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Impacts of Technology-Enhanced Dual Enrollment Mathematics Course on Rural High School Students' Intentions of Going to College

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IMPACTS OF TECHNOLOGY-ENHANCED DUAL ENROLLMENT MATHEMATICS COURSE ON RURAL HIGH SCHOOL STUDENTS' INTENTIONS OF GOING TO COLLEGE

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DEDICATION

I dedicate my dissertation work to the love of my life Mona, the most beautiful and courageous person, and to our son Bogdan, the most extraordinary and intelligent child a mother and a father might wish to have. Thank you both for supporting me and for helping me! I would not be here without everything you have done for me. I love you both!

This dissertation is also for our parents, who supported us in moving to the USA and making a dream come true.

Lastly, I dedicate this dissertation to all educators, from the caring and great K-12 teachers to the brilliant professors I have met my whole life. Thanks for your teachings, which helped me model the minds of generations of children.

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ABSTRACT

The purpose of this concurrent mixed methods action research study was to investigate the impact of new technology-enhanced Dual Enrollment (DE) math courses on students' perception of college courses, the influence the technology-enhanced DE had on students' intention of going to college, and the students' perception of the technology-enhanced DE math course. Examining student experiences in a technology-enhanced DE course informed all stakeholders as to what degree DE influenced students' perception of college. The DE experience influenced students' postsecondary plans. The innovation of this action research study was the technology-enhanced DE math course. Software used to practice computational skills, conduct descriptive statistics analysis, and perform tests was part of the innovation. Remodeling the practices of teaching DE math courses at a rural high school helped administrators and colleagues grasp the importance of change and explained the conditions under which the new practices occurred.

For this concurrent mixed methods design, data was collected from a group of six students from a rural South Carolina high school using self-reported surveys and semi-structured interviews. Descriptive and inferential statistics and inductive analysis were performed to interpret the data from all sources. The findings from both data sources were converged to develop a comprehensive understanding of rural high school students' perception of technology-enhanced DE math courses. The findings of this study confirmed that the innovation improved the perception of students enrolled in the Mat

120 course about college courses, positively influenced students' intention of going to college and recognized the benefit of technology embedded in the DE course on students' perception of DE math courses. This research confirmed that rural high school students valued their DE experience and liked to be challenged by college-level courses, indicating that the technology-embedded DE course positively influenced their decision to enroll in college. Thus, a district-wide presentation of the results of this study to DE faculty members who taught rural students should explain the benefits of embedding technology in DE courses and offer the opportunity to participate in course-specific workshops during the school year. DE faculty should meet regularly and design best practices to embed technology in their courses. Reflecting on the implementation, I am considering introducing more technology in the other Math DE course, College Algebra, I am teaching and in any future DE math course, I will teach.

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CHAPTER 1

INTRODUCTION

The dialogue for a more rigorous high school curriculum has continued since the end of the last century, as the Advanced Placement (AP) program grew dramatically in urban areas and voices from the academic community asked for a serious synchronization with college standards (Hyser, 1999; Lichten, 2000). Darity et al. (2001) examined the access of minority students from North Carolina to College Credit earning classes. Their study was extended by Klopfenstein (2004) to underserved students in Texas, finding that their access to AP courses increased "in absolute but not in relative terms" (p. 2).

A National Center for Education Statistics (NCES) study, conducted during the 2010-11 school year revealed that 53% of collegiate institutions had high school students taking college courses under Dual Enrollment (DE) programs or similar (Arnold et al., 2017; Marken et al., 2013). Research in the last ten years has shown that high schoolers partaking in college credit-earning courses have a higher probability of remaining in college to graduate with a bachelor's degree, even in cases where students start at a community college or technical institute and graduate with a bachelor's degree (Allen & Dadgar, 2012; An, 2015; Delicath, 2000; Ozmun, 2013; Pretlow & Wathington, 2014; Schachter, 2014; Wachowiak, 2015). Nationwide there are over two million students enrolled in DE courses (Arnold et al., 2017; Schachter, 2014).

The demand for DE classes has been justified by the students' need to experience the rigor of college classes, working independently and engaging in analytic discussions,

and taking responsibility for their learning. In her 2012 study, Karp concluded that DE courses offered in high schools present the same academic structure and rigor as the ones taught on "the college campus, they, therefore, provided students with more authentic opportunities to practice the role of the college students and were better at making the difference between high school and college visible to students" (p. 25). Karp's conclusion confirmed Conley's (2005, 2007, & 2010) work on developing a college readiness model that includes academic content, behaviors, and cognitive strategies. That model follows Byrd's and McDonald's (2005) findings regarding the successful transition to college of students with goal orientation and excellent time-management skills who can understand college requirements and procedures.

Students' decision to pursue post-secondary education is proven to be influenced by dual enrollment classes. Programs that allow students to receive college credit while in high school have existed for an extended period. According to Ozmun (2013), when students were surveyed,

> A majority (73.7%) indicated that the decision to enroll in a dual-credit class was influenced by none other than themselves. … In terms of post-high school plans, 89.5% of the respondents stated they planned to enroll in a four-year university, while 7% stated they intended to enroll in two-year colleges. (p. 67)

A review of relevant research revealed that not many states track or report DE outcomes. Hoffman et al. (2009) conducted a study in Florida that highlighted the wide variety of benefits of DE for underrepresented students similar to the rural population from a Title 1 school that the author of this research wants to include in his study. In the same study, it is strongly suggested, "that dual enrollment can prepare high school

students for college and give them momentum in completing a degree or credential" (Hoffman et al., 2009, p. 53).

Hofmann's (2005) Florida case study report showed that students enrolled in dual enrollment courses are more susceptible to continuing their post-secondary education, having a mindset for college, unlike students taking CP courses. A 2001 study by Peterson et al. revealed the effect that the DE classes had on students' decisions to attend the Salt Lake Community College, noting "56% of the respondents reported that it encouraged them and 42% reported that it had no effect, and the courses discouraged fewer than 1%" (p. 30).

Hoffman (2007) supports DE, as at least nine states have or are considering policies that allow all students the opportunity to acquire college credit while in high school. An's (2013) study revealed that students who were enrolled in DE performed better than those who took regular CP classes, and DE students "earned a GPA that is 0.23 points higher than non-dual enrollees. Dual enrollees earned a GPA that was 0.25 standard deviations higher than non-dual enrollees.… [Students] in dual enrollment are less likely to take a remedial course than nonparticipants" (p. 417).

In a 2001 study, Hébert conducted a comparative statistical study between students taking DE mathematics courses taught by high school teachers versus college faculty. He found a statistically significant difference in learning outcomes, with the former students performing better than the latter group in future math college-level courses. A College Board national study compared college outcomes of AP and DE students, taught by high school teachers and college faculty. Even when accounting for factors such as gender, demographics, or parental education, the study found that AP students, regardless of AP

exam scores, outperformed their DE peers when looking at college graduation and grades (Wyatt, 2015).

In a ten-year history of DE in Virginia, Catron (2001), "quoting Donald Finley, the secretary of education and task force member, argued for the benefit of DE programs for gifted students in rural areas" (p. 52). Unfortunately, most studies on the benefits of DE participation were done on urban populations due to ease of access to faculty and resources in these areas. Farrell (2007) notes in her study that "the community college studied is located in an urban region in Arizona" (p. 70). Longitudinal studies such as the one done by O'Brien and Nelson (2004) in Dallas, Texas, were made possible due to the large population of students available.

Even though students would experience the same effect of enrolling in DE on academic performance and college readiness, students from low-income schools may need to pass an obstacle created by the parental-educational level. The local school administration should concentrate on providing dual enrollment programs that target the needs of rural area, low-income high school students regarding their pursuit of continuing the post-secondary education, moving towards equity of chances of targeted students (An, 2013).

Local Context

South Carolina does not have an educational database connecting student data from K-12 through post-secondary institutions, making research more challenging. A K-20 or even a K-16 initiative in other states offers not only DE opportunities but also access to interrelated databases (Venezia et al., 2006). The Education and Economic Development Act of the 116th Session of the South Carolina General Assembly states that

the Advisory Committee on Academic Programs recommended to the Commission on Higher Education for “dual enrollment courses to be accepted in transfer within a related course of study” (p. 12). The possibility to earn college credits in collaboration with community colleges allows rural high school students to delve into the rigorous academic environment while still in high school.

Trident Technical College is part of the South Carolina Technical College System (SCTCS). The 2005 Education and Economic Development Act made DE in South Carolina possible. The SCTCS (n.d.) provides most of the state's DE programs, having 14,742 DE during the 2019-2020 academic year. This number represents a 10.9% increase from the previous academic school year, raising the total number of DE courses offered by 1,452.

In the rural part of South Carolina, students predominantly come from low-income families with a low percentage of higher education and a lack of role models. These attributes are essential when students decide to enroll in post-secondary educational institutions (Gibbs, 2000). Ferguson's 2014 study focused on how DE programs from three South Carolina colleges integrated rural students into post-secondary environments' academic, social, and institutional requirements.

The South Eastern County School District has been AdvancED accredited since 2010. Marvelous High School (MHS) is located, according to US News & World Report (2018), in a 100% economically disadvantaged rural community, and 100% of the students on free lunch program, with a distribution of 58% Black, 41% White, 1% Hispanic and 2% other or a mix of races. The mathematics and reading proficiency of the students is 69% and 71%, respectively. Since the 2019/2020 school year, the MHS in

Collaboration with Trident Technical College has been offering a DE math course - Mat 120 for the first semester. Next year, the offer increased to two DE math courses. The initiative was intended to help the students from our rural community graduate with more college credits and ease their financial burden when applying to college. The number of students enrolled in DE math courses has consistently been low, so there was a concern about student perception regarding enrollment in the DE math classes and the influence DE math course had on students' decision to continue their post-secondary education.

With student mathematics proficiency at 69% as illustrated by a 2019 US News & World Report and only a small student population enrolled in college-earning math courses, MHS started offering a technology-enhanced dual enrollment math course. The goal was to increase enrollment in college credit-earning classes and positively change student perception of college courses. For the last decade, the best junior and senior students from MHS were moving to South Eastern Middle College, where DE courses had been offered in all subjects, leading to MHS administrators trying to retain these students by providing more DE courses. A study was needed to evaluate student perception regarding enrollment in a DE technology-based math course versus its corresponding college prep math course.

Statement of the Problem

In the 2019-2020 school year, Marvelous High School, in collaboration with Trident Technical College, introduced a DE math course, leading to the high school administration's call to investigate student perception regarding enrollment in this dual-credit class.

