was to determine the effectiveness of a redesign effort in a community college Principles of Biology (Bio-110) course. Specifically, the success rates in sections of the course that were taught using the redesign components were compared to those that were taught using the typical (non-redesigned) lab/lecture format and standard course materials. Further, this study explored the impact of the redesign on faculty in the Biology Department to determine how their teaching changed based on their experience in the redesign process. This analysis is significant because it is necessary to thoughtfully design courses tailored to the student population that the faculty serve. The diverse student population requires educators to consider student's needs and learning styles and account for the unique challenges they face in the community college setting.

The open-door policy at community colleges gives students a unique opportunity for education. However, these students face challenges, as their familial, financial, and employment situations typically differ from their counterparts at four-year institutions (Zeindenberg, 2008). These challenges can be more influential than the students' academic preparedness (Bean & Metzner, 1985); however, all of these factors should be addressed in order to improve student retention. Therefore, careful course redesign, particularly in the community college setting, must account for a myriad of factors, such as the uniqueness of the student population, diverse learning styles, and the varied educational and professional experiences of the faculty.

Summary

In this chapter, I discussed the significance of the UbD framework and contextualized its relevancy to the redesign of the Bio-110 course at South City. The work of theorists such as Merrill, Gagné, Wiggins and McTighe, and Tyler was integrated into the discussion of the

foundations, origins, and history of UbD. I also compared UbD with other instructional design models. Full-time and part-time faculty were characterized according to the roles they play in their institutions and their approaches to instruction. Additionally, influences on faculty's teaching decisions and the incorporation of South City's Teaching and Learning Excellence framework were covered. Collectively, this literature review provides the backdrop for the necessity of intentional course redesign and the analysis of student performance in the Principles of Biology course. This study is unique in that it examines the impact the course redesign has on faculty's teaching beyond just the Bio-110 course. The manner in which faculty have adjusted their approach to teaching as a result of their experiences during the redesign is explored in a way that will help practitioners support both student success and faculty development.

Chapter III: Methodology

Chapter III presents the methodology for this study and describes the research design approach, participants, data collection, and data analysis techniques. The purpose of this study was to evaluate the impact of the redesign of a Principles of Biology (Bio-110) course at South City Community College. Institutions embark upon course redesign as a means to improve student outcomes, lower course costs, and ensure teaching strategies are aligned with best practices (Twigg, 2009; AAAS, 2019). This study evaluates the success of students in the redesigned and non-redesigned Bio-110 courses and faculty's perceptions of course redesign after their experience with the Bio-110 course.

Anonymity of the Institution

The researcher received the permission of the External Research Review Committee in conducting this research study contingent upon using pseudonyms for the College, as well as any College students and employees, and making no identifiable references to the College, its students, or its employees in any published document. In protecting the College's confidentiality, the researcher has followed the College's requests in not identifying the College name in the research, including in any citations, of the dissertation. The researcher provided the external research approval letter in Appendix A, and any questions about the veracity of the study or authenticity of College as the research site should contact the party who shared approval of the request.

Study Design Approach

This is an *ex-post facto* quasi-experimental study that utilized mixed methods. Specifically, an explanatory sequential mixed methods design was used. Creswell and Plano-Clark (2017) describe the two study strands in explanatory sequential mixed methods design. A

strand is the portion of the study that includes all the processes necessary to conduct the research: asking a question, gathering the data, evaluating the data, and interpreting the results (Creswell & Plano-Clark, 2017). In explanatory sequential mixed methods design, the first strand involves gathering and examining the quantitative data and connecting that to the qualitative strand (Creswell & Plano-Clark, 2017). In this particular study, the first strand included collection and analysis of quantitative Bio-110 student grade data during the course's redesign. The second strand consisted of the qualitative faculty interviews. The study strands were independent and timed sequentially with the quantitative phase occurring first. The primary point of interface occurred at the data analysis phase, and the strands were connected by using the quantitative grade data to help draw conclusions about the themes identified in the analysis of the faculty interviews.

Context and Study Setting

The data for this study was collected from South City Community College in the South City region of the United States. According to its website, South City is a regionally accredited two-year college. It has eight locations in the county and offers 300 programs of study. In the Fall of 2021, the student population of South City consisted of 17,559 curriculum students, including dually enrolled high school students. Of those, 6,842 (39%) were full-time and 10,717 (61%) were part-time. The College's programs span Arts and Sciences (8,739; 50%), Career and Technical Education (8,416; 48%), and other special programs (404; 2%). The college transfers 1,000 students to institutions within the state's system each year.

Principles of Biology (Bio-110)

Bio-110 is a 6-contact hour, 4-credit course targeted to students who wish to complete their transfer degree (Associate in Arts). The description and stated learning outcomes describe Bio-110 as:

> …a survey of fundamental biological principles for non-science majors. Emphasis is placed on basic chemistry, cell biology, metabolism, genetics, evolution, ecology, diversity, and other related topics. Upon completion, students should be able to demonstrate increased knowledge and better understanding of biology as it applies to everyday life" (NC Community Colleges, 2022b).

The Biology Department offers roughly 30 sections of Bio-110 in a given fall and/or spring semester at four area campuses in traditional, blended/hybrid, and fully online formats. Table 3 indicates the number of Bio-110 sections offered in the semesters in which the course redesign was implemented.

Table 3

Number of Bio-110 Sections During the Course Redesign

Semester	Non-redesigned Bio-110 sections	Redesigned Bio-110 sections	Total Bio-110 sections offered
	n	*n*	*n*
Spring 2017	16	15	31
Fall 2017	13	17	30
Spring 2018	14	16	30

Sample

The sample consisted of South City students who took Bio-110 in the Spring 2017, Fall 2017, and Spring 2018 semesters. Summer terms were excluded because only the non-redesigned Bio-110 course was taught in summer 2017 and 2018. Success rates of students who took the non-redesigned Bio-110 in Spring 2017, Fall 2017, and Spring 2018 were compared to those in the redesigned Bio-110 sections in the same terms. Instruction of the Bio-110 course was delivered in three formats: traditional (100% face-to-face instruction), blended (</= 50% of instruction online), and fully online (100% asynchronous virtual instruction). The redesigned course was comprised of blended and fully online sections; the non-redesigned course was comprised of traditional, blended, and online sections. Figure 4 indicates the groups that were compared to address Research Questions 1 and 2.

Figure 4

Comparison Groups, Bio-110 Course Redesign

	Delivery Method	
Redesigned	Fully Online	Blended (flipped)
Non-redesigned	Fully Online	Blended (not flipped)

Note. Blended (flipped) is defined as < = 50% instruction online using *BioBeyond* and the redesigned in-person lab components. Blended (not-flipped) is defined as < = 50% instruction online with lecture online using a traditional textbook and in-person lab activities.

Research Questions

The following research questions guided this study:

1. Did students who took the redesigned Bio-110 course study have higher success rates (measured as ABC course letter grades) than students in the non-redesigned course?
2. Did faculty status (measured as part-time vs. full-time) impact student success rates (measured as ABC course letter grades) for those who took either Bio-110 course type (non-redesigned vs. redesigned course)?
3. How did faculty members' experiences in the Bio-110 course redesign influence their pedagogy?

Research Approach

A mixed methods approach was used for this study. Mixed methods are a research methodology wherein the researcher uses elements of both quantitative and qualitative approaches to allow for depth and breadth of understanding of a topic (Johnson et al., 2007). The

goal in combining the approaches is to answer the research questions in a way that contributes to knowledge in the field and achieves multiple validities (Schoonenboom & Johnson, 2017). This cannot be achieved with just a single approach (Bryman, 2006). Multiple validities must meet the standards for both qualitative and quantitative research (Johnson et al, 2007).

Rationale for Mixed Methods

Greene et al. (1989) identified the five purposes for mixing methods in research as follows: triangulation of results, complementarity, developing the results of one method to inform another, discovery of paradox or contradiction among the results, and explanation of breadth and range of inquiry. Bryman (2006) added to Greene's purposes for mixed methods with the following: adding credibility to enhance the integrity of the study, offering context to better understand findings, illustrating qualitative data with quantitative data, providing utility or usefulness to the findings, confirming the hypothesis by discovering knowledge, and providing a diversity of viewpoints. In this particular study, because of the difference in the research questions, quantitative and qualitative methods must be used to answer each question (Creswell & Plano-Clark, 2017). This type of expansion is necessary to advance the depth and range of inquiry (Creswell & Plano-Clark, 2017).

Mixed Methods Design Approach

A quantitative approach was most appropriate for Research Questions 1 and 2 to evaluate the success of the Bio-110 redesign. It was necessary to analyze how the students performed in the course and if there was a difference in success rates in the redesigned and non-redesigned courses based on faculty status. Further, as it relates to course redesign, the manner in which faculty's practices and perspectives changed during the process are often not revealed (Stavrianeas et al., 2022). There are few studies that connect quantitative student success data

after a course's redesign with the impact the overall experience had on faculty pedagogy. Therefore, in Research Question 3, it was necessary to explore how the Bio-110 redesign impacted the way faculty taught and how they changed their pedagogy as a result of the experience. This type of querying required a qualitative approach to obtain a full picture of the impact of the redesign. Findings from such research questions can have far-reaching effects because institutions can potentially use these improvements to impact large-scale outcomes. Thus, this diversity of views can help to explain the complexities that exist and discern what works best for whom with relevance and context (Schoonenboom & Johnson, 2017).

Assimilating Qualitative and Quantitative Research

Mixing methods allows for the assimilation of qualitative and quantitative research approaches. Qualitative studies contain characteristics that include: setting, multiple data sources, participant meanings, and emergent design (Bryman, 2006). Further, the researcher plays a significant role because she must be interested in interpersonal experiences and develop a clear picture of the problem being studied (Morgan, 1998). Quantitative research, however, collects numerical data by employing empirical methods to explain phenomena by analyzing with statistics (Creswell, 1994). Additionally, a quantitative methodology allows for characteristics of groups to be observed (Creswell, 1994), and in the case of this study, identification of possible relationships between the type of course completed and the earned grade.

Prioritization and Timing of Quantitative and Qualitative Data

Morgan (1998) described four strategies for combining quantitative and qualitative approaches in research. Each of the strategies centers on the researcher making decisions about the priority and sequencing of qualitative or quantitative approaches. A mixed methods study can

have “preliminary qualitative methods in a quantitative study, preliminary quantitative methods in a qualitative study, follow-up qualitative methods in a quantitative study, or follow-up quantitative methods in a qualitative study” (Morgan, 1998, p. 1). Additionally, Creswell and Plano-Clark (2017) discussed the weight of quantitative and qualitative strands. They can be prioritized based on their importance in the study. The two methods can have equal priority (equal emphasis on qualitative and quantitative), quantitative priority (greater emphasis on quantitative methods), or qualitative priority (greater emphasis on qualitative methods).

Creswell and Plano-Clark (2017) also explained the significance of timing in a mixed methods study. Timing identifies a study’s pace and implementation. It can also refer to the time at which the data in the strands is collected and the sequence in which the results are used. Timing can be classified as concurrent, where both the quantitative and qualitative strands are implemented in a single phase; sequential, where the researcher decides to collect and analyze one particular stand before the other; or multiphase combination, where multiple phases exist that can be implemented either sequentially or concurrently.

In this study, a sequential approach was used where the quantitative Bio-110 grade data was analyzed first and followed by the qualitative faculty interviews. There was equal priority placed on the quantitative and quantitative strands.

Level of Interaction

According to Creswell and Plano-Clark (2017), in mixed methods, there must be two strands in the study: one qualitative and one quantitative. These strands each consist of the research questions, data collection, data analysis, and interpretation of results. The manner in which these strands interact will determine if they are kept independent or are interactive. Independent interaction means that the quantitative and qualitative strands remain distinct in

terms of the research question and collection and analysis of data. Thus, the strands are only mixed when conclusions are drawn at the end of the study. In interactive interaction, the quantitative and qualitative strands are commingled at different points in the study, so the results of one strand may inform the design of the other strand. In this study, an independent approach was used, as the research and data analysis techniques questions were quite distinct.

Quantitative Methods to Address Student Success in the Bio-110 Redesign

One of the research questions in this study was to compare the success rates of students in sections of Bio-110 courses who were taught using the redesign components and instructional technologies to those who were taught using the non-redesigned lab/lecture format and standard course materials. The analysis was further delineated to explore whether student success during the redesign differed based on faculty status (part-time vs. full-time). The quantitative hypotheses that guided Research Questions 1 and 2 are described below.

Research Question 1 Hypothesis

I hypothesized that students in the redesigned course were more successful (ABC letter grades) than those in the non-redesigned course. The null hypothesis below was also tested in this study:

H_0: There is not a statistically significant difference in the course grades of students in the redesigned course and those in the non-redesigned course at a 0.05 level of significance.

Variables, Research Question 1

The operational definition of the independent variable, course type, explored in the analysis of Research Question 1 is defined as: (a) the redesigned Bio-110 course that integrated *BioBeyond* software, an OER supplemental textbook, flipped classroom teaching approach, and realigned lab activities, and (b) the non-redesigned Bio-110 course that used traditional lab and

lecture components. The operational definition of the dependent variable, final course grade, explored in Research Question 1 are defined as: A, B, C, D, and F.