A study by Arnold et al. (2017) on DE student achievement in various learning environments concluded that "DE is effective insofar as it results in higher course grades as compared to comparable non-DE students" (p. 30). Although the DE environment resulted in important differences between the English, Math, and History DE courses, Arnold et al. recommended that DE courses be analyzed bi-yearly, underlying the necessity of research studies on how these programs best serve the students and the communities. Students from the DE math course were taught by a high school teacher and had access to a web platform, giving web access to class materials such as unlimited homework attempts and class lesson videos from both the textbook author and course teacher. It was expected that they would have better results than in a traditional course since technology allows course material accessibility at all times (Suh et al., 2008). Examining student experiences in a technology-based course to determine the impact of experiential and practical learning through the program informed all stakeholders as to what degree DE prepares students for a first-year college math course, and the effect in getting students ready for their entire college career, from both an academic and readiness point of view.

Purpose Statement

The purpose of this study was to investigate the impact of a new technology-enhanced dual enrollment math course on student perception of college-level courses, intentions of attending post-secondary education, and their experience in dual enrollment math courses.

Research Questions

1. How does participation in a technology-enhanced DE course influence high school students' perception of college courses?
2. How does participation in a technology-enhanced DE course influence high school students' intention of going to colleges?
3. What is the student's perception of the DE math course that they participate in?

Statement of Research Subjectivities and Positionality

My interest in mathematics was awakened from an early age by my grandfather, with whom I lived until I turned 16. My parents and most of my adult relatives were teachers, and getting a good education was essential in our families. I am a white, 52-year-old middle-class immigrant male. I came to the U.S.A. in 2003, and it took me 17 hardworking years to receive United States citizenship, of which I am very proud. I started teaching before 1992 when I received my Bachelor of Science degree with a Major in Mathematics and a Master of Science degree in Mathematics. From the first day of school, I knew that I had made the right choice. I continuously learned how to improve my teaching methods to make mathematics easily accessible to all my students throughout my life.

I also have a Master of Science degree in Mathematics with a specialization in Complex geometry, Topology, and Computational Algebra since 2008. The Master of Business Administration that I decided to pursue in 2002 after I obtained my tenure at National College “Gh. Vranceanu” was, in my opinion, the one that prepared me the best for my career and instilled in me the desire to pursue a Doctoral Degree. The year after I

started, I had the opportunity to come to the United States to teach mathematics through a Cultural Exchange program. The teaching methods and the technology that I discovered here, mixed with my own experience, provided me with an idea for my Master's thesis and a research theme: Evaluation Methods in Mathematics--Designing and Experimenting a Portfolio-based Assessment Model. Working with six groups of students, I validated my hypothesis and presented my research results in front of my colleagues and professors.

Since 2016, I have taught in a Title 1 rural high school where all students have free lunch. In order to enhance lessons and use the school-issued Chromebooks to their full capacity, we had to give students the opportunity to move from knowledge to application of their learning. To know and to do has to be part of the same class activity. They do not have to be two independent experiences in two different subjects or even in two separate class periods of the same course. Learning by doing and practical learning are the two essential elements of pragmatism. The pragmatic paradigm has been the philosophical foundation for supporters of mixed methods research (Grant, 2016; Teddlie & Tashakkori, 2009). My pragmatic research paradigm view allowed me to use any combination of methods necessary in my quest to answer research questions by using a technique or combination of techniques to advance specific research in the best manner. As Grant (2016) noted, the pragmatists are free to do research in areas that they value and are most interested. The ontology of a pragmatic paradigm fit like a glove in my worldview. I have firmly believed that we all hold a unique interpretation of the same reality in which we try to fit and make a positive contribution to maintain it as we see it (Mertens, 2010).

Being a teacher at the same high school where I was doing the research study gave me an insider position. The results of the research were of interest for the administration since my high school, in collaboration with a Technical College, introduced a DE math course taught by my wife, leading to the high school administration's call for an evaluation of student perception regarding enrollment in this DE class versus its corresponding high school CP math course. Therefore, I was positioning myself as an outsider in collaboration with insiders, with a Co-Learning Mode of Participation as defined by Herr and Anderson (2005).

According to Stringer (2007), in an action research study, the stakeholders have multiple opportunities to question what they know and can "repudiate misconceptions and misrepresentations" (p. 11). I was aware of the power factor and the fact that according to Cunningham and Fitzgerald (1996), any claims of Truth can be seen as acts of power. Agee (2009) warns that when working with students, the positioning might be difficult since I did not want to put pressure on them because most of the participants in the study were my students in previous years. I did not want them to please me, giving the answers that I would expect. The STEM activities that I used to do with my students prove that consistent collaboration between students notably enhances the productivity and overall quality of learning math concepts and scientific phenomena. I was giving students opportunities to show their skills outside the rigorous math curriculum, but still rigorously, by investigating an idea in various settings, which fosters ingenuity and encourages knowledge application and problem-solving. Along with the trust that I gained from my students, the clarity of the presentation of the purpose of my research study helped eliminate any wrong assumptions that my students might make about the

purpose and the benefits of my study. I learned that Peshkin's (1988) Subjective I's such as E-Pluribus-Unum I, Justice-Seeker I, and the Pedagogical-Meliorist I, could easily be aspects that characterized me. However, more importantly, I learned that I need to tame my subjectivities. Systematically seeking my subjectivity, monitoring myself, I was looking for potential influence while collecting the data and not in the conclusions stage. I refused to let myself carry this burden, of which I am aware, while I was collecting, analyzing, and writing my data.

In science, the term paradigm is defined as the matrix of values, methods, perceptions, and technical abilities that developed the necessary instruments for the scientific community needed for a specified period. Kuhn (1970) observed that the history of science was not a linear process. The change in the scientific paradigms made possible the discovery of solutions needed to solve problems that were considered turning points in the development of science.

Since antiquity, Aristotle's beliefs were the basis of the scientific community paradigm until the end of the Middle Ages. As an example, the much-needed development of Calculus was held back by Aristotle's philosophical beliefs, and only the independent development of Calculus by Leibniz and Newton led to a seismically change in this scientific community. Newton's paradigm was inspired by Copernic's discoveries and was followed by Einstein's view, which developed the Theory of Relativity.

The main goal of a pragmatic paradigm is to offer solutions to problems from any domain (Creswell & Creswell, 2018). Therefore, all knowledge and the known truth are tools needed to solve such problems. For a long time, the focus was on finding the

necessary resources at all costs. However, in the last period, the vast majority of people ceased ignoring their wishes, which changed the pragmatic paradigm.

I believe that education needs change. It is the responsibility of the stakeholders to educate the young generation for the 21st Century. The pragmatic paradigm has its roots in Piaget's theory "In order to know objects, the subject must act upon them, and therefore transform them: he must displace, connect, combine, take apart, and reassemble them" (Piaget, 1970, p. 704). This opens the possibility for students to move from knowledge to the application of their knowledge. Pragmatic researchers "recognize that there are many different ways of interpreting the world and undertaking research, that no single point of view can ever give the entire picture and that there may be multiple realities" (Saunders et al., 2012, p. 151).

My research questions related to my pragmatic view. The research methods that I utilized within this paradigm allowed me to examine DE student experiences to determine the impact of experiential and practical learning through this program. It also allowed me to assess the impact on student performance in future math courses and college enrollment for each student group.

The contribution of technology in DE classes was also evaluated, and lessons were recorded and uploaded on the Desire to Learn (D2L) College platform. Students could access their homework on the XYZ Homework platform, and the instruction was primarily paperless. The high school instructor recorded the classes for posting online, pending approval by the school administration. Through D2L, students had access to video recordings from two different instructors (college and high school) to use when reviewing for tests or the final exam. DE students all had a Chromebook issued by the

school and access to a TI 84 calculator 24/7 and statistical analysis software, JASP. This was a tremendous advantage taking into consideration that this was a Statistics class, and they had to analyze data provided in electronic format as compared to previous years when all data was provided on paper and already outdated.

Through a mixed-methods action research approach, I evaluated the impact of DE courses taught by high school teachers on student perception of college courses. Not only did I hope to find that DE classes prepare my students for first-year college math, but also that they had a positive effect in getting them ready for their entire college career, both from an academic and mental point of view. The DE enrollees were rural students, including a sizable minority population, which allowed me to also look at the course impact on these student populations. I was employing a qualitative approach, including a survey and semi-structured student interviews aiming at capturing an accurate assessment of student perceptions on DE math classes. In addition to hearing about their experiences as DE students, I also followed a quantitative approach to determine the impact of taking dual-enrollment courses on student achievement in future relevant math courses.

In my daily duty of educating young minds, I lived with a continuous fear that my teaching would imprison my students' minds in the way that they would stop looking for answers and proof. I was afraid that they would only see the reality through my eyes because today's education tries to convince the young generation of what is and what is not essential, eliminating a wide range of possibilities on how children could see the world around them. By using technology, I worked to ameliorate this fear. Through D2L, DE students accessed video recordings from two different instructors to use when reviewing for tests or the final exam. For Mitchell (2017), “ontological pragmatism is a

plausible position for pragmatists and others to endorse" (p. 9) by motivating the view and defending it from objections.

Epistemologically, for my particular study, I made all the necessary efforts to stay objective and maintain the confidence of high school participants that I gained while working with them in previous years. Since my wife is a high school teacher, the relations inside the project were determined by what I consider appropriate for the study (Mertens, 2010). According to Hayashi et al. (2019), for qualitative research, specific criteria replaced the concepts of internal and external validity, reliability, and objectivity that are specific to quantitative studies.

Methodologies represent the body of knowledge, "discipline-specific approaches and processes of research" (Kinash, 2018, p. 6). The pragmatic paradigm is best associated with my methodology because of the possibility of exploring new themes resulting from the interviews and the back and forth movement between the researcher's approach (Mertens, 2010).

Wilson (2010) stated that axiology demonstrates the researchers' perception during the research process being "concerned with the nature of value" (p. 11). The ethical behavior of a pragmatic researcher is influenced by their values, especially in my case, since I came from a different culture, having a desire to gain knowledge through my research. As a result of my study, I hoped that students from my community enrolled in DE classes would benefit from the technology offered by DE compared with the scarce environment in which they would take a similar course in a CP high school program.

Definition of Terms

Various terms are defined based on their meaning in educational settings. For the purpose of this study, knowledge of these terms is essential. For ease in locating, the terms are presented in alphabetical order.

College-level Courses

College-level courses, as defined by the Office of Planning, Evaluation, and Policy Development of the US Department of Education, are considered to teach the material at a college level while allowing high schoolers who successfully complete it to earn credit to be recognized for their college courses.

The intention of Going to College

College commitment is defined as the student acceptance or enrollment in a two or four-year high education institution (Fergusson, 2014).

Diversity

Students' individual differences are recognized, understanding that each individual is unique based on their race, ethnicity, gender, sexual orientation, socio-economic status, religious beliefs, or physical abilities (Banks, 2015).

Dual Enrollment

Dual Enrollment (DE) is generally defined as a program that requires "a partnership between a school or district and a local institution of higher education …. Students may or may not simultaneously earn high school credit (i.e., dual credit), but their college performance is documented on a college transcript" (Cassidy et al., 2010, p. 1). In this study, DE courses are defined as courses that provide the high school students a challenging academic experience following academic rigor imposed by the credit

criteria required by a college being taught by high school teachers that meet the college qualification criteria. At the same time, students can earn credit for both college courses and required high school courses (Karp & Hughes, 2008; Rivera et al., 2019). The students are enrolled—concurrently—in two distinct academic programs or educational institutions, i.e., students that take college courses while they are still enrolled in high school (Grubb et al., 2017; Hofmann, 2005; Wachowiak, 2015). DE indicates a dual-credit high school course that allows students to simultaneously earn credit at both institutions (Giani et al., 2014; Ozmun, 2013; Wyatt et al., 2015).

Higher Education Institution

A higher education institution is defined by Merriam Webster dictionary as a college or a university. For the purpose of this study, students graduating from a high school are considered enrolled in a higher education institution if, after high school graduation, they are enrolled for the subsequent academic year in a two-year post-secondary institution that offers an associate degree or a four-year post-secondary institution that offers a bachelor degree.

Rural High School

The definition of a rural high school corresponds to the general understanding of rural areas characterized by small population size and geographic isolation.

Student's Perception

The focus of this study when defining DE students' perceptions of college courses "is on the perceptions of college academics and academic rigor students hold prior to and after enrolling" (Meyer et al., 2009, p. 1070). For this study, student perception of post-secondary education is defined as the level of awareness, lack of, and the influence that

DE courses have regarding students' decision to pursue a post-secondary education path. It includes the challenges and contributing factors they perceive as helping or hindering their future educational goals.

Technology-Enhanced Course

A technology-enhanced course is defined by Lingefjärd and Kilpatrick (1998) as courses that "are designed to give the students insight into how they could solve extended mathematical problems using mathematical modeling, a good background in mathematics, and technology" (p. 2). Dockstader, J. (1999) defines technology integration in a 21st Century class as

> using computers effectively and efficiently in the general content areas to allow students to learn how to apply computer skills in meaningful ways. . . . Integration is incorporating technology in a manner that enhances student learning. Technology integration is using software supported by the business world for real-world applications so students learn to use computers flexibly, purposefully and creatively. (p. 2)

Technology Integration

Technology integration in this study is defined as the use of technology as tools to achieve skills that include critical thinking, reasoning, interpretation, perseverance, synthesizing information, and analysis that would help them to solve real problems by collaborative learning (Bransford et al., 2000; Ertmer & Ottenbreit-Leftwich, 2010; Jonassen et al., 2008; Koh, 2019).

Title I Schools

To ensure that all children meet challenging state academic standards, schools with at least 40% of the students coming from low-income families, based on the definition of low-income from the United States Census, are identified as Title 1 Schools (US Department of Education, n.d.).

CHAPTER 2

LITERATURE REVIEW

The purpose of this mixed-methods action research study was to describe the impact of new technology-enhanced Dual Enrollment (DE) math course on student perception of college-level courses, post-secondary education and find what factors influence DE students' decision to enroll in DE classes at Marvelous High School.

The review of related literature focuses on the research questions, “How does participation in a technology-enhanced DE course influence high school students' perception of college courses?”, “ How does participation in a technology-enhanced DE course influence high school students' intention of going to colleges?” and “What is the student's perception of the DE math course they participate in?”

Based on the research question, three main constructs were identified to guide the literature search: (1) Dual Enrollment, (2) technology integration, (3) student perception of post-secondary education.

Literature Search Methods

The journal articles, books, book chapters, and dissertations thesis relevant to this study were collected through various strategies for this literature review. Databases such as *EBSCOhost, ERIC, ProQuest Dissertations & Theses Global* and *JSTOR,* were used to search relevant literature. Some authors were previously identified from a different source such as references from research studies and their names along with a combination of the following keywords: Dual Enrollment, Dual Credit, AP, technology integration,

student reflections, student perception, expectations, post-secondary, community college, academic rigor, academic integrity, math instruction, mathematics, action research, case study, rural high school, low-income poverty were used to filter through the databases. To help identify more resources, I also explored *Google Scholar* to cross-reference and locate new references. Mining through the related articles and the bibliography of the articles related to my variables that cited the searched authors was another method used to expand the search area. When searching on ERIC, I used a combination of search parameters, including publication dates such as - since 2010, a description such as education technology, the publication type such as journal articles or books, peer-reviewed, and full text. Sometimes, when an author like P.A. Ertmer or M. M. Karp was a key contributor to my research field, I added the author's name and changed other parameters or limits. The reference lists from the dissertations' thesis that I came across were a valuable resource. When searching the *EBSCOhost* database, I had the advantage of searching for a specific word or combination of words such as Dual Enrollment inside the title and other specific terms inside the text of the journal article or avoiding articles that were done in urban areas.

One of the main themes of this study is the influence of Dual Enrollment programs in the student decisions of pursuing post-secondary education. This chapter will discuss the following topics in more detail: (a) accelerated learning programs developed in secondary or post-secondary United States educational institutions, (b) factors that influence enrollment in post-secondary education institutions. (c) reviews of DE research on programs effectiveness, location, and methods, (d) how the technology integration on education was conducted.

The literature review is organized into five sections according to the main variables identified to guide the literature search. The first main section looks at the dual-enrollment programs and other types of accelerated learning programs in rural or low-income high schools. The second main section examines the factors that influence enrollment in post-secondary education and students' perception of post-secondary education. The third main section examines multiple aspects of technology integration in high school mathematics education and the methods used to research technology integration in education. Exploring these topics, I will find if students' perception of college courses influences their enrollment in higher education institutions for students from a rural high school who are enrolled in a technology-enhanced DE math course.

Theoretical Framework

In this literature review, a theoretical framework combines the constructivist learning theory and the decision-making process that followed through the lens of Chickering's (1969) theory of student development and Hossler and Gallagher's (1987) general model of college choice.

This study describes the impact of DE courses taught by high school teachers on student perception of college courses. I hope to determine whether DE classes prepare my students for first-year college math courses and get them ready for their entire college career, both from an academic and mental point of view.

A theoretical framework is used to find relevance and serve as the research study's structure (Grant & Osanloo, 2014). The interrelation of Constructivist learning theory, Ajzen’s Theory of planned behavior, Chickering’s theory, and Hossler and Gallagher's General Model of College Choice with the present study are presented next.

Constructivist Learning Theory

A critical part of the theoretical framework of this study is the constructivist theory in which the instructor takes the role of a facilitator, the students learn in small groups, and the knowledge is shared between the facilitator who have equal responsibility and authority with the students whose "own effort to understand at the center of the educational enterprise" (Prawat, 1992, p. 357). The learner-centered design of the Math DE course observed in this study assumes that the transfer of knowledge is facilitated through involvement in authentic tasks that are anchored in a meaningful context, putting the student's efforts to understand the new material in the center of the educational process, and engaging them in the process of constructing own interpretations of learning experiences (Applefield et al., 2001; Ertmer & Newby, 2013; Harasim, 2012; Prawat, 1992; Swiderski, 2011). The authenticity of the activities is critical for the learner's ability to use their ideas to make meaning of the concepts presented (Brown et al., 1989; Ertmer & Newby, 2013). When applying this theory, the researcher considers both areas of constructivism, individual and social constructivism. Individual constructivism is based on Piaget's work that emphasizes constructing own experiences that lead to successful learning (Blake & Pope, 2008; Kalina & Powell, 2009). The social constructivism developed by Vygotsky considers the learner having a more critical role than the instructor does, suggesting that the students learn more straightforward when they have a chance to express what they are thinking, justification and argumentation play an essential role within a mathematical learning environment (Anthony et al., 2015; Hunter & Anthony, 2011; Wood et al., 1976; Wright, 2018).

Ajzen's Theory of Planned Behavior

Ajzen's theory of planned behavior (TPB) is an extension of the theory of reasoned action developed by Fishbein and Ajzen (1975) and revised by Ajzen and Fishbein (1980). The extension was needed because the theory of reasoned action had "limitations in dealing with behaviors over which people have incomplete volitional control" (Ajzen 1991, p. 181). The central factor is the subject's intention to perform a given behavior. The theory of planned behavior is built upon the central tenet of the intention behind a certain person's action or behavior. The assumption being made is that intention describes all motivations behind a behavioral action. Intentions are a direct measure of the effort put forward by a person to achieve a goal.

Furthermore, the intention behind a behavior directly correlates to the likelihood that the person commits the action leading to the abovementioned behavior. However, it must be noted that the action leading to such behavior has to be realistically allowed to take place and must only depend on a person's will. The person must have access to the resources and skills required to perform the behavior.

The theory of planned behavior was also has been used to make predictions regarding the behavior related to the use of technology (Ajzen & Schmidt,2020). Using technology in the classroom is a blessing but quickly becomes a burden for educators when used unwisely. Understanding the response and the effect a technology-embedded course would have on the students is mandatory for an instructor who designs a technology-based intervention in the curriculum. In the educational field, the TPB tries to deal with prediction and change of the student's behavior. The TPB has success in explaining and predicting the behavior regarding technology adoption Steinmetz et al.,

2016; therefore, I decided to include it in the theoretical framework of my study. The TBS has a clear definition of the behavior of interest in terms of (a) target, (b) action - involved, (c) context – in which the action occurs, and (d) the time frame the action takes place. In terms of my study, the behavior defined refers to (a) the decision to continue the post-secondary education, (b) after attending a technology-embedded DE course, (c) at a local HS, and (d) during the Spring semester. Once the behavior has been defined according to Ajzen's (2005) Principle of Compatibility, as mentioned in Ajzen and Schmidt (2020), "all other constructs in the theory must correspond to the behavior in all four elements" (p. 18). The greater the control of the actors involved in the behavior, the better the chances that the intention will be followed (Fishbein & Ajzen, 2010). Three factors determine the TPB behavioral intentions according to Ajzen (2020): (a) behavioral beliefs - the attitude toward the behavior seen as "a function of readily accessible beliefs regarding the behavior's likely consequences" (p. 315) (b) accessible normative beliefs – a subjective norm that include an injunctive normative belief seen as the expectation or subjective probability that a person or a group (family, school staff) approves or disapproves of the subject actions and descriptive normative beliefs that "are beliefs as to whether important others themselves perform the behavior," (p. 315) and (c) accessible control beliefs – which represent the base of perceived behavioral control, the control factors including necessary academic skills, money, lack of time cooperation with classmates and others. The three factors are conceptually independent predictions of intentions, but empirically, they correlate, and Hagger et al. (2002) reported in their research the correlation's low to moderate magnitude. Suppose we assume that a student learns from a friend that his sibling drops from college because of hard work. In that case,

this information might lead to a less favorable attitude toward enrolling in college, while if the DE course experience with technology eases the fear of high-level math might lead to a more favorable attitude toward the same goal. However, his attitude toward the behavior, subjective norm, and perceived behavioral control are also influenced by other factors, but some degree of correlation between the three factors exists. What matters in a TPB is whether a person's beliefs encourage or discourage the behavior if the information the subject receives might be correct or incorrect is immaterial (Ajzen, 2020).