Research Question 2 Hypothesis

I hypothesized there would be an interaction between faculty status (part-time vs. full-time) and course type (redesigned vs. non-redesigned) such that students who took the redesigned course with full-time faculty would have the highest success rates, followed by those who took the redesigned course with part-time faculty, then those who took the non-redesigned course with full-time faculty, and, finally, those who took the non-redesigned course with part-time faculty.

Alternatively, the below null hypothesis was also tested in this study:

H_0: There was no statistically significant difference in the success rates of students based on the interaction of faculty status (part-time vs. full-time) and course type (redesigned vs. non-redesigned) at a 0.05 level of significance.

Variables, Research Question 2

There were two independent variables in Research Question 2: course type and faculty status. The operational definition of course type is (a) the redesigned Bio-110 course that integrated *BioBeyond* software, an OER supplemental textbook, flipped classroom teaching approach, and realigned lab activities, and (b) the non-redesigned Bio-110 course that used traditional lab and lecture components. The operational definition of the dependent variable, faculty status, is: (a) full time faculty, who teach a minimum of 18 contact hours per semester, and (b) part-time faculty, who teach 50% or less of a full-time instructional load in a semester. The operational definition of the dependent variable, final course grade, explored in Research Question 1 are defined as: A, B, C, D, and F.

Data Collection

An application was submitted to the Institutional Review Board (IRB) at Appalachian State University. The study was submitted as a non-exempt research study. A copy of the approved application is located in Appendix B. Additionally, an External Research Review request form was submitted to South City. A copy of the application's approval is located in Appendix A.

To collect the sample for Research Questions 1 and 2, extant data from South City was extracted and collected from database sources *Informer* and *Colleague*. The sample data included information such as: final course grade, student demographics (age, race, gender, program of study, credit hours completed, enrollment status, veteran status, and financial aid status), and course information (faculty status, section number, semester, course meeting session, and instructional format). To maintain FERPA standards, the data was anonymized so that the individual student information could not be linked back to the original student record system. An anonymized master data file was synthesized from the de-identified file.

Data Cleaning

Data from South City's student database systems (Informer and Colleague) was sent to the researcher from South City's Planning and Research Department via email in an SPSS file. First, the data was cleaned in order to prepare it for analysis (Chu et al., 2016). This involved removing missing values and replicated entries (Chu et al., 2016) as well as verifying that personally identifiable information, such as names or student ID numbers, were not present.

Data analysis was conducted using SPSS software. It provided an automated analysis of the statistical measures. After data cleaning, new separate files parsed by academic term were created. Assumption testing for descriptive and statistical testing then followed. The success

rates of students in the redesigned and non-redesigned Bio-110 course were evaluated for descriptive statistics. This provided an overview of the data's characteristics, including measures of central tendency and variability (Chu et al., 2016).

Data Analysis

To investigate Research Question 1, a one-way analysis of variance (ANOVA) was conducted. ANOVAs are commonly used to test for statistical differences among the means of two or more groups (Coladarci & Cobb, 2014). A one-way ANOVA was performed to analyze the impact of the independent variable (e.g., course type) on the dependent variable (e.g., students' final course grade). To conduct an ANOVA, specific conditions must be met. First, the dependent variable must be continuous and the independent variable must be categorical (Coladarci & Cobb, 2014). Second, the groups must be independent of each other and must represent a random sample of data from the population (Coladarci & Cobb, 2014). In this study, data distributions were analyzed with a Q-Q plot, and the variance was approximately equal across groups. Histograms were also created to ensure a normal distribution of the dependent variable for each group and to guarantee that there were no outliers.

To explore Research Question 2, a 2 (Course type: redesigned vs. non-redesigned) x 2 (faculty status: part-time vs full-time) ANOVA was used. A 2x2 ANOVA is performed to analyze the impact of two or more independent variables (Ary et al., 2010). A 2x2 ANOVA also assumes that the sample is normally distributed, is independent, and has equal variance among the population (Ary et al., 2010). In this study, a 2x2 ANOVA allowed the researcher to examine if students' final grade was impacted by the faculty status as well as whether they were enrolled in a redesigned or non-redesigned section of the course. For the semesters when there were significant interactions (Fall 2017 and Spring 2018), the interactions were further probed by

conducting two independent sample *t*-tests (Ary et al., 2010). This allowed for the analysis of the mean comparisons to determine how different levels of one independent variable (Course type: redesigned vs. non-redesigned) impacted student success rates when the second independent variable (Faculty status: part-time vs. full time) was controlled.

Qualitative Methods to Address the Impact of Course Redesign on Faculty

The qualitative portion of this study was enacted by conducting interviews to address Research Question 3. The focus of the interviews were to determine if faculty's orientation toward teaching changed based on their experience during the Bio-110 redesign. This approach enabled a deeper understanding of the faculty's experiences with course redesign in a community college setting. Further, understanding how meaning is connected to a problem should allow the faculty to construct realities (Creswell, 2014). The interview guide (Appendix C) consisted of questions tailored to the competencies in South City's Teaching and Learning Excellence framework: pedagogical content knowledge, feedback and assessment, inclusive pedagogy, curriculum alignment, classroom strategy, instructional strategy, faculty engagement, and educational technology.

Biology Faculty at South City

The Natural Sciences Division at South City is home to Biology, Chemistry, Anatomy & Physiology, Physics, Astronomy, Geology, and Geography. It offers these courses on six of the college's area campuses and supports lab and lecture facilities both in-person and online. Table 4 indicates the number of full-time and part-time faculty and staff members who taught the Principles of Biology course during the semesters that were evaluated in this study.

Table 4

Bio-110 Faculty and Teaching Staff Composition

Semester	FT Faculty	FT Teaching Staff	PT Faculty	All Faculty/Staff
	n	*n*	*n*	*n*
Spring 2017	9	3	6	18
Fall 2017	9	1	7	17
Spring 2018	7	1	7	15

Description of Participants

The participants were selected because of their full-time status and that their work specifically included collaboration with the technical developers at the Inspark Network to design the virtual lessons, revise the course's learning objectives, and schedule and manage the course (Inspark, 2022). Full-time faculty are contractually obligated to teach 18 contact hours per semester, and during the redesign period, most taught a combination of General Biology courses offered at the college. Table 5 describes the profiles of the participants. The six faculty members consisted of one current Biology department chair, one former (retired) Biology department chair, and four Biology faculty members (3 current, 1 retired) who all taught the course in hybrid and online formats. The researcher was provided a list of faculty members who taught Bio-110 in the Spring 2017, Fall 2017, and Spring 2018 semesters. A consent form and description of the study (see Appendix D) was sent to potential participants who were contacted via email (see Appendix E).

Table 5

Participant Profiles

Pseudonym	Title	Employment status*
Adrienne	Faculty	Current, Full-time
Gia	Faculty	Current, Full-time
Layne	Faculty	Current, Full-time
Lila	Dept Chair	Retired, Full time
Kathleen	Faculty	Retired, Full time
Kendra	Dept Chair	Current, Full-time

Note. Reflects employment status at the time of the interview.

Data Collection

To collect the qualitative data in this study, semi-structured interviews were conducted. This approach allowed the interview questions to be structured so the situation could be explored with depth, while also providing room for follow-up inquiry based on participant responses (Claxton & Michael, 2020). Conducting interviews also provided insight into how faculty at South City Community College perceive the impact of the Bio-110 redesign on their overall teaching pedagogy. The protocol used for the semi-structured interviews is located in Appendix C.

Interview Procedures

Interviews were conducted in person, in one-on-one formats, at one of South City's campus locations. Interview protocols that were used included ensuring interviewee accessibility, gaining institutional permission, and collecting demographic information (Claxton & Michael, 2020). Before the interview began, participants were allowed to ask questions pertaining to the study and were reminded of the voluntary nature of their participation and their right to end the interview at any time.

The participants were notified of the presence of an audio recording device, and they consented to allowing the interview to be recorded. They were informed of the process'

confidentiality and prompted to offer a pseudonym. Only one selected a pseudonym, and the remaining five participants were assigned one. Each in-person interview consisted of the same questions (see Appendix C) that followed the same order and were presented in the same manner (Creswell, 2014). Only clarifying and follow-up questions changed based on the participants' responses. The length of the interviews varied, ranging from 25 to 60 minutes.

Member checking of the collected data occurred throughout the data-collection process; this was done to ensure clarity and to verify the participants' responses (Creswell, 2014). Further, participants were encouraged to assist in clarifying and verifying that their responses were accurately recorded. Each recording was transcribed immediately after the conclusion of the interview. After each interview, a follow-up email was sent to express appreciation for the participants' thoughtful responses, participation, and time. Participants were also offered the opportunity to review the transcripts for accuracy; however, no one indicated that changes were necessary to the transcriptions. Upon completion of the transcription process and following the offer to participants to review transcripts, data analysis commenced. This consisted of identifying codes and themes to assist with analyzing the data.

Data Analysis

Creswell (2014) asserts that qualitative data analysis requires taking the data apart and then putting it back together. This interactive approach involves six steps:

1. Assemble and compile data for analysis.
2. Carefully deliberate over the data.
3. Initiate data coding.
4. Use data coding to describe the people, setting, and themes.
5. Use narrative to reveal descriptions and themes.

6. Determine the lessons learned.

There was continuous analysis and reflection during qualitative data collection. Leading questions were avoided (Creswell, 2014), and the questions were asked respectfully (Merriam, 2009). In order to validate the accuracy of data collected, audio of the interviews was recorded and transcribed via the Otter AI transcription application. The transcriptions were organized by typing notes and digitally cataloging the documents (Creswell, 2014). They were then downloaded into Word files for editing, analysis, and archiving.

Additionally, a reflexivity journal was kept via Google Docs to record any biases and identify common themes or notable phenomena that occurred. Similarities and differences were noted between each of the interviews, including recurring phrases, terms, and ideas.

Coding

Coding involves organizing and labeling data into manageable portions with a representative word or code (Creswell, 2014). To further the analysis of the interview data, open coding was used to create codes from the collected data. This required a careful line-by-line review of each transcript, assigning words or abbreviations in the comments portion of the document to note significant experiences, terms, or phrases. The words and abbreviations led to the assignment of broad categories. Next, axial coding was performed to make meaning from the phenomena revealed in open coding (Creswell, 2014). As shared experiences emerged, a table was used to identify categories. Then, participants' quotes and notes from the researcher's reflexivity journal that aligned with the categories were placed into the table. This allowed the researcher to make connections to the categories (Creswell, 2014). This process was repeated until the categories were refined into themes that served as the basis for the findings.

Validity, Reliability, and Triangulation

According to Merriam (2009), validity refers to how well a research method measures what it is intended to measure, and reliability refers to whether or not a measure is reproducible under the same conditions. Roberts and Priest (2016) assert that triangulation can further enrich the research by offering various datasets to explain differing aspects of a particular phenomenon. Thus, by using two or more data sources, methods, or researchers the study is enhanced (Roberts & Priest, 2016).

Research Questions 1 and 2. According to Zumbo (2007), validity can be divided into two groups: internal and external. Internal validity refers to the extent to which the observed results can be attributed to the factors in the study alone. External validity is how well results can be generalized to an entire population.

For Research Questions 1 and 2, validity was derived from the accuracy of the data analysis, the actions the researcher took to address the question, and the conclusions that were drawn (Zumbo, 2007; Coladarci & Cobb, 2014). According to Heale and Twycross (2015), there are four types of validity: content, construct, criterion, and face. Construct validity ensures that a particular measure is actually assessing its intended construct, while content validity ensures the measurement captures all aspects of the construct. Criterion validity evaluates the extent to which a test measures an outcome predictively or concurrently. Face validity is more incumbent upon the researcher; it provides the appearance that a test is appropriate for the intended purpose of the study.

Benge et al. (2012) describes internal validity as the extent to which the observed results can be attributed to the factors in the study alone. In quantitative research, it is important to carefully consider these factors that can result in errors in measurement. Creswell and

Guetterman (2018) assert that history, maturation, randomization, and manipulation can potentially threaten internal validity. History includes the events that take place between measurements. Maturation is described as the process of making improvements or changes over time (Creswell & Guetterman, 2018). In this study, as the redesign period progressed, teaching improved via professional development offered by the department and enhancements to the *BioBeyond* platform. These factors could be a potential internal threat to validity. Additionally, Creswell and Guetterman (2018) also assert that in causal comparative research, randomization, location, and instrumentation may threaten internal validity. Randomization refers to bias among characteristics. This was not a concern in this analysis because the student and faculty information were de-identified. The site of the research, or location, was not a threat because the student grade data was provided by South City. Instrumentation was not a threat because the same systems, tools, and software (*BioBeyond* and the learning management system) were consistent throughout the redesign period.

Reliability is described as the consistency of a measure (Merriam, 2019). Roberts and Priest (2016) identify three types that were relevant to this study: inter-rate and test-retest. Inter-rate means that the test should yield the same information even if conducted by different people, and test-retest means that the test should yield the same information even if used at different times. Test re-test reliability was mitigated in data cleaning by removing all duplicate student entries (students who repeated the course).

Research Question 3. For this portion of the study, validity was potentially threatened by the researcher's bias based on personal experiences. Having familiarity with the field, the subjects, and the environment (Johnson, 1997) can precipitate distortions in the analyses and interpretation (Roberts & Priest, 2016). Additionally, this familiarity may also cause the

researcher to overlook some ambiguities in the data because they already have a clear understanding of the research setting (Johnson, 1997). However, during the interview process, the researcher was careful to capture the faculty perspectives by remaining non-reactive and maintaining analytical distance (Roberts & Priest, 2016). Additionally, verbatim accounts of the participants' experiences were included in the findings. This demonstrates that the conclusions drawn were grounded in the data (Roberts & Priest, 2016).

In terms of qualitative research, reliability refers to the trustworthiness of the data collection process and the data itself (Stiles, 1993). If the results are repeatable, even under different circumstances, then they are said to be reliable (Bryman, 2006). In this study, the reflexivity journal served as a way to maintain reliability, as notes were kept about the decisions made throughout the research process.

Carter et al. (2014) describes triangulation as a useful strategy that can improve the internal validity of a study. It involves the researcher comparing and cross-checking the data. Additional credence was given to credibility by member-checking. This included the researcher reviewing and editing the transcripts and then requesting that the participants review and verify the digitally transcribed interviews for accuracy (Birt et al., 2016).

Delimitations, Research Questions 1 and 2

For Research Questions 1 and 2, the study was delimited to students who took Bio-110 in the Spring 2017, Fall 2017, and Spring 2018 semesters. These semesters were selected because they were the terms in which the Department was offering the course in both the non-redesigned and redesigned formats. Success rates during Summer 2017 and 2018 were not analyzed because the Department taught Bio-110 in the non-redesigned method exclusively.

Delimitations, Research Question 3

For Research Question 3, the study was delimited to full-time faculty members who taught the Bio-110 course in the Spring 2017, Fall 2017, and Spring 2018 semesters. Full-time faculty were selected by virtue of their required role in course design and textbook selection in the department. They also made significant contributions to the Bio-110 redesign. According to the Public Agenda and Achieving the Dream (2011), there has been a longstanding challenge with integrating adjunct faculty into reform efforts that are critical to student success. Additionally, colleges are often unable to develop the appropriate infrastructure to effectively communicate with adjunct faculty. In terms of course redesign, as a cost-saving measure, institutions may employ a design approach wherein full-time faculty do the course design work and adjunct faculty implement the strategy (Felber, 2020).

Limitations, Research Questions 1 and 2

There are some important limitations to consider in the quantitative portion of this study. Because of the uniqueness of community colleges and the students they serve, traditional metrics, such as grade data, may not accurately reflect what success may mean in this nuanced setting (Zeindenberg, 2008). Community college students typically are non-traditional; the average age of a community college student in the state where South City is located is 28 years old (NC Community Colleges, 2022a). Zeindenberg (2008) asserts that their needs reach far beyond academics, so a holistic approach to serve and assess their success is necessary. Community colleges are much more diverse in their student composition; therefore, traditional metrics like course grades may not accurately capture the ways these institutions serve their students. Thus, otherwise non-conventional metrics can also be touted as student successes.

Further, the selection of the Bio-110 sections that were taught using the redesigned pedagogy was not randomized. The decision was made by Biology Department leadership based on the instructors' willingness to participate in the redesign project and experience with course development. These instructors were stationed at specific satellite campuses at South City; therefore, it cannot be assumed that there was a random sampling of the student population who would otherwise take the Bio-110 course.

Limitations, Research Question 3

Alcoff (1988) describes the particular benefit of positionality as a fluid concept that can be used to create and critique different interpretations of meaning. During the time of the Bio-110 course redesign, my position at South City as the Division's leader included the Biology Department and its faculty and staff. Additionally, I have prior experience as a Biology faculty member at South City and another community college in the region. Therefore, care was taken to not overemphasize my authority as an agency of interpretation (Alcoff, 1988).

Information retrieval and recall for faculty who were queried also served as a limitation. Lavrakas (2008) describes the memory processes that participants use to respond to questions. One of those is retrieval, which is the recovery of prior information from long-term memory into working memory. Long-term memory includes memory of facts and from events. Respondents may have been challenged when the retrieval process was unaided without cues related to the situation queried. Typical cues related to time (i.e., Spring 17 or Fall 17) or a repetitive action (i.e., teaching the Bio-110 course for several semesters) may have elicited error-prone responses, as the memories associated with the Bio-110 redesign process were encoded several years ago.

Role of the Researcher and Potential Biases

As discussed in Chapter 1, my role as the researcher may have precipitated some biases. My perspectives as the administrator of the Natural Sciences Division and former experience as a biology faculty member could have influenced the research. However, reflexivity helped to address these biases. Reflexivity is the ongoing process of evaluating and critiquing how the research may be influenced by one's own beliefs and practices (Olmos-Vega, 2022). Positionality refers to what we know and believe, and reflexivity refers to what we do with this knowledge (Holmes, 2020). To address this and to maintain credibility, a reflexivity journal with rich and thick descriptions was kept and updated regularly before and after each interview and throughout the coding process.

Study Implications and Significance

This study has implications for community college stakeholders, including practitioners and administrators. In this particular redesign, faculty used the UbD framework to reimagine how the Bio-110 course was taught. The course was planned by taking well-defined outcomes and intentionally mapping them to assessments that integrated a digital gaming simulation platform. This aligned with the key stages outlined in the UbD framework (Wiggins & McTighe, 2005). Using a mixed methods approach to analyze both the student success data and the impact of redesign in teaching pedagogy has two-fold significance. First, connecting the implementation of the UbD framework to the analysis of grade data can determine if student performance was indeed enhanced by integration of the framework. Bringing together the theory and practice is essential to improving student outcomes (Rust, 2019). However, this must be extended beyond a

single course. Long-term student success is predicated on faculty members' ability to take the knowledge gained and scale it to their teaching practices (NCAT, 2014).

Using this particular mixed-method design approach for this study was significant because the goal was to analyze two separate strands of data: the quantitative student success data and the qualitative information revealed from the faculty interviews. The quantitative student success data can reveal misalignments in faculty experiences and perceptions in the redesign components and can then be used to improve other redesign projects moving forward (Ariovich & Walker, 2014). My positionality as an administrator in the Natural Sciences Division required that I carefully consider both of these types of data in order to make impactful changes at the institution. Therefore, the selection of this unique approach is novel in that the findings could be informative for other practitioners who have a responsibility to both improving student success and developing faculty as better educators.

Furthermore, for administrators and other key stakeholders, South City's Teaching and Learning Excellence Framework allows for teaching effectiveness to be measured through key competencies. Analyzing the impact of the Bio-110 redesign using the framework ensures a synergy between teaching practices and the college's mission, vision, and values.

Summary

The purpose of this study was to evaluate the impact of the redesign of the Bio-110 course at South City Community College. Using an explanatory mixed-methods approach, this study evaluated the success of students in the redesigned and non-redesigned Bio-110 course and faculty's perceptions about course redesign after their experience. This chapter discussed the methodology for this study. It described the research questions, hypotheses, and design approach. It also rationalized the use of a mixed-methods study and described the participants, data

collection methods, and analysis techniques. To address Research Questions 1 and 2, a one-way ANOVA was performed to analyze the impact of the course type on students' final course grade. Additionally, a 2x2 ANOVA was conducted to examine if students' final grade was impacted by the faculty status as well as whether they were enrolled in a redesigned or non-redesigned section of the course. To address Research Question 3, interviews were conducted with Biology faculty to ascertain if there was a shift in their pedagogy based on their experiences. Using this approach, the quantitative student grade data provided a clear picture of the impact of the redesign on students' performance. That information also informed how faculty were influenced to change their teaching strategies based on South City's Teaching and Excellence Learning Framework.

Chapter IV: Results

Chapter IV will present the results of this mixed-methods study. This section will begin by analyzing the difference in success between students who took the Bio-110 course in the redesigned or non-redesigned formats. The results will be further delineated according to whether the students were taught by either part-time of full-time faculty. Then, the impactful themes and codes from the semi-structured interviews will be identified.

Study's Purpose, Research Questions, and Hypotheses

The purpose of this study was to evaluate the impact of the redesign of a Principles of Biology (Bio-110) course at South City Community College. To do so, a mixed-methods approach was used to address the below research questions and hypotheses:

1. Did students who took the redesigned Bio-110 course have higher success rates (measured as ABC course letter grades) than students in the non-redesigned course?

   H_0: There is not a statistically significant difference in the course grades of students in the redesigned course and those in the non-redesigned course at a 0.05 level of significance.

2. Did faculty status (measured as part-time vs. full-time) impact student success rates (measured as ABC course letter grades) for those who took either Bio-110 course type (non-redesigned vs. redesigned course)?

   H_0: There was no statistically difference in the success rates of students based the interaction of faculty status (part-time vs. full-time) and course type (redesigned vs. non-redesigned) at a 0.05 level of significance.

3. How did faculty members' experiences of the Bio-110 course redesign influence their pedagogy?

Study Design Approach

In this study, I used an explanatory sequential mixed methods design, which is described by Creswell and Plano-Clark (2017). In explanatory sequential mixed methods design, the first strand involves gathering and examining the quantitative data and connecting that to the qualitative strand. In this study the research was sequential; the first phase included collection and analysis of quantitative Bio-110 student grade data during the course's redesign, followed by a second phase, which consisted of the qualitative faculty interviews. The study strands were independent and had equal emphasis.

Overview: Research Questions 1 and 2

The students who were analyzed in the study included a sample of 1,787 Bio-110 students in three academic terms (Spring 2017, Fall 2017, and Spring 2018). These terms were selected for analysis because during the redesign period, they were the ones in which sections of Bio-110 were taught using both the redesigned and non-redesigned formats. There were 91 total sections, consisting of both the non-redesigned and redesigned delivery of the course during the study period. Table 6 indicates the total number of Bio-110 sections and students, the number of redesigned sections and students in those sections, and the number of non-redesigned sections and students in those sections.

Table 6

Number of Bio-110 Students and Sections During the Course Redesign

Semester	Redesigned sections	Non-redesigned sections	Total Bio-110 sections	Students in redesigned sections	Students in non-redesigned sections	Total students
	n	*n*	*n*	*n*	*n*	*n*
Spring 2017	15	16	31	292	324	616
Fall 2017	17	13	30	329	259	588
Spring 2018	16	14	30	314	269	583

Data Screening and Cleaning

Before the data was analyzed, it was screened and cleaned to ensure it was usable, valid, and reliable (Chu et al., 2016). In this study, the data file was reviewed for accuracy by examining the variables' descriptive statistics and graphic representations. Then, cleaning was conducted to examine and remove incomplete and irrelevant data.

The data file was received in SPSS format. The text in the independent variable column (course type) was modified to a categorical type to indicate whether the student took the redesigned or non-redesigned Bio-110 course. The dependent variable (course grade) was reported as a letter grade. Course grades were then assigned a numeric value so that success in the course could be reported. The faculty status (part-time vs. full-time) was assigned a category so that the success of students in the redesigned and non-redesigned course could be placed in distinct groups for analysis based on faculty type. Table 7 indicates the numerical coding system that was devised including and assigned values for the course letter grades and faculty status.

Table 7

Text to Numeric Values for SPSS

Variable	Original code	SPSS Code	Meaning
Course Type	Redesigned	1	*BioBeyond*, Flipped
	Non-redesigned	0	Traditional
Course Grade	A	5	Excellent
	B	4	Good
	C	3	Fair
	D	2	Poor
	F	1	Fail
	W	0	Withdrawal
	WN	-1	Never attended
	I	-2	Incomplete
Faculty Status	FTF	1	Full-time
	PTF	2	Part-time

The data was also screened to remove students who were missing final grades, those who repeated the course during the redesign period, and those who received a withdrawal (W), withdrawal/never attended (WN), or incomplete (I). The new, cleaned data file was then parsed into separate files by term during the study, and these smaller files were used for analysis.

Descriptive Statistics and Preliminary Analysis

Descriptive statistics were conducted for the Spring 2017, Fall 2017, and Spring 2018 semesters. The purpose of the analysis in Research Question 1 was to determine if there was a difference in the success of students who took the redesigned Bio-110 course and those who took the non-redesigned Bio-110 course taught by either part-time or full-time faculty. The means and standard deviations for course final grades are reported in Table 8.

Table 8

Means and Standard Deviations for Final Course Grade by Course Type and Faculty Status

Term	Course type	Faculty Status	*N*	*M*	*SD*
Spring 2017	Non-redesigned	PT	170	3.66	1.20
	Non-redesigned	FT	154	3.35	1.23
	Redesigned	PT	-	-	-
	Redesigned	FT	292	3.10	1.32
Fall 2017	Non-redesigned	PT	136	3.76	1.18
	Non-redesigned	FT	123	2.97	1.45
	Redesigned	PT	38	3.71	0.77
	Redesigned	FT	291	3.50	1.37
Spring 2018	Non-redesigned	PT	192	3.73	1.19
	Non-redesigned	FT	77	2.87	1.26
	Redesigned	PT	60	3.35	1.53
	Redesigned	FT	254	3.40	1.34

Spring 2017

A one-way ANOVA was performed to compare the effect of course type, either redesigned or non-redesigned, on students' final course grade. Assumption tests were checked in the tests for homogeneity of variance and normality, and they were not violated. A one-way ANOVA revealed that there was a statistically significant difference in the final course grade between students who were enrolled in the redesigned course and those enrolled in the non-redesigned course, $F(1, 614) = 15.98$, $p < 0.001$.