In conclusion, the TPB stands tall as a very practical framework when a behavior-change intervention is designed (Steinmetz et a., 2016). The theory received recognition from many empirical research studies, as Fishbein and Ajzen (2010) stated, but the "investigators encountered a variety of theoretical and practical issues" trying to apply TPB in their own research.(Ajzen, 2020, p. 323).

Chickering's Theory of Student Development

Chickering theory of student development outlined in his 1969 book, “Education and Identity,” establishes seven tasks for students to go through while they develop their identity: developing competence, ability to manage emotions, movement through autonomy toward interdependence, development of mature interpersonal relationships, the establishment of identity, developing purpose and development of integrity (Chickering, 1969). These seven tasks deal with students’ feelings, thinking, believing, and relating with others. This theory is preceded by Erik Erikson's psychosocial theory of development that considers the impact of external factors, parents, and society on personality development. Nevitt Sanford's theory of challenge and support focused on describing college students' changing patterns of thought, emotion, and behavior.

(Erickson, 1950; Sanford, 1993). High School Seniors go through a transition period to become college students. They are not developmentally ready to make important decisions about their post-secondary academic path and future career. The formation of a student's identity follows seven directions of development (Chickering, 1969). The student's development is influenced by seven environmental factors that include institutional objectives, institutional size, student-faculty relationships, curriculum, teaching, friendships, programs, and services, Chickering and Reisser (1993) state that:

> (a) college students experience seven vectors "major highways for journeying toward individualization" of development throughout their college experience; (b) college students move through these vectors at different rates; (c) college students deal with issues from more than one vector at the same time; (d) navigating vectors is not necessarily linear; (e) the vectors build upon each other and lead to greater complexity, stability, and integration; (f) college students in order to achieve identity must proceed along these vectors developing competence, managing emotions, moving through autonomy toward interdependence, developing mature interpersonal relationships, establishing identity, developing purpose, and developing integrity. (p. 35)

Chickering's theory helps to explain how students' development in college can affect them socially, emotionally, physically, and intellectually. Developing intellectual and physical competence involves using "analytical and comprehensive thought" to deal with life events while managing emotions should not reach a point where will interfere with educational proceedings (De Larrosa, p. 2). Moving through autonomy toward interdependence can be done when the students learn how to solve their problems

independently by thinking up to solutions and putting them in practice when living away from home increases interpersonal skills (Chickering & Reisser, 1993; Ortiz, 1999). The sixth vector, "developing purpose," of why a student would attend college varies and depends on each student's goal, life aspirations, and commitments to self (De Larrosa, 2000). Developing students' integrity of their beliefs, values, and purposes must be established, as explained by Chickering and Reisser, 1993; monitoring the behavior while preserving self-respect is an important aspect of students' development of own integrity. The DE courses offer the opportunity for high school students to get help in the developmental phase by getting accustomed to three environmental factors, student-faculty relationships, curriculum, and teaching. When students go to college, their development is influenced by parents, high school teachers, and peers, bringing strengths, weaknesses, feelings of pride, prejudices, and confusions to clarify their identity and develop acute purposes and high integrity (Chickering & McCormick, 1973).

Hossler and Gallagher's General Model of College Choice

Hossler and Gallagher's (1987) model is based on some constructs of both Litten (1982) and Jackson (1982). The three key stages of the college choice process are the predisposition, search, and choice, "in which students move toward an increased understanding of their educational options as they seek a post-secondary experience" (Hossler & Gallagher, 1987, p. 208). Jackson (1982) noted that a student might elect to continue his career on a non-educational path during any key stages, choosing to postpone post-secondary education for a few years or indefinitely. Hossler and Gallagher (1987) mentioned that "of the three phases … the predisposition stage has received the least attention" (p. 210). Participation in pre-college school experiences such as

involvement in student government, debating clubs, drama, and journalism are positively related to attending more selective institutions (Hearn, 1984). Hossler and Gallager, 1987 mentioned that the results of several studies that include Hearn (1984), Kolstad (1979), and Peters (1977), reported that the quality of high school curriculum and college matriculation are positively related. The same studies mention a positive correlation between attending a college and graduating from a high school that offers more math and science courses as well as other college prep courses (Hossler & Gallager, 1987). Therefore, the purpose of the innovation of my study is to offer a technology-integrated college course to Marvelous High School students and describe how this innovation influenced their predisposition to go to college.

The theoretical framework includes Constructivist theory, Student Development Theory (Chickering, 1969), and the General College Choice Model (Hossler & Galagher, 1987) will establish a fundamental understanding of the study and inform all aspects. This research thus follows the theoretical framework to investigate the decision-making styles and the factors that influence undecided senior high school students choosing a post-secondary academic path and career.

Accelerated Learning High School Programs in Educational Institutions

The accelerated learning programs were developed to allow high school students to earn college credits while still in high school. Among the programs implemented around the US, DE programs allow high school students to interact with actual college students and instructors. Following a college syllabus provided a sense of affiliation with post-secondary education. The accelerated learning programs will be discussed next, first (a) DE programs and then (b) other types of accelerated learning programs.

Dual Enrollment Programs

The offering of DE programs started in the latter decades of the last century in all states leading to more than one million students enrolled in DE courses (Andrews, 2001; Fergusson, 2004). The definition and the historical and current implementation of DE programs that include the delivery location of DE programs, the socio-economic status of the high school population enrolled in DE programs, and the level of preparedness of the instructors of DE programs are presented next.

The Definition of Dual Enrollment Programs

Hoffman et al. (2009) defined DE programs as programs that "allow high school students to enroll in college-level course work and earn credit for it while they are still in high school" (p. 45). However, this definition did not make a distinction between location delivery and instructor employment. In this study, DE courses are defined as courses taught by high school teachers that meet the college qualifications criteria and also provide the high school students credit for both college courses and high school course, and a challenging academic experience following academic rigor imposed by the credit criteria required by a college (Karp & Hughes, 2008; Rivera et al., 2019). This definition focuses on the opportunity of students who follow a college syllabus of earning both credits while they are still in high school without having to take a standardized test to earn the credits (Karp & Hughes, 2008; Rivera et al., 2019; Tobolowsky & Allen, 2016). The focus of this study is on courses that are taught inside the high school campus under the same academic rigor, content structure, and design as the same courses offered in the college campus within the state while both the college and the high school administration handle the courses' integrity (Bowling, 2015). A distinction between dual credit, dual-

enrollment, or concurrent enrollment that existed for decades (Andrews & Marshall, 1991; Gerber, 1987; Mokher & McLendon, 2009) needs to be made since in some studies, DE and dual credit terms are used interchangeably (Radunzel et al., 2014).

Historical and Current Implementation of Dual Enrollment Programs

The history of DE implementation started in the late 1970s in Minnesota and became common in early 1990, increasing to more than two million by the 2010-2011 school year. In 2019, forty-seven states and Washington DC had regulations and statutory provisions to govern statewide DE programs (Bowling, 2015; Giani et al., 2014; Hoffman et al., 2009; Karp & Hughes, 2008; Rivera et al., 2019).

DE courses may be taught in different locations, including a community college campus, high school buildings, or delivered online (Arnold et al., 2017; Gagnon & Mattingly, 2016; Hoffman et al., 2009; Karp & Hughes, 2008; Nguyen, 2015). So, when the delivery location is high school buildings, the college instructors are asked to oversee the high school teachers hired as adjuncts. They need to know what textbook to use, learn the course logistics, and follow the college standards and expectations (Hughes, 2010).

The economic status of the high school population is playing a role in enrollment in DE programs that offer a quick pathway to an Associate degree or a bachelor's degree. The national record of students enrolled in dual enrollment programs shows that 60 percent are low-income students (Gagnon & Mattingly, 2016; Hoffman et al., 2009; Taylor, 2015). So low-income students seemed to benefit the most regarding the number of college credits earned.

Mainly, two-year community colleges that offer associate degrees are the preferred destination for those enrolling in DE courses since the credits are already in place by students' secondary education graduation (Anderson, 2010; Hoffman, 2005).

However, the level of preparedness of the instructors of DE programs is a concern for scholars who are skeptical about the value of the credit earned through dual enrollment courses taught by high school teachers (Clark, 2001; Johnstone & Del Genio, 2001; Karp et al., 2004). In some states, DE courses are delivered by college instructors or teachers who qualify for college hiring standards and demonstrate readiness to serve as college adjuncts, states like Missouri require the submission of annual reports about the DE teacher's qualification (Hughes, 2010; Karp et al., 2004; Kim & Bragg, 2008). Other states, like Wyoming, allow for any secondary teacher to teach DE courses. In contrast, states like Oklahoma, Oregon, and Tennessee do not require the same credentials from high school teachers who teach DE courses as the college faculty have (Clark, 2001; Karp et al., 2004). So the critics of teacher preparedness at the secondary level cited by Guzy (2016) need to re-examine their pedagogical practices and help to recruit dynamic teachers that did not lose their desire to teach. Otherwise, DE courses might not be accepted as college-level courses (Karp et al., 2004).

Other Types of Accelerated Learning Programs

Other types of accelerated learning programs that bridge secondary and post-secondary education are Advanced Placement (AP), International Baccalaureate (IB), Tech Prep, Early College High Schools (ECHS), Middle College High Schools (MCHS), College Level Entrance Program (CLEP), and DE Pathway that is an extension of DE programs (Anderson, 2010; Hoffman et al., 2009).