A two-way ANOVA was not performed for data in this semester because the redesigned sections were only taught by full-time faculty.

Fall 2017

A one-way ANOVA was performed to compare the effect of course type, either redesigned or non-redesigned, on students' final course grade. Assumption tests were checked in

the tests for homogeneity of variance and normality, and they were not violated. A one-way ANOVA revealed that there was not a statistically significant difference in the final course grade between students who were enrolled in the redesigned course and those enrolled in the non-redesigned course, $F(1, 586) = 1.51$, $p = 0.220$.

A 2 ANOVA (Course type: redesigned vs. non-redesigned) x 2 (Faculty status: part-time vs full-time) was used to examine if students' final grade was impacted by the faculty status, as well as whether they were enrolled in a redesigned or non-redesigned section of the course. There was a not significant main effect of course type on students' final course grade, $F(1, 584) = 2.89$, $p = 0.09$, $\eta_p^2 = 0.05$. There was a statistically significant main effect for faculty status, $F(1,584) = 12.60$, $p < .001$, $\eta_p^2 = 0.02$. Additionally, there was a statistically significant interaction effect between course type and faculty status on students' final grade, $F(1, 584) = 4.14$, $p < 0.04$ $\eta_p^2 = 0.007$. However, based on η_p^2, the effect size was small.

To further investigate how faculty status and course type impacted students' final grade, two *t*-tests were conducted. The first test was conducted on students who took the redesigned course and compared student outcomes in sections taught by part-time faculty vs. full-time faculty. There was no significant difference in students' final course grade between those taught the redesigned course by part-time faculty vs. full-time faculty in this semester, $t(72.59) = 1.43$, $p = 0.16$. The second test was conducted on students who took the non-redesigned course and compared student outcomes in sections taught by part-time faculty vs. full-time faculty. There was a statistically significant difference in students' final course grade between those taught the non-redesigned course by part-time faculty vs. full-time faculty in this semester, $t(235.77) = 4.72$, $p < 0.001$.

Spring 2018

A one-way ANOVA was performed to compare the effect of course type, either redesigned or non-redesigned, on students' final course grade. Assumption tests were checked in the tests for homogeneity of variance and normality, and they were not violated. A one-way ANOVA revealed that there was not a statistically significant difference in the final course grade between students who were enrolled in the redesigned course and those enrolled in the non-redesigned course, $F(1, 581) = 0.64$, $p = 0.42$.

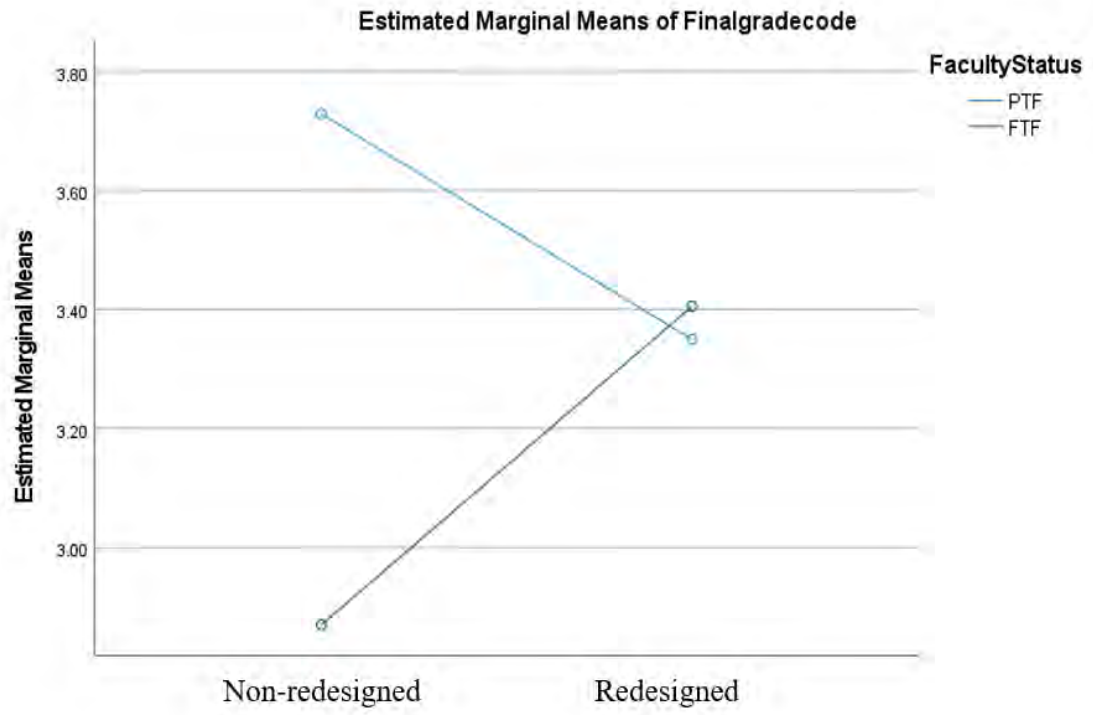
A 2 (Course type: redesigned vs. non-redesigned) x 2 (Faculty status: part-time vs full-time) ANOVA was used to examine if students' final grade was impacted by the faculty status, as well as whether they were enrolled in a redesigned or non-redesigned section of the course. There was not a significant main effect of course type on students' final course grade, $F(1, 579) = 0.37$, $p = 0.54$, $\eta_p^2 = 0.001$. There was a statistically significant main effect for faculty status, $F(1, 579) = 9.76$, $p < .002$, $\eta_p^2 = 0.02$. There was a statistically significant interaction effect between course type and faculty status on students' final grade, $F(1, 579) = 12.64$, $p < 0.001$, $\eta_p^2 = 0.02$. However, based on η_p^2, the effect size was small.

To further investigate how faculty status and course type impacted students' final grade, two *t*-tests were conducted. The first test was conducted on students who took the redesigned course and compared student outcomes in sections taught by part-time faculty vs. full-time faculty. There was no significant difference on students' final course grade between those taught the redesigned course by part-time faculty vs. full-time faculty in this semester, $t(312) = -0.280$, $p = 0.780$. The second test was conducted on students who took the non-redesigned course and compared student outcomes in sections taught by part-time faculty vs. full-time faculty. There was a statistically significant difference on students' final course grade between those sections

taught by part-time faculty vs. full-time faculty in this semester, $t(267) = 5.25$, $p < 0.001$. A visual representation of the interaction is displayed in Figure 5.

Figure 5

Plot of the Interaction Between Course Type and Faculty Status in Spring 2018



Summary of Quantitative Findings

Research Questions 1 and 2 investigated the impact of faculty status on student success in the redesigned and non-redesigned Bio-110 course. It was determined that in Spring 2017, there was a statistically significant difference in the final course grade between students who were enrolled in the redesigned course and those enrolled in the non-redesigned course. In Fall 2017, there was not a statistically significant difference in the final course grade between students who were enrolled in the redesigned course and those enrolled in the non-redesigned course. There was no significant difference in students' final course grade between those taught the redesigned

course by part-time faculty vs. full-time faculty in this semester. However, there was a statistically significant difference in students' final course grade between those taught the non-redesigned course by part-time faculty vs. full-time faculty in this semester. In Spring 2018, there was not a statistically significant difference in the final course grade between students who were enrolled in the redesigned course and those enrolled in the non-redesigned course. There was also no significant difference on students' final course grade between those taught the redesigned course by part-time faculty vs. full-time faculty in this semester; however, there was a statistically significant difference on students' final course grade between those taught the non-redesigned course by part-time faculty vs. full-time faculty in this semester.

Overview: Research Question 3

The goal of Research Question 3 was to determine if faculty's orientation toward teaching changed based on their experience during the Bio-110 redesign. This approach enabled a deeper understanding of the faculty's experiences with course redesign in a community college setting. The semi-structured interviews consisted of questions tailored to the competencies in South City's Teaching and Learning Excellence framework: pedagogical content knowledge, feedback and assessment, inclusive pedagogy, curriculum alignment, classroom strategy, instructional strategy, faculty engagement, and educational technology. Open and axial coding was used to analyze the data. This allowed for the comparing and contrasting analysis of similarities in themes and to make meaning from the phenomena that were revealed (Creswell, 2014).

Qualitative Findings

Data analyzed during coding procedures was compiled into a table that contained a master code list; this list assisted with guiding a consistent application of codes that were

generated by the research (Creswell & Poth, 2018). To answer Research Question 3, data from the six semi-structured interview questions were analyzed for patterns. The following themes emerged in relation to faculty's experience with the course redesign:

1. Alignment of course curriculum to learning outcomes was essential.
2. Appropriate use of technology can enhance the overall learning experience
3. Traditional teaching techniques were altered, and faculty continued to integrate these techniques after the redesign in other courses.
4. Assessments should be authentic and tailored to well-defined learning outcomes.

Table 9 indicates the themes and codes identified during the qualitative analysis.

Table 9

Codes and Themes from Interview Data

Theme	Codes
Alignment of course curriculum to learning outcomes was essential.	Learning Outcomes Course Objectives Alignment of Labs
Appropriate use of technology can enhance the overall learning experience.	Technology Gaming/Game Chromebook Computer *BioBeyond*
Traditional teaching techniques were altered.	Lecture Discussion Classroom Climate
Assessments should be authentic and tailored to well defined learning outcomes	Grades Assessment Low-stakes High-stakes

Alignment of Course Curriculum to Learning Outcomes Was Essential

During the analysis of the faculty interviews, the first theme to emerge was that alignment of course curriculum to student learning outcomes was essential. A seminal part of the development of the redesigned course was carefully editing the course learning outcomes to ensure that: 1) they aligned with the state-defined course outcomes; 2) they captured what faculty wanted students to know; and 3) the selected course materials were aligned with the outcomes. The study participants repeatedly mentioned the significance of grounding the course's development in well-defined outcomes. Kendra, a Biology Department Chairperson, was one of the first to pilot the redesigned course and was instrumental in its implementation. She noted:

> (Outcomes) kind of give you a ground work or foundation of what you're doing, and why you're doing it, and how you're doing it. And not just for you as a faculty member, but for the students as well. So, I feel like it's important to have these connections so that you can have your outcomes to know exactly what it is you are doing, and then you have your assessments to know how it's being done.

Other faculty indicated the significance of students' awareness of outcomes and how that can lend itself to their success. Gia noted:

> Students should know the learning outcomes, should really know what should be your learning outcomes from this chapter, from this unit, from this module. And I feel like everything should align back to that and…when it does that, then the student has a more guided path on how to get to the outcomes.

This type of intentionality was new to students and even to some faculty. Participants shared that, previously, the Biology Department was not intentional about outcomes and they only

became aware of the significance of this during the redesign process. Kathleen, a retired faculty member who served as the lead on the course redesign, indicated:

> I think it's important that you have what the learning outcomes are, and then you teach students to that, because if that's what you're assessing the students on, you want to make sure that that's what you're teaching. So, I will say *BioBeyond* was pretty good about that. As I recall, you know, we didn't really have a whole lot in the way of outcomes, it was very loose.

When asked if students understood the significance of learning outcomes and how that impacted the consistency of what each student was being taught, faculty indicated that both faculty and students had to be clear about the value of the learning. Lina stated:

> …we know that if you did *BioBeyond*, every student got through those course outcomes… they were all met by every class, basically, in the same way. Wherein the traditional, it could be well, I want to teach this part but not that part. I might touch on that but I really am going to focus on this, so some students learned a lot in this area but not in that area.

Overall, faculty perceived aligning course learning outcomes to the course curriculum as vital to the redesign process. It allowed them to have a better grasp of their own pedagogy and be mindful of how their choices influenced their teaching in other courses.

Appropriate Use of Technology Can Enhance the Overall Learning Experience

The redesigned Bio-110 course integrated a gaming simulation platform, *BioBeyond*, that introduced a backward course design framework and offered supplemental Open Educational Resources (OER). The *BioBeyond* platform was centered around the profound central question "Are we alone?" and led students through a virtual biological experience. The course relied

heavily on the integration of technology, as students had to access the *BioBeyond* software as a means to complete their lessons; these lessons served as the crux of the flipped classroom strategy. Thus, a student's successful use of *BioBeyond* was paramount in the course. During interviews, participants spoke at length about the use of technology in the classroom. Gia, Adrienne, and Kendra have all had extensive experience with online pedagogy, so they were familiar with the significance of course mapping and alignment of course outcomes. The addition of the *BioBeyond* component elevated the students' experience overall and allowed concepts that would otherwise be presented in one dimension to be experienced in a new way. Specifically, Gia noted:

> Technology is needed in the classroom. I am a big advocate for technology. So, I just felt like students…that's just what they're faced with every single day, so you can bring it up on your phone. I just felt like integrating technology advanced the course.

Kendra added:

> …(it) really allows students to kind of dive into the *BioBeyond* software, to really dive into certain topics, like if they were looking at a cell, they weren't just looking at a piece of paper of the cell. It was like a really innovative way to look into the inside of a cell and travel through the cell. So, it provided students with that…you know, I feel like more animation and more kind of in-depth; you're actually kind of looking at the mechanism of what happens.

Faculty did, however, express that there was a dichotomy between students: those who were savvy with technology and were intrigued by the novelty of *BioBeyond* and those who were not and had trouble navigating technology basics. The former may not have been that knowledgeable of the biology, but because they were tech savvy, they were able to be successful in the course.

The latter may have understood the concepts but may not have been able to demonstrate that understanding because of the barriers with the technology. According to Lila:

> It was more difficult for an older student to shift into that format of learning than for some of those younger, typical 18 to 25-year olds to fit into that. They were used to playing games and interacting in those gaming kinds of things. So that learning style, once they realize: "oh really that's how it's going to work? Oh, okay!"

As the redesign period progressed, faculty began to implement strategies to combat some of the challenges with the technology. Kathleen noted:

> I know, specifically some of the non-traditional students, it was really good for them, helping them kind of get up to speed in technology. And, once we started that hybrid, when the students would come in for the lab portion, I would put the non-traditional with the younger, most of the time, it was younger students that were more tech savvy. And, that worked beautifully, because they helped each other. So, that was probably one of the better collaborative parts of a *BioBeyond* was helping the other students helping the less tech savvy students.

The flexibility that the technology allowed served to meet the various needs of the students, particularly in the community college. Some participants had already been thinking about how instruction and technology should adjust to meet the changing needs of students before *BioBeyond*, and this process just reinforced the notion that we could not teach students the way we had before. The Bio-110 redesign highlighted the diverse learning styles and the diverse student population at South City Community College. According to Kendra:

> You had some people that liked the 'gaming type' format, and then you have some students that hated it. And that if your class doesn't have a lot of technology, then you

> may need to implement more technology, or you need to implement more group work, or you need to implement more presentations. You know, it just kind of highlights how everyone learns differently and just to have that differentiated learning within your classroom.

Overall, the participants' perceived the appropriate integration of technology as an important part of their teaching, and students' varying level of experience and savvy impacted how well they performed in the course. Similarly, technical skills were perceived to be important for not only success in this course, but other courses they would encounter.

Traditional Teaching Techniques Were Altered

The third theme that emerged during the interviews was alterations that were made in faculty's pedagogy. The participants spoke at length about the manner in which incorporating a new curriculum and technology positioned them to provide more personalized learning for students. There was less focus on lecturing by the instructor and more focus on ensuring that the students were centered in the learning process. Participants spoke to the flipped nature of the course that relied heavily on student's completion of the *BioBeyond* platform. Working through the assigned lessons introduced students to the concepts before the in-person class time. This allowed the students to ask questions about content. Layne highlighted this when recounting her experience:

> The traditional lecture was way more instructor heavy for preparation and actually instructing the students. Whereas, the redesigned (course) was more student-heavy, student-focused; the instructor was more just a facilitator. Just being personal and approachable and having (students) be able to come to me or ask questions about, you know, I need help with this.

Impact on Classroom Climate. Faculty also spoke about the manner in which the redesigned course led to a marked difference in the classroom climate. Because students were tasked with engaging virtually with the content before their class time, it prompted faculty to be more connected to their learning experience. Thus, the classroom climate was one where faculty were more in tune with how students were progressing, According to Adrienne:

> I know that sounds silly, but I think it's warmer and intentional. There's more interaction between the instructor and the students. I think because students are so different now, you definitely need to be more one-on-one with them. So, I think that the intentional approach means that you are a little more keyed into making sure that your students are really demonstrating that they know the content as opposed to just kind of going through the steps doing the test. Maybe they're not doing so well, but you just move on. It feels like you spend a little more time making sure that they have achieved the goal of learning whatever it is, as opposed to just kind of moving along.

Relinquishing the Traditional Approach. The traditional practice for Biology courses at South City was to have instructor-centered lecture and hands-on lab activities that accompanied the content. However, the course redesign was a departure from this standard "sage on the stage" approach (Adrienne's interview, 2023). During the interviews, participants shared how challenging it was to transition away from didactic lecture and re-center the students in the learning. Prior to the redesign, the department also relied heavily on a traditional textbook to introduce students to the course content. There was less emphasis on the student engaging with the content before the class meeting; rather there was a tacit, and mutual, expectation that the instructor would do the work of lecturing. Faculty shared that it was difficult to transition away from the traditional approach. They were practiced in the standard lab/lecture classroom format.

Lina noted: “So then we started shifting it and this was really hard for me, and I think all faculty, to give up that idea that you ‘lecture.’”

It was also clear that after the redesign, the participants’ efforts were scaled out to other Biology classes they taught. They continued to consider the integration of technology, classroom climate, and pivoting their traditional approaches to ensure students’ learning needs were met.

Assessments Should Be Authentic and Tailored to Well-Defined Outcomes

During the interviews, a clear connection emerged between assessments and well-defined learning outcomes. Participants shared that even in this non-majors survey Biology course, they wanted students to think critically and build knowledge. However, the previous classroom strategies likely did not prompt students to do so. There was an intentional choice during the redesign to eliminate high stakes assessments (exams), one that was difficult for faculty to accept. Doing so, according to Lina, was challenging for both faculty and students: “How do we convince ourselves, as faculty, and convince the students that what they're doing has value?”

To do this, faculty had to be specific about aligning outcomes to carefully selected assessments during the course development process. A significant amount of work was done during the redesign to ensure that the *BioBeyond* platform contained the appropriate material and it was presented in a way that aligned with the outcomes. This process was recursive; there was a fair amount of conversation between the developers and the faculty to revise the platform before and during the pilot phase. Kendra recalled:

> A team was set up to make sure that assessments were aligned with the outcomes. We worked heavily with the actual creators to make sure that they supplied us with a guide that went over each specific topic with specifics about what the students should learn, what they should get from them, and having that document in front of us before even

> piloting and comparing it with the specific outcomes that we need to make sure that we had met for the course; aligning those two together before piloting allowed us to be able to better set our assessments up to make sure that the students were getting what they were supposed to.

Further, faculty had to alter their teaching strategies in real time based on the students' response and performance. Layne used "no-stakes" assessments such as discussion questions or peer-to-peer teaching to determine if students were learning in her class. Kathleen also noted the difference in assessment: "So the one thing about *Biobeyond* was, there was no looking up the answer. They had to work through the process."

Finally, faculty did reflect on their teaching and the significance of aligning outcomes to assessments. Some conceded that they did not have prior training in teaching pedagogy, so their first exposure to concepts like assessments, outcomes, and other instructional techniques was in the midst of this redesign. Faculty, like Adrienne, shared that this experience made them realize that historically, the Department was not intentional with aligning outcomes to assessments. If it was, it was likely not done appropriately, and faculty only really thought about that during this process.

Summary of Qualitative Findings

Research Question 2 explored how faculty members' pedagogy was influenced by their experiences in the Bio-110 course redesign. Analysis of semi-structured interviews revealed four themes that emerged: alignment of course curriculum to learning outcomes, appropriate use of technology, alteration of traditional teaching techniques, and tailoring assessments to outcomes. These themes served to explain the unique phenomena that impacted faculty's teaching and the way they approached their overall pedagogy.

Summary

Chapter IV presented the quantitative and qualitative findings of this study. Research Question 1 analyzed the impact of course type (redesigned vs. non-redesigned) and faculty status (part-time vs. full-time) on student success in Bio-110 at South City Community College. A one-way ANOVA was used to analyze the overall success rates in the Bio-110 course during the redesign period. A two-way ANOVA was used to examine if students' final grade was impacted by the faculty status as well as whether they were enrolled in a redesigned or non-redesigned section of the course. It was determined that in Spring 2017, there was a statistically significant difference in the final course grade between students who were enrolled in the redesigned course and those enrolled in the non-redesigned course. In Fall 2017, there was not a statistically significant difference in the final course grade between students who were enrolled in the redesigned course and those enrolled in the non-redesigned course. There was no significant difference in students' final course grade between those taught the redesigned course by part-time faculty vs. full-time faculty in this semester. However, there was a statistically significant difference in students' final course grade between those taught the non-redesigned course by part-time faculty vs. full-time faculty in this semester. In Spring 2018, there was not a statistically significant difference in the final course grade between students who were enrolled in the redesigned course and those enrolled in the non-redesigned course. There was no significant difference in students' final course grade between those taught the redesigned course by part-time faculty vs. full-time faculty in this semester; however, there was a statistically significant difference in students' final course grade between those taught the non-redesigned course by part-time faculty vs. full-time faculty in this semester.

Exploration into Research Question 3 revealed the emergence of four themes relating to faculty's experience with the course redesign: 1) alignment of course curriculum to learning outcomes was essential; 2) appropriate use of technology can enhance the overall learning experience; 3) traditional teaching techniques were altered, and faculty continued to integrate these techniques after the redesign in other courses; and 4) assessments should be authentic and tailored to well-defined learning outcomes.

Chapter V will present a discussion of these findings, the impact these findings may have on higher education practice, and recommendations for future research.

Chapter V: Discussion

Chapter V presents an overview of this mixed methods study and a discussion of the most significant findings. It also integrates the quantitative and qualitative results, discusses implications for practitioners in higher education, outlines limitations of the study, and suggests future research endeavors.

Overview of the Study

The purpose of this study was to examine the effectiveness of an instructional redesign effort in a community college non-majors Biology course. South City Community College was the setting of this study. The faculty embarked upon a redesign of their Principles of Biology (Bio-110) course that was centered on essential principles of instructional design. With the support of a grant from the Inspark Foundation (Inspark, 2022) and the integration of a digital learning platform, *Biobeyond*, faculty members laid out the steps to create learning experiences that were meaningful and well-organized (Heaster-Ekholm, 2020).

Careful course design is important at community colleges because these institutions face a variety of challenges, especially related to science education (Lloyd & Eckhardt, 2010). Additionally, community colleges are responsible for educating a unique and diverse population of students, so the manner in which courses are delivered must be intentional and student-centered (Zeindenberg, 2008). Using an explanatory mixed-methods approach, this study drew parallels between students' success in a redesigned Bio-110 course at South City and the redesign's impact on faculty's pedagogy.

The following research questions guided this study:

1. Did students who took the redesigned Bio-110 course have higher success rates (measured as ABC course letter grades) than students in the non-redesigned course?

2. Did faculty status (measured as part-time vs. full-time) impact student success rates (measured as ABC course letter grades) for those who took either Bio-110 course type (non-redesigned vs. redesigned)?
3. How did faculty members' experiences in the Bio-110 course redesign influence their pedagogy?

It is important to draw parallels between conventional student success metrics and faculty pedagogy. In this study, exploring these two factors was significant because it was necessary to determine if the redesign efforts were meaningful and if they had potential implications for other learning environments. This study connected both the traditional quantitative course success metrics with qualitative data regarding the orientation of faculty to their teaching and future redesign endeavors.

Discussion of the Findings: Research Question 1

Research Question 1 examined the impact of course type (redesigned vs. non-redesigned) on student success rates in sections of the Bio-110 course. The results revealed that there was a statistically significant difference in the final course grade between students who were enrolled in the redesigned course and those enrolled in the non-redesigned course in Spring 2017. Students in the non-redesigned course performed better than those in the redesigned course. However, there was not a statistically significant difference in the final course grade between students who were enrolled in the redesigned course and those enrolled in the non-redesigned course in Fall 2017 or Spring 2018.

My hypothesis was that students in the redesigned course were more successful than those in the non-redesigned course. However, these findings do not support the hypothesis.

Below, prior studies will be contrasted with these particular findings to explain why these unexpected results may have occurred.

Institutions embark upon careful redesign efforts to integrate technology and re-align course outcomes with assessments (AAAS, 2009). The faculty at South City implemented the UbD framework to reimagine the Bio-110 course. UbD, which uses backward course design as its foundation, requires faculty to consider the goals of the learning first, and then develop assessments based on their goals to aid in planning their teaching (Wiggins & McTighe, 2005). South City's approach to implementing the UbD framework was unconventional because there was an emphasis on a central question "Are we alone?". This allowed students to make meaningful connections to real-life topics and invoke deep thought (Wiggins & McTighe, 2005). Furthermore, faculty also collaborated to take a novel approach to course delivery, sequencing of topics, and more intentional use of class and lab time.

Prior studies that have incorporated similar redesign efforts have yielded results contrary to the findings in this particular study. Ueckert et al. (2011) describes the redesign of a large-enrollment biology course that used the AAAS reform initiatives. Similar to the work that South City did, faculty in this study also integrated a central theme to connect the course's concepts and worked carefully to align lab activities to lecture content. Contrary to the redesign at South City, however, the researchers found that the percentage of As and Bs increased during and after the redesign process, and the D/F/W rates decreased across course sections.

Long et al. (2020) also incorporated the UbD framework into an undergraduate Biology course at a two-year community college. After their redesign, faculty members indicated a statistically significant decrease in the D/F/W rates and a significant increase in students passing with a C

grade. Thus, their efforts were found to be effective in improving student learning and retention in the course.