The delivery of the AP or IB learning programs is made by specially trained teachers certified for teaching AP or IB subjects. The Tech Prep encompasses two years of high school and two years of a post-secondary education leading to appropriate employment or further education. The CLEP is proctored and graded by college instructors, colleges administer MCHS, and the teachers need to demonstrate readiness to serve as college adjuncts. ECHS is located near or on college campuses, using a mix of DE courses, AP, IB, and Tech Prep learning programs (Gagnon & Mattingly, 2016; Gruman, 2013; Waits et al., 2005). DE Pathway is an extension of DE programs, take place in high school locations, students are graduating with one to four semesters worth of college credits (Anderson, 2010; Bishop-Clark et al., 2016; Duncheon, 2020; Gagnon & Mattingly, 2016; Gruman, 2013; Hébert, 2001; Hoffman et al., 2008; Hughes, 2010; Valdez, 2012; Vargas, 2010; Waits et al., 2005).

Factors That Influence Enrollment in Postsecondary Education Institutions

This study focuses on identifying the DE students' perceptions about post-secondary education. Identifying both beneficial and detrimental factors that influence the enrollment in post-secondary education helps to understand the level of awareness and the influence that DE courses have regarding the student's decision to pursue a post-secondary education path. Students' perceptions also include the challenges and contributing factors they perceive as helping or hindering their future educational goals.

In this section, the enrollment in post-secondary education will be discussed in the following sequence: (a) enrollment in community colleges, (b) enrollment in a four-year post-secondary educational institution, (c) student's perception of post-secondary education institutions, (d) student's perception of accelerated learning programs, (e)

research methods of student's perception of post-secondary education institutions and dual enrollment programs.

Factors for Enrollment in Community Colleges

Attending a DE course at a Technical College would provide students with opportunities to enroll in a two-year college. The students might encounter beneficial factors as well as detrimental factors when deciding to enroll.

Beneficial Factors

Among the beneficial factors that lead to enrollment in community colleges is that students do not need to reapply once they receive the college credit at the end of the DE program and finish high school, “they can go right on in the host community college” (Hoffman et al., 2009, p. 46). The DE program is closing the gap between high school and college. The pursuers of Associate Certificates need fewer semester credits to gain accreditation (Arnold et al., 2017; Hoffman et al., 2009; Jones, 2014; Kanny, 2015; Karp & Hughes, 2008; O'Gara et al., 2009).

Detrimental Factors

Detrimental factors that deter students from enrollment in community colleges include the financial need to work, the fear that college is not for them, and the desire to stay local (Anderson, 2010; Chenoweth & Galliher, 2004). So, students may not participate in DE programs if they need to pay for DE courses. Students from low-income families who participate in DE programs make arrangements with the school's administration to help students in need financially, but once the DE program is growing, the schools shift the burden to students (Karp et al., 2004; Morest & Karp, 2003).

Factors for Enrollment in a Four-Year Postsecondary Educational Institution

Attending a DE course would provide students with opportunities to enroll in a university or might deter them from doing it. Struhl and Vargas, 2012 found that economically disadvantaged students were 2.41 times more likely to attend a university compared to 2.03 for those who were not economically disadvantaged, but when analyzing the nature of DE courses, some courses such as vocational, foreign language, and physical education are not as beneficial as ELA and math courses and have more positive outcomes. There are beneficial and detrimental factors for enrollment in a four-year postsecondary educational institution.

Beneficial Factors

Beneficial factors that lead to enrollment in four-year colleges consist of DE programs' opportunity to earn one to two years of credit toward a bachelor's degree tuition-free (Farrell & Seifert, 2007; Hoffman et al., 2009; Struhl & Vargas, 2012). In some states, students who take DE courses through a university earn college credit via transcript. In contrast, those who participate in DE courses at a technical college must take additional exams that validate the dual credit if they need to transfer to a university (Karp et al., 2004). These differences in credit-earning validation lead to a preference for a university DE program versus a DE technical college program. Struhl and Vargas, 2012 found that economically disadvantaged students would benefit more than those without economic challenges.

Detrimental Factors

Students that attend other colleges that offer undergraduate programs are making attempts to transfer their dual enrollment earned credits. However, their credits are not

always accepted since some colleges are highly selective institutions or out-of-state colleges that do not accept dual credits. Some students attend private institutions, enter the military, or start working (Anderson, 2010; Hoffman, 2005; Jordan et al., 2006; Struhl & Vargas, 2012).

On the other hand, an important detrimental factor that deters from enrollment in four-year colleges is the cost of tuition and the fees associated with living on the college campus. College affordability and the student loan debt crisis bring dual enrollment to the front and center in the discussion (Davidson et al., 2020; Denning, 2017). Therefore, students from low-income, rural areas prefer to stay at home, enroll in a local technical college for two years, transfer their credits to a four-year college, and minimize the after-college tuition debt.

Definition of Student's Perception

Student perception is defined as the ability to become aware of the academic preparedness for post-secondary education and their attitude toward the post-secondary education viewed through the lenses of the DE program. (Anderson, 2010; Chenoweth & Galliher, 2004). The awareness allows students to describe precisely how the "DE strengthened their study skills/habits, writing skills, reading skills, math skills, technical skills, computer skills, and critical thinking skills" and prepare them for college (Anderson, 2010, p. 9). By recognizing how their experience in DE courses influences their educational goals, students' perceptions can be defined concerning the career opportunities post-secondary education offers and the improved standard of living (Artman, 2017; Lile et al., 2018). For this study, student perception of post-secondary education is defined as the level of awareness, lack of, and the influence that DE courses

have regarding students' decision to pursue a post-secondary education path. It includes the challenges and contributing factors they perceive as helping or hindering their future educational goals.

Student's Perception of Accelerated Learning Programs

Participants in Accelerated Learning programs (ALP) were reporting that instructors teaching students in ALP are using new approaches that involve group projects, small groups cooperative learning, and presentations (Birkholz, 2004). The perception that ALP offers an opportunity to learn in small class sizes that allow for individual attention had a score of 4.43 on a scale of 1 to 5, and the use of the internet during class time to enhance course content had a score of 3.44 on the same scale being positive aspects reported by ALP participants (Birkholz, 2004). Students enrolled in DE programs offered at the college campus had higher educational aspirations, contributing to their decision to enroll in post-secondary education and giving them the freedom to grow academically and socially. Even if they took classes in a high school location, they had the feeling that they had an advantage during their freshman year because of the experience gained in the DE program (Anderson, 2010; Artman, 1989; Azimzadeh et al., 2015; Duncheon, 2020; Kinney, 2018; Lile et al., 2018; Woodcock & Beal, 2013).

Some studies report that students were not entirely satisfied with the DE experience when the courses were taken on college campuses, feeling isolated from the rest of the students, being judged by classmates, and report discomfort because of the lack of familiarity within this context of learning. The high amount of work, commuting to college, and the high pressure added stress to students' daily lives even though many agreed that it was worth it (Azimzadeh et al., 2015; Kanny, 2015; Smith, 2007). By

taking away the commuting time to college, and the pressure the students feel when being classmates with college students, I expect that students' perceptions about college would change. The lack of evidence of students' perception of technology-enhanced courses in ALP is a gap in the literature.

Research Methods for Students' Perceptions

Research findings of studies like those conducted by Peterson et al. (2001) focused on DE programs to learn about student perceptions of DE programs and student's decision to attend college, confirmed student's satisfaction with the DE courses, while Kim and Bragg (2008) mention that Nitzke's (2002) study concluded that the DE program had a negative impact on students' completed credits. Karp et al. (2007) raised the issue about the lack of research that controls some unmeasured characteristics. Therefore, the authors like Kuh et al. (2007) and McClanahan (2004), who focused on post-secondary students' success, examined DE students' academic outcomes in Florida and New York, concluding that low-income students were more likely to enroll in college as a result of DE program participation. Various research methods were employed in studies that researched the student's perception of DE programs, and next, the quantitative, qualitative, and mixed methods used in similar studies are presented.

Quantitative methods such as the Central Wyoming Accelerated College Education (ACE/BOCES) Student Follow-up Survey were given to students to test null hypotheses using chi-square analysis on blinded, archival data. In other quantitative studies, the participants completed anonymous classroom questionnaires administered by teachers or administrative assistants. Two groups of hypotheses using chi-square

analyses, analysis of variance, and logistic regression were tested (Anderson, 2010; Chenoweth & Galliher, 2004).

Qualitative studies involved an analytic induction model in examining how the students' perceptions were influenced. Case studies allowed the interpretation of the DE settings based on the views of its participants. The interview questions were tested for unclear questions or bias with a sample of a group of students. Interpretive Qualitative studies included interviews of program administrators, students, and parents. Site observations of classes and offices, as well as document reviews, were conducted. The emailed survey set up similar to a semi-structured interview sent to a group of demographically diverse students collected data for qualitative studies (Burns & Lewis, 2000; Ferguson, 2014; Lewis, 2009).

Mixed methods research was also used to study the students' perceptions of DE programs. Surveys containing close-ended and open-ended questions were meant to gather demographic information and student participant experiences and perceptions of dual-listed courses. A descriptive study used a mixed methodology to analyze the quantitative data, the researcher employed descriptive statistics, and qualitative responses were analyzed through coding and counting the data. Quantitative and qualitative results were compared and contrasted to help establish the validity of the reported results (Diggs, 2013; Kinney, 2018). Action research mixed-method studies included workshop sessions, initial assessment, and surveys at the end of the sessions. Data analysis included data reduction, data display, and conclusion drawing. Action research studies also used a semi-structured group interview process on a group of participants selected using a purposeful sampling technique (Balassiano et al., 2014; Midcap, 2003).

The Effectiveness of Dual Enrollment Research Program

The effectiveness of the dual enrollment program is influenced by the location, instructor's preparedness, and socio-economic status of the high school population. In this section, dual enrollment will be discussed in the following sequence: (a) DE program effectiveness, (b) influence of location on the enrollment in DE programs, (c) research methods of DE programs.

Benefits of Dual Enrollment Program

The beneficiary of DE programs includes students from rural and low-income areas, Piontek et al. (2016) and Karp and Hughes (2008) mentioning that students from those areas do not always have AP certified teachers. However, the proximity of technical college campuses offer them opportunities to take DE courses in college campuses or high school building with college-certified adjuncts. Gagnon and Mattingly (2016) and Klopfenstein (2004) found that rural high schools are less likely to offer AP courses. Therefore, the DE enrollment programs are a viable option for students from rural areas. Students enrolled in DE programs in small towns that are far away from college campuses, according to Hoffman et al. (2008), benefits the taxpayers since the students are on a pathway of receiving a certificate quickly and entering the labor market with a credential to contribute to the economy and pay taxes.