Conventional Success Metrics May Not Indicate Success

There is some evidence, however, that conventional success metrics such as course grades are not an indicator of achievement of learning outcomes. Incorporating the Vision & Change (V&C) strategy, Gonzalez (2016) redesigned a high-enrollment online introductory biology course at a diverse, two-year community college. Although the grade distribution and final exam scores did not indicate improved student success in the redesign course compared to the traditional course, the student opinion surveys told a different story. The students reported an increased level of engagement and also described the alignment of outcomes to assessments and a heightened awareness of the world around them. South City's Bio-110 course description indicates that upon completion of the course, students should have an increased knowledge of Biology and be able to apply it in their everyday life. The quantitative findings from South City are similar to the findings from Gonzalez (2016) in that there was no indicated improvement in students' grades. However, the similarities between the goals of the Bio-110 course and Gonzalez's (2016) findings indicate that this style of course should be measured in a different way. Overall increased understanding of Biology topics in everyday life is the goal, but traditional grade data may not measure that.

Elimination of Exams and the Impact of Technology

As a part of the redesign, the faculty at South City decided that students would not be assessed via high-stakes exams. The *BioBeyond* platform was developed as a gaming-like simulation that led students through a virtual tour of biological concepts. It was an integral part of the course, therefore, faculty decided that the students' learning should be gauged by their

completion of the virtual lessons and accompanying lab activities. Connell et al. (2016) found that student performance improved with the implementation of more frequent low-stakes assessments and more active learning strategies. Although the faculty at South City took this approach, students in the non-redesigned course performed better than those in the redesigned course in Spring 2017, and there was no difference in success in Fall 2017 and Spring 2018.

The findings in this study are unexpected because faculty took great care to make changes to the Bio-110 course in an effort to improve student success rates. AAAS (2009) calls for reforms in science education that allow students to engage with their course material and use active learning strategies (Haak et al., 2011). Wiggins and McTighe (2008) further explained that faculty are often remiss in assessing for understanding. A large part of the Bio-110 course grade was successful completion of *BioBeyond* lessons. Faculty expressed challenges students encountered with accessing and navigating the platform. Parts of *BioBeyond* were developed simultaneously with the course redesign, and it was consistently updated and altered by external developers during the course delivery. Consequently, there were some technical challenges that could have been a barrier to students successfully navigating the platform. These challenges could have impacted their overall success in the course.

Discussion of the Findings: Research Question 2

To explore Research Question 2, the quantitative analysis was further delineated to explore whether there was a difference in student success in the Bio-110 course based on faculty status (part-time vs. full-time). In Fall 2017 and Spring 2018, there was a statistically significant difference in students' final course grade between those taught the non-redesigned course by part-time faculty vs. full-time faculty. Students who were taught by part-time faculty performed better in the non-redesigned Bio-110 course. For Research Question 2, I hypothesized that

students who took the redesigned course with full-time faculty would have the highest success rates and those who took the non-redesigned course with part-time faculty would have the lowest success rates. However, these findings are counter to my hypothesis. Below, I will discuss two factors that may have contributed to these unexpected findings.

Grade Inflation

Grade inflation is viewed as a norm in higher education (Chowdhury, 2018). Tucker and Courts (2010) describe it as the deflation of a student's actual grade resulting in the dilution of the standard of excellence. Some faculty may feel pressure to issue higher grades to students in an effort to keep their career on track and garner more favorable feedback on course evaluations (Tucker & Courts, 2010). Students may be more likely to provide more favorable feedback when the instructor is giving higher grades (Millea & Grimes, 2002). At some institutions, course evaluations are used to help committees decide whether to award a teacher more courses (Johnson, 2003). For part-time faculty, this equates to increased pay and greater job security.

Students taught by part-time faculty in the non-redesigned Bio-110 course at South City were more successful than those taught by full-time faculty. Part-time faculty at South City are assigned their classes based on scheduling preference (i.e., teaching during the day or evening) and availability of sections. As a large institution with high-demand Biology offerings, the leadership is typically able to honor adjunct faculty preferences and offer the opportunity to teach a section if one is available. However, given the nature of the Bio-110 redesign, part-time faculty may have felt that negative feedback or poor grades would result in student complaints that could threaten their employment. Additionally, Tucker and Courts (2010) assert that issuing good grades requires less effort on the part of the faculty member; whereas, issuing bad grades could result in a grade appeal. This means additional paperwork, justification, and inquiry into

their teaching. It is the responsibility of the faculty member to justify a bad grade in the case of an appeal, whereas good grades are rarely questioned. Part-time faculty may feel that the strategy of issuing better grades will avoid the hassle of a grade appeal and will also allow them to remain in good favor with the institution.

Professional Development for Part-Time Faculty

Counter to their colleagues at four-year institutions, community college faculty focus primarily on teaching and learning (Galanek & Gierdowski, 2020). Galanek and Gierdowski (2020) surveyed faculty technology preferences, support, and experiences. They found that faculty's Information Technology (IT) support experiences or the type of software they used impacted their overall feelings about using technology in the classroom. Additionally, proper and timely training with the technology was associated with increased use of the tools. Furthermore, in this study, some community college faculty indicated that professional development related to technology, including individualized consultations, was very helpful. However, in spite of their awareness that this could be beneficial to students, they did not use these services.

By virtue of their employment status, part-time community college faculty specifically have fewer opportunities to take advantage of professional development activities (Phillips & Campbell, 2005). They are often transient, temporary, or moon-lighting at various institutions (Tuckman, 1978). In contrast, full-time faculty have a contractual commitment to engage in professional development as a part of their job duties (Williams & Wiatrek, 1987). Full-time Bio-110 faculty at South City were obligated to attend and support professional development devoted to their assigned courses. Training related to implementing the *BioBeyond* platform, engaging with the learning management system, and delivering the new lab activities was offered to all faculty. Although sessions were held in the evenings and on Saturdays to accommodate

varying schedules of part-time faculty, they were not required to attend; thus, many were tasked to teach the redesigned Bio-110 course without this valuable professional development.

Resources were shared with faculty in an effort to provide a consistent experience for all students. This included copying course models in the learning management system. Thus, for all faculty, including part-time, the *BioBeyond* platform was integrated into their course models to mitigate some technical challenges, and they had access to resources such as low-stakes quizzes and student study guides. The leadership in the Biology department made every effort to encourage participation in professional development opportunities and share the resources that were developed with all faculty. They made the decision to strategically expand the implementation of the redesign so that there was variation in delivery method, campus location, and faculty type (part-time vs. full-time). They believed this was necessary to determine if their efforts would be scalable to serve the expanse of the institution and the diversity of the student population at South City.

Discussion of the Findings: Research Question 3

Research Question 3 examined how faculty's orientation toward teaching changed based on their experience during the Bio-110 redesign. After conducting semi-structured interviews with full-time Biology faculty members at South City, four themes emerged. Below, I will discuss each of the themes and connect them to the quantitative findings from Research Questions 1 and 2.

Theme 1: Alignment of Course Curriculum to Learning Outcomes was Essential

During the interviews, study participants spoke at length about the significance of ensuring that the Bio-110 curriculum was aligned with the course's outcomes. As a part of the redesign, faculty at South City carefully considered how course materials should be used. A part

of this process was re-envisioning the lab activities and integrating a supplemental Open Educational Resource (OER). Working collaboratively, they reviewed the virtual *BioBeyond* lessons and revised existing lab activities, developing new ones when necessary. As a result, the leadership decided to create and self-publish a lab manual that was tailored to the *BioBeyond* lessons. An extension of this was the creation of unique lab assessments that served to connect the virtual activities, hands-on activities, and flipped learning approaches that occurred in the classroom. As a result, not only were the lab experiences elevated, but the faculty essentially reduced the cost of the course materials for students to $25.

Traditional Textbook vs. OER. In the non-redesigned Bio-110 course, students were required to purchase a traditional textbook and a lab manual to use for their course materials. Collectively, these items exceeded $200 in cost. Fisher (2018) describes the various money-saving options students may employ when faced with the high cost of textbooks. These include illegally downloading copies, purchasing older editions, or simply going without. The exorbitant costs may also negatively impact students' persistence rate because the financial burden may result in them taking fewer classes per semester. To combat this issue, some faculty have begun using OERs. OERs are low-cost education resources that allow users to modify or redistribute them for their own needs (Hilton, 2016). The faculty at South City selected an OER to supplement the *BioBeyond* lessons. During the interviews, faculty described the significance of incorporating the OER because it gave students an additional resource to help them achieve the learning outcomes.

Intentionality of Outcomes. Faculty expressed that their thinking about learning outcomes shifted during the redesign process. The Bio-110 course has loosely defined state outcomes, and prior to the redesign, each faculty member had a fair amount of latitude in the

specific topics on which they focused. Based on responses in the interviews, the result was an inconsistent experience for students; faculty may have emphasized topics that were of particular interest to them. The redesign forced faculty to review the state outcomes and collaborate to decide what topics every Bio-110 student should learn. Using the state outcomes and the course's description as a guide, faculty collectively decided that the learning emphasis should be on the biology concepts that allowed students to apply that knowledge to their everyday life. They also indicated that emphasis on outcomes transcended their Bio-110 teaching. After the redesign experience, faculty paid careful attention to the learning outcomes in all their courses and made sure that the selected course materials were well aligned to those outcomes.

Theme 2: Appropriate Use of Technology Can Enhance the Overall Learning Experience

The redesigned Bio-110 course relied heavily on the integration of *BioBeyond*. During interviews, faculty spoke at length about the challenges students had with the software. Because *BioBeyond* was being developed and revised in real-time, both students and faculty often encountered technical issues. Participants expressed how frustrating this was because they were not able to provide meaningful assistance with troubleshooting. With conventional digital textbooks, there is an existing publisher's infrastructure for support and institutional familiarity with the resources. Because *BioBeyond* was so new and not familiar to South City's Information Technology Department, faculty had to rely on each other to assist with technical issues and make other concessions in the classroom for problems that could not be fixed. These concessions included extending deadlines, excluding items from grade calculations, and skipping sections of lessons. Faculty expressed that this impacted students' ability to persist through the course and influenced their overall attitude about the content.

Devices in the Classroom. Galanek and Gierdowski (2020) discuss the significance of integrating devices into classrooms. In their study, they found that faculty's own technical savvy was related to encouraging students to use their own devices in a meaningful way. Participants in this study described how the integration of *BioBeyond* prompted them to think more about how technology can be used effectively in the classroom. The Department was able to purchase Google Chromebooks for each campus where Bio-110 was offered. Students could use these devices during class to complete their work. Participants expressed that this allowed them to help students troubleshoot technical issues, and it also allowed students and faculty to make meaningful connections. Students would pair with classmates to help each other with the work, and they were also prompted to reach out to the instructor for assistance. This initial connection may have been centered on a technical issue, but faculty used this opportunity to personalize the learning experience, something that did not happen in the traditional lab and lecture format. As a result, faculty realized the benefit of having devices that were easily accessible to the students.

Students' Technical Savvy. During the interviews, faculty expressed that students' technical savvy was essential in successfully navigating the *BioBeyond* platform. Because much of the students' grade was based on completion of the virtual lessons, tech savvy was directly related to student success. Bloom's taxonomy asserts that students' mastery increases with differentiated instructional opportunities (Bloom et al., 1956). As students engage with different instructional methods, their knowledge of the material increases (Bloom et al., 1956). In the case of this redesign, 60% of the course grade was composed of *BioBeyond*. Therefore, students' mastery was primarily demonstrated by successful completion of the *BioBeyond* lessons. There may not have been sufficient differentiated instruction. Therefore, lack of technical ability could have impeded their demonstration of content mastery, as reflected in their final course grade.

Theme 3: Traditional Teaching Techniques Were Altered

The redesigned Bio-110 course integrated a number of approaches that were novel for faculty. This included a flipped classroom, more technology, and intentional realignment of lecture content to hands-on lab activities. During the interviews, faculty indicated how challenging it was to relinquish the traditional didactic lecture format. Two of the six participants had been teaching community college biology for more than 15 years. There was a heavy reliance on a traditional textbook and an expectation that the instructor would do the work of learning by preparing teacher-centered lectures for each class. These particular faculty spoke specifically about the adjustment to more active learning strategies. Courses that are well-designed incorporate active learning strategies because they allow students to apply and comprehend concepts (Freeman et al., 2014). Faculty recognized the value of this, particularly with the renewed emphasis on learning outcomes.

Classroom Climate. Moreover, faculty described how their classroom climate differed in redesigned sections of Bio-110 and how this prompted them to recognize the significance of climate after the redesign. Classroom climate is described by South City's Teaching and Learning Excellence framework as the *physical, virtual, social, and emotional environments* in which learning takes place. Additionally, the classroom should be an inclusive space for students with clear expectations for the learning. Using strategies such as a flipped classroom and innovative technology allowed faculty members to be aware of the classroom climate they were creating. Students had to work through *BioBeyond* prior to coming to class, so faculty were able to see what content students had engaged with and use that information to tailor their lessons. Kakarougkas and Abdellatif (2022) described how significant this is in STEM courses because they are traditionally so lecture heavy. Flipping the classroom requires faculty to know what

content the students have connected with and be prepared for those students who have not completed the work prior to class (Berrett, 2012). Similar to studies by Kakarougkas and Abdellatif (2022), faculty at South City also indicated that they had to be ready for the varying questions that were posed and be able to navigate the class time with a variety of activities such as discussions and group work.

Theme 4: Assessments Should Be Authentic and Tailored to Well-Defined Learning Outcomes

Backward course design emphasizes assessment centered on achievement of learning outcomes (Wiggins & McTighe, 2005). McDaniel and Fraser (2016) discussed the careful consideration of outcomes and assessment and how these serve as the crux of redesign efforts. There are benefits of adapting course content to instructional technology and learning outcomes. However, it is important that educators take care to not mistake simple technology integration with course redesign. Completion of the *BioBeyond* lessons was attributed to students' achievement of the learning outcomes because faculty worked carefully with the software developers to tailor the lessons to the students' learning goals. Additionally, there were other low-stakes assignments, such as lecture and lab quizzes, that served to determine if students learned the concepts. Faculty shared that they felt meaningful assessments directly aligned to the material presented in *BioBeyond* had the most value.

Intentionality of Learning Outcomes. Faculty expressed that after the redesign experience, they were much more intentional about outcomes-centered teaching. The emphasis on curriculum alignment allowed them to better assess student learning. Further, they also indicated that they had to expand upon the state's vague learning outcomes to ensure that students were learning. Many shared that they paid little attention to the state outcomes prior to

this experience, but because of the knowledge gained, they felt more empowered to critique and contribute to the Department's efforts in all Biology courses.

Value of Low-Stakes Assessments. Traditionally in the Biology Department, a students' course grade was primarily determined by lecture and lab exams. The faculty made the intentional decision to eliminate high-stakes exams in the redesigned Bio-110 course. Active learning, timely feedback, and fewer high-stakes assessments are approaches that foster learning and improve retention of the material (Katzman et al., 2021). Further, Wiggins and McTighe (2005) assert that assessments should vary to allow students to demonstrate sufficient evidence of learning. Low-stakes assessments that cover less material, such as short quizzes, have been shown to improve academic performance in the classroom (Katzman et al., 2021). Although this strategy did not indicate improved student success in this study, there is some indication that the manner in which *BioBeyond* was integrated could have presented a challenge.

The intention of *BioBeyond* was to present the course's content in a unique way. The gaming simulation platform allowed students to explore biological concepts virtually. Faculty shared that its interactive nature made *BioBeyond* appealing, but the manner in which it was delivered to students made it difficult to determine if the student was simply completing the lessons or if they were gaining understanding. Reynolds and Kearns (2017) asserted that in course design, it is necessary that faculty members are clear on what they want students to understand because this is different from simple knowledge acquisition. If students understand, they can ask questions, apply concepts, and perform investigations (Wiggins & McTighe, 2005). *BioBeyond* presented the material, but it did not assess for understanding. It was up to faculty to develop well-crafted assessments to do this; however, the faculty may have mistaken the intention of *BioBeyond* as a means of assessment instead of a vehicle to present the course

material. In other words, some may have assumed that completion of lessons meant the student understood the material. When assessed for understanding via low-stakes assignments, students may not have demonstrated mastery.

Mixing Methods

In a mixed methods study, it is necessary to integrate the quantitative and qualitative results. Specifically, in explanatory mixed methods, the quantitative strand comes first, those results are used to inform the qualitative strand, and then the overall findings are merged during the analysis phase (Fetters & Tajima, 2022). In this particular study, quantitative Bio-110 student grade data was collected first, and it revealed that there was no significant difference in the success of students who took the redesigned and the non-redesigned course in Fall 2017 and Spring 2018. Additionally, in those same terms, students who took the non-redesigned course with part-time faculty were the most successful. The interview questions probed further into these significant quantitative findings. The questions served to query participants so that the collection instrument, the interview guide, was built in a manner that allowed integration of the quantitative and qualitative findings (Fetters & Tajima, 2022).

Table 10 integrates the most significant quantitative findings with interview questions that elicited unique responses from participants. These questions prompted the participants to share some of their reasoning for teaching decisions, the types of classroom strategies they implemented, and the ways in which faculty collaborated to build the course and engage in professional development. Teaching strategies such as a flipped classroom approach and integrating technology into the classroom were ones that were used in the redesigned course, and they persisted in the faculty's teaching after the redesign period. However, as indicated by the student's grades in the Bio-110 courses, those strategies did not serve to improve overall success.

Participants also spoke about the novelty of aligning assessments to learning outcomes. It was necessary to have targeted professional development to support faculty with connecting well-defined outcomes to meaningful assessments. By nature of their employment status, there was a disparity in how this was achieved with part-time and full-time faculty. Part-time faculty were more challenged with collaborating with colleagues and integrating the key redesign tenets into their courses. Therefore, the difference in success in the non-redesigned Bio-110 course taught by part-time faculty in Fall 2017 and Spring 2018 could be attributed to their reversion to traditional teaching strategies in sections otherwise designed as redesigned.

Table 10

Integrated Data on Bio-110 Redesign

Research Question	Relevant Quantitative Finding	Interview Question and Rationale	Participant's Quote
Impact of course type (redesigned vs. non-redesigned) on success in Bio-110	No significant difference between redesigned and non-redesigned student success in Fall 2017 and Spring 2018.	*How did a "typical" (traditional, non-redesigned) Bio-110 course differ from one taught with BioBeyond?* Illuminate differences in the teaching styles in the redesigned and non-redesigned courses.	"Traditional Bio-110 was just like a standard 'sage on the stage' lecture. *BioBeyond* …many of them struggled with it, we really had to do some IT work in the classroom. There was a very little lecture going on where I was teaching content". -Adrienne
Impact of faculty status on success in Bio-110	Students were more successful in the non-redesigned Bio-110 course taught by PT faculty in Fall 2017 and Spring 2018.	*How do you think your experience in the redesign allowed you to strengthen your connections with colleagues, both internally and externally?* Illuminate the opportunities for PT and FT faculty to connect through professional development during the redesign.	*"BioBeyond* was different from the traditional Bio-110, and it was new for part-faculty and new for students as well. And so making sure that we had the proper materials to support different faculty, that brought on its own set of challenges before piloting". -Kendra
Impact of redesign on faculty pedagogy	No significant difference between redesigned and non-redesigned student success in Fall 2017 and Spring 2018.	*After your experience with the Bio-110 redesign, can you describe an example of how you used a flipped classroom approach or backward design to teach a particular concept in one of your Biology classes?* Illuminate the different pedagogical strategies implemented in the redesigned course.	*"BioBeyond* started with a question, 'Why are we here?' and we kind of worked our way to learning about 'What is life?' to see how to answer that question. So, I felt like when I came back into the classroom and not using *BioBeyond*, my teaching was more theme based, and then going through the individual topics to answer that question. I think students didn't want the lecturing anymore after doing *BioBeyond*." -Gia

Implications for Theory and Practice

The results of this study indicate that there are implications for students, faculty, and leaders in the community college setting. Using a mixed-methods approach to analyze both the student success data and the impact of redesign in teaching pedagogy is significant. First, connecting the implementation of UbD to the analysis of grade data can determine if student performance was indeed enhanced by integration of the framework. Although the results indicated that the redesign approaches did not improve student grades, bringing together the theory and practice is still an essential component to improving student outcomes (Rust, 2019). However, this must be extended beyond a single course. Long-term student success is predicated on faculty members' ability to take the knowledge gained and scale it to their teaching practices (NCAT, 2014). Faculty were able to do this as a result of their experience in the redesign.

Using this particular mixed-methods approach in this study was significant because the goal was to analyze two separate strands of data: the quantitative student success data and the qualitative information revealed from the faculty interviews. The quantitative student success data revealed some misalignments in the faculty perceptions of the redesign; however, the experience can be used to improve redesign efforts for other courses (Ariovich & Walker, 2014). The researcher's positionality as an administrator required careful consideration of both quantitative and qualitative data in order to make impactful changes at the institution. Therefore, the selection of this unique approach is novel in that the findings could inform other practitioners who have a responsibility for improving student success and developing faculty as better educators.

Finally, it is necessary to ensure that any efforts remain centered on the institution's mission, vision, and values. For administrators and other key stakeholders, South City's

Teaching and Learning Excellence Framework measures teaching effectiveness through its key competencies. Analyzing the impact of the Bio-110 redesign on faculty using the framework ensures a synergy between teaching practices and the college's mission, vision, and values.

Study Limitations

One of the most significant limitations of this study was the emphasis on traditional student success metrics to address Research Questions 1 and 2. Prior studies have indicated that grade data may not accurately reflect what students know, particularly in the community college setting (Zeindenberg, 2008). Because these students are non-traditional and diverse (NC Community Colleges, 2022a), course grades may not indicate that students have achieved the learning outcomes.

Further, the selection of the Bio-110 sections that were taught using the redesign components was not randomized. The decision to assign an instructor to teach a particular Bio-110 section was made by the Biology Department leadership and was based on the instructors' willingness to participate in the project. These instructors were stationed at specific satellite campuses at South City; therefore, it cannot be assumed that there was a random sampling of the student population who would otherwise take the Bio-110 course.

Another study limitation was the lack of qualitative interview data from part-time faculty members. As the redesign occurred in 2017-2018, many of the part-time faculty members who taught during that time are no longer with the college. Therefore, their availability to participate in the study was limited. Since students were more successful in the non-redesigned Bio-110

course taught by part-time faculty, their insights about pedagogy, assessment, and classroom climate would have been valuable.

During the time of the Bio-110 course redesign, the researcher's position as a leader at South City included the Biology Department and its faculty and staff. Additionally, the researcher has prior experience as a Biology faculty member at South City and another community college in the region. Although care was taken to not overemphasize the researcher's authority as an agency of interpretation (Alcoff, 1988), this particular positionality also served as a limitation.

Finally, information retrieval and recall for faculty who were queried also served as a limitation. Lavrakas (2008) describes memory retrieval, which is the recovery of prior information from long-term memory into working memory. Long-term memory includes memory for facts and from events. Study participants may have been challenged when the retrieval process was unaided without cues related to the situation queried. Typical cues related to time (i.e., Spring 17 or Fall 17) or a repetitive action (i.e., teaching the Bio-110 course for several semesters) may have elicited error-prone responses, as the memories associated with the Bio-110 redesign process were encoded several years ago.

Future Research

There are several areas where this research can be extended. First, the quantitative student grade data could be disaggregated to examine how students in a particular demographic performed in the redesigned and non-redesigned Bio-110 course. There are studies that discuss the benefits and challenges of incorporating OER (Hilton, 2016; Tang, 2021), the potential impact of active learning (Freeman et al., 2014; Haak et al.,2011), and the digital divide (van Dusen, 2000), particularly for underserved students. Analyzing the data by race, gender, or age

would aid faculty members in developing teaching strategies that could best serve this unique population of students.

Furthermore, Bio-110 is an introductory survey course. Its primary learning objective is for students to use the knowledge they gained to be able to apply Biology to everyday life. Traditional metrics, like course grades, may not actually indicate if students achieved the learning goal. Therefore, it would be necessary to query them by survey or focus group to ascertain if they actually achieved this outcome. This qualitative inquiry, if centered on South City's tenets of Teaching and Learning Excellence Framework, would reveal some of the nuances of the redesign from the student perspective.

The qualitative focus of this study was on the experiences of full-time faculty members. However, the quantitative analysis revealed that students performed better in the non-redesigned Bio-110 taught by part-time faculty. Therefore, part-time faculty members should be interviewed about their experiences and how their teaching changed as a result of the redesign process.

Finally, in this study faculty revealed that they implemented some of the techniques they used during the redesign into other courses. These include careful alignment of outcomes to assessments and integrating technology. To extend the inquiry into faculty's pedagogy, the success data for students in the courses they taught after the redesign experience should be examined. This would reveal if students benefited from the knowledge faculty gained during the redesign process and if those techniques are transferable to other courses.

Conclusions

This mixed-methods study examined the effectiveness of a redesign of the Bio-110 course at South City Community College. The Biology faculty implemented a UbD framework and aligned the learning outcomes to the course materials and instructional strategies. The

research questions examined the performance of students who took Bio-110 in the redesigned and non-redesigned formats. Additionally, this study analyzed if the biology faculty's pedagogy changed based on their experiences during the redesign process. The results revealed that students in the non-redesigned Bio-110 course were more successful in Spring 2017, and there was no significant difference in success between students who took the redesigned and non-redesigned course in the Fall 2017 or Spring 2018 semesters. Furthermore, students were more successful in the non-redesigned course taught by part-time faculty. Semi-structured interviews with faculty who participated in the course redesign revealed that their pedagogy did change after their experience. Four themes emerged that centered on curriculum alignment, learning outcomes, assessment, and use of technology in the classroom. Although there is more work to be done, the result of this study indicates the necessity for practitioners to consider traditional student success metrics, course design and pedagogy, and the overall faculty experience in developing strategies to improve course delivery.

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Appendix A

Research Approval, South City Community College

January 9, 2023
Ms. Jasmin Feimster
Delivered electronically to jasmin.feimster@[redacted]

Ms. Feimster,
This letter is to confirm that the research project titled "*Mixed Methods Study Evaluating the Impact of a Redesigned Biology Course on Students and Faculty*" has been reviewed, approved, and is supported by [redacted] external research review.
As noted in the title, the research project is designed to connect both the traditional quantitative course success metrics with qualitative data regarding the orientation of faculty to their teaching and future redesign endeavors.