Critics of Dual Enrollment Program

Critics of DE programs like Andrews (2000) and Johnstone and Del Genio (2001) were afraid that the quality of the college courses offered on college campuses might decline since high school students would influence the academic environment (An, 2013; Giani et al., 2014). Other critics favored keeping the AP programs because the DE lacks

standardization, being difficult for four-year colleges' admissions to make a correct judgment on the rigor of some DE programs, Karp et al. (2004) mentioning that some states are regulating the DE programs by requiring high school students to attend the DE enrollment classes with matriculated college students. The screening process, individualized advising, and coursework diversity are among themes discussed by Artman (1989), concluding that DE programs should make changes regarding the lack of advising and course limitation. Kanny (2015) mentions the negative impact of DE courses on students' GPA when failing courses because of the leniency from structured high school courses that students gain while taking college courses. With all critics raised by Artman (1989) and Kanny (2015), the overall conclusion of both studies is that the experience of taking dual enrollment courses was helpful and meaningful to their future college success.

Influence of Location on the Enrollment in Dual Enrollment Programs

DE programs are being offered in rural areas, urban small-towns, or urban high-density population locations. Each location influences the DE program differently because of the multitude of factors specifics to each area.

Rural high school students going to college are usually disadvantaged (Gagnon & Mattingly, 2016; Lapan et al., 2003; Yan, 2002). DE programs offer the opportunity to receive college credits before graduating from high school, which is one option for rural students to overcome these factors. The exposure to academic rigor and the college environment provides incentives to continue post-secondary education (Gagnon & Mattingly, 2016; Hoffman et al., 2008; Lapan et al., 2003; Lochmiller et al., 2016). Because of the better success with the rural high schools, Gagnon and Mattingly (2016)

and Lochmiller et al. (2016) concluded that DE programs have a better penetration in rural high schools than AP and IB programs. Therefore, the rural settings are not a barrier to the DE programs.

Most of the research studies done on the participation of rural high school students in DE programs are focused on specific states, Bailey et al. (2002) Wisconsin, Bowling (2015) Kentucky, Johnson and Brophy (2006) Washington, Fergusson, (2010) South Carolina, Robinson (2015) Louisiana, Yan (2002) Pennsylvania. Their findings suggested that the students felt the DE programs positively influence their post-secondary aspirations if there is a connection between their career goal and the coursework offered. Washington's State "Running Start" DE program that started in 1990 was a source for a few research studies, Johnson and Brophy's (2006) study focused on rural high school participants, concluding that the DE program "provides a way to broaden and enhance their academics" (p. 30). Other studies done on rural high school students focused on the transition between high school and secondary education for students enrolled in DE programs, concluding that courses provided in DE programs have not been able to be previously provided by rural high schools due to lack of preparation of teachers or budget shortfalls (Alliance for Excellent Education, 2010; Bailey et al., 2002; Karp et al., 2007). Research on rural students enrolled in post-secondary education confirmed that they attended DE programs in various forms while enrolled in high school, Gibbs (2000) and Karp et al. (2007) finding that low-income students receive tremendous success as participants in DE programs.

Students from urban small-town schools going to college may see the DE programs as a substitute for AP courses. In isolated communities, online learning is the

option for gifted students who do not have access to AP courses due to school size and staffing capabilities (Gagnon & Mattingly, 2016; Schaefer & Rivera, 2016). So, DE programs offered by local technical colleges might be a better option for online learning since DE offers better contact with the college's academic rigor.

Minority students and low-income students are positively influenced in their decision to go to college by participation in DE programs, as Johnson (2013) revealed, Haskell (2016) and Johnstone and Del Genio (2001) justifying it by the decreased time to completion needed for a Bachelor's degree. Studies that contradict these findings provide conflicting evidence that students of color enrolled in DE programs were just as likely to enroll in college as others (An & Taylor, 2019; Speroni, 2011).

Research Methods of Dual Enrollment Programs

Literature exploration on how DE programs affect students' perceptions about post-secondary education leads to studies that employ various research methods. Studies provide evidence about explorative qualitative methods, quantitative methods, or mixed methods. Different techniques used by researchers are presented next.

Common quantitative methods for this type of study were collecting data from surveys like the one developed by the National Alliance of Concurrent Enrollment Partnerships (2009), similar to the one used by Anderson (2010). Testing the null hypothesis, comparing test scores before final test grades of DE and non-DE students using an unequal variances t-test and ANOVA to study differences in the final course grade where steps used by Arnold et al. (2017), Ganzert (2012), and Gatlin (2009). A quasi-experimental analysis of students matched with control group students is another example of quantitative methods (Giani et al., 2014).

Qualitative studies about DE programs were conducted using an analytic induction model, ethnographic study, or case-study design. Bowling's (2015) ethnographic study has all seven characteristics categorized by LeCompte and Schensul (1999). The ethnographic study takes place in a natural setting with face-to-face interactions that accurately reflect participants' perspectives. Inductive, interactive, and recursive data collection from multiple data sources and analytic strategies build local cultural theories, framing all human behavior and belief within a historical context. The interpretations of the results were made through the concept of culture lens. Burns and Lewis's (2000) study used the analytic induction method, selecting appropriate subjects and interviewing them regarding their experiences in the co-enrollment program. Data is classified using the perspectives held by subjects, a technique discussed by Bogdan and Biklen (1997). Artman (1989) and Ferguson (2014) used a case-study model with a pilot study, site and phone interviews, artifacts reviews, and direct site observations, providing knowledge about individuals and organizations, using the researcher as the primary research instrument.

Mixed method action research studies using causal-comparative research design, mixed methods longitudinal studies, or action research using mixed research methodology were used to study the effects of DE programs (Bailey, 2017; Cygan, 2014; Diggs, 2013; Donham, 2005; Fletcher, 2018). Cygan (2014) used an explanatory mixed methods design to collect qualitative data after the quantitative phase to explain the quantitative data in greater depth. Wang et al. (2020) analyzed data using Jeffreys's Amazing Statistics Program **(**JASP**)** software.

Technology Integration and Mathematics Education

Technology integration in education includes using technology as a tool with which students learn instead of learning from it, enhancing instruction and learning as students' motivation and engagement are amplified (Rykard, 2020; Sang et al., 2011). In this section, the technology integration on education will be discussed in the following sequence: (a) math education benefiting from technology integration, (b) methods used to research technology integration on Math Education.

Math education benefiting from technology integration

Technology integration in math education has many definitions, according to the specifics of each research study and the need for an in-depth explanation for a better understanding of the affordances and constraints in teaching math with technology.

Definition of Technology Integration

Kopcha et al. (2020) identified the technology integration means as the quest for technology integration (Ertmer, 2005), in which researchers differentiated the use of technology as student-centered vs. teacher-centered (Cennamo et al., 2010; Hixon & Buckenmeyer, 2009; Hughes et al., 2006; Moersch, 1995; Puentedura, 2014; Reinking, 1997; Salomon & Perkins, 1996). Others focused on the class environment and the support of the teachers for integration of the technology in their daily routine (Baylor & Ritchie, 2002; Ertmer, 1999; Ertmer, 2005; Hew & Brush, 2007; Zhao et al., 2002). Researchers focus on determining if technology integration would help learners build new knowledge upon the foundation of traditional learning (Inan & Lowther, 2010a; Jonassen et al., 2008; Mueller et al., 2008; Sang et al., 2011). In this study, technology integration is defined as the use of technology as tools to achieve skills that include

critical thinking, reasoning, interpretation, perseverance, synthesizing information, and analysis that would help them to solve real problems by collaborative learning (Bransford et al., 2000; Ertmer & Ottenbreit-Leftwich, 2010; Jonassen et al., 2008; Koh, 2019). The on-site support and the shift from evaluating the quantity of technology towards the quality of the results are also part of the successful integration of technology (Ertmer, 1999; Hadley & Sheingold, 1993; Lei, 2010; Lei & Zhao, 2007).

Integration of Technology in Mathematics

Researchers were interested in finding if attending professional development is necessary to help teachers integrate technology in their classrooms and build necessary skills (Er & Kim, 2017; Lowther et al., 2008; Martin et al., 2010; Mouza, 2009; Wang et al., 2014). Lavicza (2010) reviewed the aspects of technology integration in post-secondary education math courses from the very beginning. The invention of computers led to a crucial change in math classes and in how math is taught (Kaput, 1992). Dubinsky (1996) and Strasser (2008) identified the benefits of technology integration in math classes that led to new methods of studying computational algebra, statistics, and computer science. The Technology Principle was formulated by the National Council of Teachers of Mathematics (2000). The high cost was a barrier, and technology integration in schools was limited, which was only a temporary situation (Kaput, 1992; Paola, 2008; Rubin, 1999). In many countries, governments approved additional funding to provide new technology in math classes leading to the rapid integration of technology on all levels of education (Hawkridge, 1990; Kaput, 1992; Steen, 1988). Computer Algebra Systems (CAS) is a relevant example of how technology was integrated into math classrooms (Lavicza, 2010). Allen et al. (1999), Ruthven (2007a), and Laborde (2002)

identified some obstacles provided by the fact that math classrooms are lecture friendly and movement to computer labs is disrupting classroom routines. Monaghan (2004) found that teachers feel obligated to stay the whole period in the labs even though they needed the CAS for only a short period, but Laborde (2002) suggested that this leads teachers to become courageous in integrating more technology and allowing the students to use more technology. Leonard and Leonard (2006) identified constraints on integrating technology such as unwillingness or lack of technological ability on behalf of the teachers. Cuthell (2006) found a strong correlation between computer technology and students' engagement and improvement in mathematics. McCulloch (2018) noted that teachers participating in his research started to integrate technology when they felt that was beneficial for a particular lesson, depending on the time, topic, and their ability to manage the activity with graphic calculators or Virtual Manipulatives, Desmos, GeoGebra, Fathom, TinkerPlots, Kahoot!, Quizlet, Mastery Connect and many other computer programs. Therefore, since the invention of computers, the number of tools used to integrate technology in math classes has increased, and applications' ease of use and success in helping students learn math increases faster every day (McCulloch, 2018).

Affordances and Constraints in Teaching Mathematics with Technology

Affordances and constraints in teaching mathematics with technology lead teachers to a critical issue they have to solve regarding integration. The acquisition of technology without knowing how and why to use it does not lead to effective technology integration but instead inhibits it (Hew & Brush, 2007; Polly et al., 2010; Roblyer, 1993).

In the discussion of affordances when implementing technology in mathematics classrooms, Brown (2004), Brown and Stillman (2014), and Gresalfi (2013) pointed out

that an affordance is an opportunity for interactivity between the teachers and students and the technology for some specific purposes while strong affordances are required in order for students to engage critically when they have a reason to do so. The initial considerations of the strength of affordances need to be grounded in pilot analysis, followed by larger-scale studies. Brown (2005) mentioned that in a teaching and learning environment that incorporates new technology, the affordances would level the environment's offerings.

Methods Used to Research Technology Integration on Math Education

Common quantitative methods were collecting data from surveys and testing the null hypothesis, comparing test scores before final test grades of DE and non-DE students by using an unequal variances t-test and ANOVA to study differences in the final course grade. Bailey (2018) and Sahli (2017) analyzed the results using factorial analysis of variance (ANOVA) to determine if there was a statistically significant mean difference between two groups or within each group. Bowen and Peterson (2018), Bray et al. (2015), Fabian et al. (2018), and Guerrero et al. (2016) used a paired-samples t-test to determine whether there was a statistically significant mean difference of the academic achievement between the pre-and posttests on an algebra concept or to identify gains in subscales scores. Quasi-experimental analysis where students were matched with control group students is another example of quantitative methods used to measure technology integration's longitudinal effect (Bicer & Capraro, 2016).

Qualitative studies about technology integration in math education were conducted using an analytic induction model or case-study design. The researchers rely on individual or group interviews, classroom observations, and documents that include

syllabi, lesson plans, handouts, PowerPoint presentations, and student artifacts (Chen, 2008; Erduran & Ince, 2018; Kaleli-Yilmaz, 2015). McCulloch (2018) collected data from semi-structured interviews. So, using qualitative methods leads to units of analysis, divided into themes that emerged after the coding process, discrepancies being resolved by the research team, revisiting the research questions, and identifying themes that address each question.

Hughes (2005) employed a mixed-methods research design to examine the role of teacher knowledge and learning experiences in technology integration practices, while Wachira and Keengwe (2011) use it to investigate the urban teacher's perspectives on barriers hindering technology use in math classrooms. Kalonde (2017) used a concurrent mixed-methods to collect data and analyze it. Lavicza (2010) used a constant comparison method to identify patterns among teachers' practices through interviews and qualitative survey data, HyperResearch software, and Structural Equation Modeling techniques to uncover influences on Computer Algebra Systems (CAS) integration with Asset Management Operating System (AMOS) software.

Summary

One of the main themes of this chapter was the influence of dual enrollment programs on student decision-making regarding the pursuit of post-secondary education. This chapter discussed the following topics: (a) accelerated learning programs developed in secondary or post-secondary US educational institutions, (b) factors that influence enrollment in post-secondary education institutions and students' perception of post-secondary education institutions, and (c) how the technology integration on education was conducted.

This literature review looked at the impact of DE programs on high-school participants regarding their perception and preparedness for college. First, DE programs are defined. The focus of this study is on courses that are taught inside the high school campus under the same academic rigor, content structure, and design as the same courses offered in the college campus within the state while both the college and the high school administration handle the courses' integrity (Bowling, 2015). Distinctions between Dual Credit (DC), DE, or concurrent enrollment that existed for decades (Andrews & Marshall, 1991; Gerber, 1987; Mokher & McLendon, 2009) were made since in some studies, DE and DC terms are used interchangeable (Radunzel et al., 2014).

The extant research reviewed indicates that students enrolled in DE programs offered at the college campus had higher educational aspirations, contributing to their decision to enroll in post-secondary education and giving them the freedom to grow academically and socially. The location does not influence their perception of post-secondary education. Even if they took classes in a high school location, they had the feeling that they had an advantage during their freshman year because of the experience gained in the DE program (Anderson et al., 2010; Artman, 1989; Azimzadeh et al., 2015; Duncheon, 2020; Kinney, 2018; Lile et al., 2018; Woodcock & Beal, 2013). DE eases the transition from high school to college while clarifying students' understanding of academic achievement and rigor, required skills, self-identification, and job opportunities. Students from a rural setting were able to adapt to the structure of college coursework of a DE program and learn the role and the benefits of being a college student. Advantages such as college tuition savings, job opportunities, and academic achievement outweighed the stress and the pressure brought by the rigor and a large

amount of DE coursework (Azimzadeh et al., 2015; Lile et al., 2018). DE courses' experiences and opportunities to underrepresented students in urban settings allowed the participants to graduate from high school with college credits, which the literature search suggests promotes successful future participation in post-secondary education (Duncheon, 2020; Kinney, 2018; Schaefer & Rivera, 2016).

It was concluded that acquiring technology without knowing how and why to use it does not lead to effective technology integration but instead inhibits it (Hew & Brush, 2007; Polly et al., 2010; Roblyer, 1993).

CHAPTER 3

METHODOLOGY

The purpose of this mixed-methods action research study was to investigate the impact of new technology-enhanced Dual Enrollment math courses on student perception of college courses, post-secondary education, and students' perception of Dual Enrollment courses. The study's research questions are as follow:

1. How does participation in a technology-enhanced DE course influence high school students' perception of college courses?
2. How does participation in a technology-enhanced DE course influence high school students' intention of going to colleges?
3. What is the student's perception of the DE math course that they participate in?

Research Design

This study uses an action research approach defined by Mertler (2017), linking action and research by critical reflection. The fact that this study took place in my classroom and the application and benefits of the research were contextualized within a teacher's classroom fit into the definition of action research that is a systematic inquiry into the educators' practices, which allows the study of their classroom to gain rich understandings of their teaching environment and methods used and to increase the quality of their actions and the results (Mertler, 2020; Schmuck, 1997). I conducted this action research, a practitioner in the classroom, for myself, to solve a real school situation

and find the answers that I knew would work in my school with my students, research that transformed teaching inside the organization (Mertler, 2020). Being a systematic inquiry into my own practice that leads to educational transformations inside the classroom (Johnson, 2008), this study sought to enhance the stakeholders' lives (Mills, 2018). Action research, as mentioned by Mertler (2020), is not a "haphazard trial-and-error exercise or stabs in the dark" (p. 3). The systematic inquiry follows specific steps, starting with identifying a problem that needs to be corrected, collecting data, analyzing and interpreting the data, and making a practical data-informed decision that "lead to highly effective professional growth" (Mertler, 2021, p. 4).

The objective of action research is to find solutions to problems that appear in a specific context, during a teaching-learning process at my worksite and maybe sampling only the students from a class, trying not only to achieve knowledge of the world but making the world better (Kemmis, 2010). The benefits of an action research study are in the findings of the study in a way that improves one's practice and provides a better understanding of the context in which one is working and can immediately be used to produce valuable knowledge to other educators, as compared to traditional research where a large sample is required. A theory is developed as a result of the study, and the theory has extensive applicability. The action research approach is determined by the need to have instant access to the research findings and to inform the stakeholders about the benefits of the change while making the action research part of educational reform rather than a scholar's obsession (Mills, 2014)

The purpose of this research was to remodel the practices of teaching DE math courses at MHS, help the administrators and colleagues understand the importance of

change, and explain the conditions under which the new practices take place. Since the purpose was to inform educators within the same organization, it aligned with the definition of action research given by Kemmis and McTaggart (1986) that stated action research aims to understand and change practices and the surrounding conditions.

Since the study would transform practices at MHS, the action research was viewed as a practice that can shape other practices (Kemmis, 2007). This study focused on bettering education practices, but some consequences might be unsustainable for professionals involved in the process. Carr and Kemmis (1986) would classify this action research as practical action research since professional interest is to be educated to act more knowingly and carefully. The Aristotelian practical philosophy was replaced by the action research paradigm that required "a research methodology appropriate to the social scientific study of action" (Carr, 2007, p. 432), improving the practice by meeting the need of the professionals.

The cyclic nature of the action research allows the approach to be adjusted when inquiry reveals patterns and other directions. Being characteristic of the action research, the cyclic process that repeats until a sufficient understanding of the research question is achieved provides a more profound understanding moving through several interventions and evaluations (Mertler, 2019). The advantage of using action research is given by the fact that such a study is not focused on testing theories but instead is designed to focus on the solution-driven research results. The action research cycle is a learning cycle that has direct and evident relevance to enhance practice (Kemmis & McTaggart, 2005).

The type of design that I used was a concurrent mixed-method design (Creswell & Plano Clark, 2017) in which both quantitative and qualitative data were collected

simultaneously and had the same emphasis and "both quantitative and qualitative data neutralized the weaknesses of each form of data" (Creswell & Creswell, 2018, p. 14). For a detailed analysis of all three research questions with this type of design, I merged both forms of data that provide different types of information (Creswell & Creswell, 2018). I used the concurrent mixed-methods design for three reasons. At the general level, collecting both types of data minimized the limitations of using only a qualitative or quantitative approach; on a practical level, this method provided a knowledgeable approach to research. This method proved its usefulness at the procedural level through a complete understanding of the three research questions by explaining quantitative results with qualitative follow-up data collection and analysis (Creswell & Creswell, 2018). The advantage of using this model was integrating the two databases from both findings by doing data transformation, that is "transforming qualitative codes or themes into quantitative variables and then combining the two quantitative databases" (Creswell & Creswell, 2018, p. 220). A limitation when using the concurrent mixed-methods design was the lack of follow-up when the quantitative findings and the qualitative themes diverged because different concepts or variables on both sides were used, and the findings might be incomparable and challenging to merge (Creswell & Creswell, 2018, p. 221). This study collected both types of data from surveys and semi-structured interviews to find out if the findings from all sources converge, a characteristic of mixed-methods research design (Creswell, 2015; Springer, 2010).

Setting and Participants

This mixed-methods action research study occurred at Marvelous High School (MHS), a rural high school in South Eastern County, South Carolina. The school's total

student enrollment is about 700. Minority students (i.e., African American, Hispanics, and other underrepresented groups) make up 58% of the student population and the rest of 42% are Caucasian (U.S. News Best High Schools Ranking). MHS is considered a Title 1 school, and therefore students who enroll in DE courses have all course-related fees waived. The school offers College Preparatory (CP), Honors (H), Advanced Placement (AP), and (DE) courses taught by approximately 47 teachers, bringing the student-teacher ratio in core subjects to 26:1 in this school (SC Report Card, 2021).

The outlined research involved students from a DE math course—Mat 120-Statistics—taught at MHS during the 2022 spring semester, from January 4th until May 15th. Only students with a GPA of 2.50 or higher and who pass the community college placement test, named ACCUPLACER, were eligible to enroll in the DE course. In contrast, students in CP courses did not have such requirements. Students needed at least three math credits upon enrolling in the DE course. Six students were enrolled in the Mat 120 statistics course.