The request is for access to Biology 110 faculty for interviews and student data sets. Planning and Research will pull the student data requested in your application. Please enter a data request via the Planning and Research Request Form to ensure that your request is tracked and the appropriate analyst can reach out to you should there be questions about any of the variables. Due to the current data request volume, the request will take a minimum of 10 business days to complete.
You have the permission of the External Research Review Committee and the support of the college in conducting this study contingent upon using pseudonyms for the College, as well as any college students and employees, and make no identifiable references to [redacted], its students, or its employees in your final document. The College also requests a copy of your work upon completion.

If you need to make any changes to the protocols outlined in your application, you must obtain written approval from my office or the Office of Planning and Research. You will receive confirmation with a status update of the request within seven business days of submission of the notice and are not permitted to implement changes prior to receiving approval. Once change approval is received, you may implement approved changes.
Please contact me if you have further questions.
Much success!

Sincerely,
[redacted]
Vice President, Strategy and Organizational Excellence
[redacted]

Appendix B

IRB Approval

To: Jasmin Feimster, Jasmin Feimster
Department: Curriculum & Instruction

Re: HS-23-163 - Initial: Expedited Approval

STUDY #: HS-23-163
STUDY TITLE: Mixed Methods Study Evaluating the Impact of a Redesigned Biology Course on Students and Faculty
EXPEDITED CATEGORY: 5. Research involving materials (data, documents, records, or specimens) that have been collected, or will be collected solely for nonresearch purposes (such as medical treatment or diagnosis).
7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

APPROVAL DATE: January 29, 2023

The Institutional Review Board (IRB) approved this study. The IRB found that the research procedures carry no more than minimal risk and meet the expedited category or categories cited above. This approval applies to the life of the study, and you do not need to submit an annual request for renewal. You are required to request approval for any changes you may make to the study in the future as described in our Standard Operating Procedure #4. Changes are not permitted to be made to research procedures or study documents prior to receiving IRB approval, unless changes are necessary to eliminate immediate hazards to participants.

IRB approval is limited to the activities described in the IRB approved materials. All approved documents for this study, including consent forms, can be accessed through Cayuse.

Approval Conditions:
Appalachian State University Policies: All individuals engaged in research with human participants are responsible for compliance with the University policies and procedures, and IRB determinations.
Principal Investigator Responsibilities: The PI should review the IRB's list of PI responsibilities. The Principal Investigator (PI), or Faculty Advisor if the PI is a student, is ultimately responsible for ensuring the protection of research participants; conducting sound ethical research that complies with federal regulations, University policy and procedures; and maintaining study records.
Modifications and Addendums: IRB approval must be sought and obtained for any proposed modification or addendum (e.g., a change in procedure, personnel, study location, study instruments) to the IRB-approved protocol and informed consent form before changes may be

implemented, unless changes are necessary to eliminate apparent immediate hazards to participants. Changes to eliminate apparent immediate hazards must be reported promptly to the IRB.
Post-Approval Monitoring (PAM): The PI is responsible for providing requested documentation and/or in-person review time of the study by the Office of Research Protections if this study is selected for a Post-Approval Monitoring Review.
Prompt Reporting of Events: Unanticipated Problems involving risks to participants or others; serious or continuing noncompliance with IRB requirements and determinations; and suspension or termination of IRB approval by an external entity, must be promptly reported to the IRB.
Closing a study: When research procedures with human subjects are completed (including the destruction of all identifiable information collected for research purpose), please submit a closure form in Cayuse.

Websites:
1. PI responsibilities:
http://researchprotections.appstate.edu/sites/researchprotections.appstate.edu/files/PI%20Responsibilities.pdf
2. IRB forms: http://researchprotections.appstate.edu/human-subjects/irb-forms

Appendix C

Interview Guide

The interview questions will center on South City's Teaching and Learning Excellence Framework, but may also be guided by the findings of Research Question 1.

To interviewee: The purpose of this interview is to ascertain your perspectives on the Bio-110 course redesign at South City in Fall 2016-Spring 2018. Specifically, I want to understand how your teaching pedagogy changed as a result of your experience in Bio-110. We will start with some questions related to how the redesigned Bio-110 was delivered, compare that to the traditional course, and then I will ask how your teaching may have changed after the redesign.

1. Describe your role in the Bio-110 course redesign that began in 2016.
2. How did a "typical" (traditional, non-redesigned) Bio-110 course differ from one taught with BioBeyond? (i.e.: How instructional time was used in each? How was the technology integrated)?

Now, I will move onto some questions that will ask about your teaching after the experience with Bio-110:

3. After your experience with the Bio-110 redesign, can you describe an example of how you used a flipped classroom approach or backward design to teach a particular concept in one of your Biology classes?
4. After your experience with the Bio-110 redesign, can you describe how you used assessments to determine if the learning outcomes in the course you were teaching were indeed met?
5. As a result of the redesign, how did your perspective change relative to providing an inclusive learning environment for students?

6. How do you now consider students' perspectives, experiences, and learning styles in your teaching?
7. After your experience with the redesign, can you describe the significance of aligning course outcomes with assessments and instructional materials?
8. How does the classroom climate differ in a course with intentional design vs. a course that takes a more standard approach? How do the physical, virtual, social, and emotional environments differ in each?
9. After your experience with the redesign, what is your perspective about how course materials (textbook, technology, etc.) and overall design of a course meet students' needs? (Follow up: Did it foster engagement, critical thinking, help build knowledge?)
10. How do you think your experience in the redesign allowed you to strengthen your connections with colleagues, both internally and externally?
11. The Bio-110 redesign required the integration of technology into the classroom. Describe how this helps students become more engaged.
12. Is there anything else you want to share or that you find relevant, that you want to include?

Appendix D

Consent Form

APPALACHIAN STATE UNIVERSITY

CONSENT FORM

Faculty Interviews: Bio-110 Course Redesign at South City Community College

Researchers: Jasmin D. Feimster, Graduate student, Doctoral Program in Educational Leadership

Reich College of Education

[redacted]

feimsterjd@appstate.edu

Dr. Jennifer McGee, Dissertation Chair
Associate Professor, Research and Evaluation
Department of Curriculum & Instruction
Reich College of Education
mcgeejr@appstate.edu

Researchers Statement:
We are asking you to be in a research study. This form gives you information to help you decide whether or not to be in the study, such as the purpose of study; the procedures, risks, and benefits of the study; how we will protect the information we will collect from you; and how you can contact us with questions about the study or if you feel like you have been harmed by this research. Please read it carefully. You should ask any questions you have about the research and, once they are answered to your satisfaction, you can decide whether or not you want to be in the study. Being in the study is voluntary, and even after you agree to participate, you can change your mind and stop participating at any time without losing any benefits from the University or South City Community College to which you may be entitled.

PURPOSE OF THE STUDY
The purpose of this study is for the researcher to understand your thoughts and experiences about the redesign of the Bio-110 course at South City. The goal is to better understand how your teaching may have changed as a result of the knowledge you gained during that process.

STUDY PROCEDURES
We would like to interview you to ask questions about your teaching practices and your experiences teaching during and after the Bio-110 redesign process at South City. The interview involves one, 60-90 minute in-person interview that will take place on any South City area

campus. It will occur in a private room reserved by the researcher. You may refuse to answer any question in the interview. As part of this study, we would like to take a(n) audio recording of the interview. We will use this recording for the purposes of transcribing your answers during the interview and coding your responses. The total time commitment will be approximately 2 hours, which may include a follow- up conversation for clarity on responses given.

RISKS, STRESS, AND DISCOMFORTS

Some of the questions the interviewer will ask may be upsetting or make you feel uncomfortable. You do not have to answer any questions you do not want to answer and you can stop at any time.

Since voice recordings are identifiable, there is always a risk that someone who does not have permission may see or hear the recording and find out what you said during the study. In order to protect your privacy and keep your responses confidential, we will store the file on a password protected laptop. Once we have transcribed your responses and completed the study, we will delete your file from the password-secured device.

There are risks with any study involving collection of data, there is the possibility of breach of confidentiality. A breach of confidentiality occurs when private information you share with the research team is seen by or made accessible to people who do not have permission to see the data. In order to reduce the risk of a breach of confidentiality, the study team will store data in secure, locked storage and electronic files will be saved on a computer that requires a password to access.

BENEFITS OF THE STUDY

You will not receive individual benefit or monetary compensation from participating in this study. However, you may benefit by contributing to this study which aims to determine how successful the Bio-110 course redesign was for both students and faculty. This knowledge can help with student retention efforts and assist with faculty development.

PROTECTION OF RESEARCH INFORMATION

The collected data will remain confidential. All interview participants will be able to select a pseudonym to be used during the study. All data will be secured in locked storage and electronic files will be saved on a computer that requires a password to access. The researchers and administrators at South City may have access to identifiable information.

Government or university staff sometimes review studies such as this one to make sure they are being done safely and legally. If a review of this study takes place, your identifiable data may be examined.

All of the information you provide will be confidential. However, if we learn that you intend to harm yourself or others, we must report that to the authorities.

USING YOUR DATA IN FUTURE RESEARCH

The information that we obtain from you for this study might be used for future studies. We will remove anything that might identify you from the information and specimens. If we do so, that information may then be used for future research studies or given to another investigator without getting additional permission from you.

RESEARCH-RELATED HARMS

In the event of study-related injury, illness, harm, distress, you can contact:

1. Jasmin Feimster (336-362-5227) or email at feimsterjd@appstate.edu
2. Jennifer McGee, Associate Professor, Dept of Curriculum & Instruction at Appalachian State (828) 262-2270 or email at mcgeejr@appstate.edu.
3. Appalachian State also has an Institutional Review Board (IRB) that protects the rights of people participating in research. You can contact the Vice Provost for Research at Appalachian State at (828) 262-8557 or IRB@appstate.edu.

By signing this document, you are not waiving any legal rights that you have to act against Appalachian State University for harm or injury resulting from negligence of the University or its investigators.

YOUR RIGHTS AS A RESEARCH PARTICIPANT

Your participation in this research is completely voluntary. If you choose not to participate, there will be no penalty and you will not lose any benefits or rights you would normally have.
If you choose to take part in the research, you can change your mind at any time and stop participating. If you agree to participate but decide later that you don't want to be in this study, please email the researcher at feimsterjd@appstate.edu. If you have questions or concerns about your rights as someone taking part in research, please contact the Appalachian State University Office of Research Protections at **828-262-4060** or **irb@appstate.edu**.

Subject's statement

By signing below, I volunteer for this study and agree that:

- The purpose and procedures of the study have been explained to me;
- I have been informed of the risks of participation;
- The study is voluntary, I do not have to participate, and I can withdraw at any time;
- I have been given (or have been told that I will be given) a copy of this consent form to keep.
- I have had the opportunity to ask questions, and was able to get all of my questions satisfactorily answered;
- If I have questions later about the research, or if I have been harmed by participating in this study, I can contact one of the researchers listed on the first page of this consent form.

_____

**Printed name of subject Signature of subject

Date_____

Copies to: Researcher
Subject

Appendix E

Email Request for Participation - Potential Interview Participants

Dear _____,

My name is Jasmin Feimster and I am a doctoral student in the Educational Leadership Program at Appalachian State University. My dissertation will focus on the redesign of the Bio-110 course at South City Community College in Spring 2016-Fall 2018. The purpose of my study is to analyze the performance of students in the redesigned and non-redesigned courses during those terms and to ascertain how faculty's teaching pedagogy changed based on their experiences with the Bio-110 redesign.

For this study, I hope to meet with faculty and other department leaders who participated in the various stages of the redesign (development, piloting, and implementation) at South City. The college Provost has given me permission to conduct my study, and you have been identified as a participant in the Bio-110 redesign efforts at the college. I am requesting your assistance in participating in this study. In order to collect data about faculty's perceptions of the redesign, I will conduct interviews with faculty members in the Biology Department. Completion of the interview will be in person in a private space on one of South City's campuses and should take no more than 90 minutes.

Participation in this study is voluntary and you can skip any questions that you do not wish to answer. If you would be willing to participate in this study, please respond to this email identifying your participation.

If you would like more information about this research study, please contact me at feimsterjd@appstate.edu or by telephone at [redacted]. You may also contact Dr. Jennifer McGee, who is supervising this study, at (828) 262-2270 or by

email at mcgeejr@appstate.edu. For questions about your rights as a subject, contact the Appalachian State University Institutional Review Board for the Protection of Human Subjects, (IRB@appstate.edu) or Debra Paxton (paxtonda@appstate.edu), Director of Research Protections, John E. Thomas Bldg. Room 382, 287 Rivers Rd, Boone NC.

Vita

Jasmin Feimster was born in Greensboro, N.C. and is a product of Guilford County Schools. She graduated from North Carolina A&T State University with a Bachelor's Degree in Biology and UNC-Greensboro with a Master's Degree in Biology. Upon completion of her Master's Degree, she began teaching Biology and Anatomy & Physiology at a small community college in North Carolina. During her time there, she worked on several college initiatives and was instrumental in the implementation of the college's Quality Enhancement Plan (QEP) at the time. In the Fall of 2015, Jasmin began working as a Biology instructor at South City Community College. Soon thereafter, she became the Division Director and then the Associate Dean of the Division. Jasmin also serves on a number of college committees and action teams devoted to student retention and strategic scheduling of classes.

Jasmin has one daughter, Emerson, who is five years old. She enjoys baking and spending time with family and friends.