I served as an instructor. I have previously taught Probability and Statistics courses at both high school and college levels across three countries. I needed the same qualifications as all Trident Technical College (TTC) instructors to teach this college-level course. The class ran for 90-minutes per day during the whole semester. I also provided one 60-minute after-school tutoring session per week. The class setting was a regular classroom located in the math area of the high school. In the DE course, as presented in the TTC course syllabus, the students studied:

> descriptive statistics by constructing and interpreting statistical charts and tables and by computing standard statistical measures for sets of data using accepted

> statistical theorems and principles in a logical manner, work with probabilities and probability distributions by computing probabilities of simple and compound events and by solving problems dealing with the binomial distribution, normal distribution, and distribution of sample means using accepted statistical theorems and principles in a logical manner, and do inferential statistics by finding and explaining a confidence interval for a population mean and by formulating and testing hypotheses and explaining conclusions using accepted statistical theorems and principles in a logical manner (Trident Technical College Mat 120).

The DE students used the TTC math textbook, which is accessible at no charge. The school provided a Chromebook to each MHS student, and the classroom had a projector and a smartboard. A computer lab was also available, and students could loan a TI-84^{+} calculator. Students were able to go to the Media Center or move desks around the class to form small groups for group activities.

The MHS Power School system contains students' roster and grade book and records final averages for high school transcripts. The students enrolled in the DE course had access to multiple learning management systems such as Desire to Learn (D2L) and Google Classroom. The integrated learning platform D2L was only used to record students' attendance and grades. Students also had access to TTC video lessons recorded in D2L. D2L offers the option of creating quizzes and uploading projects, but these options were never used for the Mat 120 class. Google Classroom was used for daily announcements and communication with absent students since schools were closed because of the Covid-19 pandemic. Google Classroom was previously used on the traditional form of the Mat 120 course during the 1^{st} year of implementing DE courses at

MHS. When some students were in quarantine because of the pandemic, Google Classroom was essential in student-instructor communication. Students at MHS used this learning management system daily since it was the primary location where students downloaded or uploaded course materials as the South Eastern County School District required at that time.

The 2021-2022 school year began with face-to-face instruction without the option for virtual learning. The school district had a Covid Quarantine Instruction (CQI) protocol for students and district employees. The daily schedule was the regular four blocks of 90 minutes with a break of 40 minutes for lunch. Due to the Covid-19 Quarantine protocol, students placed in quarantine had access to daily classroom lessons through the Google Meet platform. The Google Classroom learning management system shared lesson notes and classroom worksheets and distributed necessary notifications to all students, especially ones in quarantine. The tutoring sessions took place through Google Meet and were recorded for future access.

Survey Participants

Survey participants consisted of all six students enrolled in the DE course. All six students agreed to participate in the study as all participants and their parents signed a consent letter to be research subjects. A description of the sample population regarding race, gender, and grade was included in Chapter 4, page 95 in the Selection and Description of Participants section. All six students responded to the survey.

Interview Participants

Data for the qualitative research part was collected from a group of six students with a similar GPA during the Spring of 2022 semester. The students were selected based

on purposeful sampling for the identification and selection of information in order to gather rich, thick descriptions with limited resources (Creswell & Creswell, 2018; Meriam, 1998; Patton, 2002). The chosen participants were presented in detail in the Analysis and Findings of this study.

Innovation

The innovation of this study was a technology-enhanced dual enrollment math course at MHS. This innovation aimed to improve the perception of students enrolled in the Mat 120 course about the college courses. The following sections present 1) the rationale, 2) the description, 30 technology tools, and 4) the design of the innovation, technology integration.

Rationale

The goal of offering the DE course at Marvelous High School (MHS) was to increase enrollment in college credit-earning classes. The student's development is influenced by seven environmental factors: institutional objectives, institutional size, student-faculty relationships, curriculum, teaching, friendships, programs, and services (Chickering & Reisser,1993.) The DE courses offer the opportunity to high school students to help in the developmental phase by getting accustomed to three environmental factors, student-faculty relationships, curriculum, and teaching. MHS started offering the DE math course because only a small student population was enrolled in AP college-earning math credit courses. In the 2019-2020 school year, MHS introduced a traditional DE math course, where the teacher directed the students to learn through memorization and recitation techniques in collaboration with Trident Technical College.

However, Hossler and Gallagher (1987) mentioned that of the three stages of college choice, “the predisposition stage has received the least attention” (p. 210). More research was needed to investigate the decision-making styles and the factors that influence undecided senior high school students in choosing a post-secondary academic path and career. Students’ proficiency may influence their perception of courses and their decision to pursue a college degree.

The 2019 US News & World Report noted that the MHS student mathematics proficiency was 69%. Nolan and Swart (2015) researched the Statistics College Course student's perception regarding the use of technology in a college math course mentioning that Mutanga's (2013) work showed that educational technology improved the educational experience of mathematics students. The use of software to practice computational skills and conduct descriptive statistics analysis and perform tests is recommended by North and Zewotir (2006). The innovation of this Action Research study was looking to find if the DE technology-enhanced math courses made a difference in student decisions and to describe their perceptions of college courses.

Description

The new Mat 120 technology-enhanced DE course was planned for the whole spring semester of 2022, starting in January and ending in mid-May. The course was taught for 90 minutes every day of the week. I was the instructor responsible for teaching the Mat 120 material and creating the new syllabus. The students met me, the teacher, in a face-to-face lecture environment that permitted real-time interaction and immediate feedback from the teacher and classmates. Due to Covid-19 restrictions, I followed the protocol imposed by the school district for the spring semester, referring to quarantine

students and class rules. Each student had to take the Honorlock Monitor Quiz during the first two weeks of school. During the Module Exams, the student's Chromebooks were in Lockdown Browser Mode, meaning they did not have access to any website except the Module Exam page. If they had to take the Exam in a remote location due to Covid-19 restrictions, their movements were monitored, and I received a report about a potential breach in Honor Code conduct at the end of the Exam.

Unlike the traditional Mat 120 course, the innovation introduced new technology tools to students and then integrated those tools in the course units. The innovation brought to this course gave students access to JASP, a graphical program for statistical analysis that allowed them to work with large, real databases. I was able to visualize questions, present the interpretations, guide students through a plethora of analyses, grade their answers, and provide homework feedback. The following sections outline an introduction of those tools and how those tools were integrated into the course.

Technology Tools

Six educational technology components were used in this course: the XYZ Homework platform, the JASP software, Microsoft Excel, educational videos created by the instructor or available at MathTv.com, TI 84+ graphing calculators with Stats apps, and the learning management system Desire to Learn.

The XYZ Homework website was used as the assignment platform, offering each enrolled student access to daily homework, video lessons, module reviews, module exams, and the final exam for the Technical College created by the TTC math department. XYZ Homework was an online instructional tool that combined online assessment for Mat 120 with MathTV.com video lessons to reinforce my class concepts.

Compared to paper and pencil homework, online homework overcomes subjectivity and provides instantaneous feedback (Mavrikis & Maciocia, 2003). Open-source online homework system has emerged as a viable alternative to the traditional PPH assignments in several mathematics-oriented subjects as reported by Roth et al. (2008), such as probability and statistics as reported by Lucas (2012) and Segalla and Hauk (2010). The students had access to randomized questions to practice. The feedback was instantaneous since students benefited from automatic grading. They had unlimited attempts to do their homework assignments, only the highest score from all attempts being recorded. After three unsuccessful attempts on one question, the platform generated a new question. Demir and Souldatos (2020) revealed that students who made more attempts had considerably higher grades on homework and on the final exam than their peers with fewer attempts.

JASP is a computer statistical analysis software that allows users to quickly analyze a real dataset from websites like Kaggle/datasets, Data.gov, UNdata, or StatWebStanford Public Data Repository that contains real data sets in CSV format. The introduction of JASP helped students conduct statistical analysis on large datasets that would be difficult and time-consuming to conduct using a TI 84+. North and Zewotir (2006) recommended "that the emphasis should be statistical reasoning in a richer context so that students with multiple interests, strengths, purposes, and worldviews, might see the beauty and understand the uses and abuses of quantitative approaches in their profession" (p. 509). When using JASP, the results can be extensively annotated. Changing the input options can dynamically change the results. The students were able to compare and adjust old results by changing the input conditions. All these options were

either not available with a TI 84+ or EXCEL or were time-consuming. Students had the option to choose any technology tool or Apps when solving the projects or during the module exams.

Microsoft Excel was used instead of hard copies of the selected necessary probability distribution tables. I provided directions on how students used Microsoft Excel to participate in statistical analysis actively. Using free statistical packages that produce probability values, “once students understand the notion of probability and know how to read tabulated probability values, topics on statistical inference can be introduced much more effectively and appreciably” (North & Zewotir, 2006, p. 510).

Videos available from MathTV.com or the videos recorded by me were available on the XYZ Homework platform or the Google Classroom's page. Compared with the traditional course, the students benefited from the videos recorded by me on how to use JASP and practice on some examples. Valenti et al. (2019) mentioned that “students were seeking more interaction, with multiple opportunities to engage with the material. While students valued text-based resources, they also wanted to have options to learn and interact via video and audio” (p.14).

The Texas Instrument TI 84+ calculators’ Statistics functions like normalpdf(, normalcdf(, invNorm(, binompdf(, binomcdf(, and tests like 1-PropzTest, 2-PropZTest were used for descriptive statistics and inferential statistics.

D2L was used in student-instructor communication. The projects were posted on the D2L Mat 120 page. Students used the D2L to upload their projects and upload snapshots of the JASP screens when practicing, allowing them to communicate with me and ask for help when needed. Considering the disruptions provided by the Covid-19

pandemic, students in quarantine could communicate with me through the D2L announcement page and the D2L discussion board.

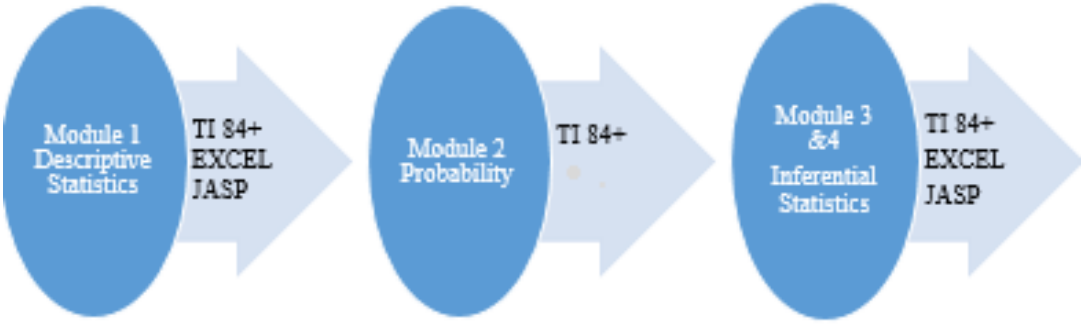

Figure 3.1 Mat 120 Pacing Guide and the Use of Statistical Technology Tools

The Design of the Innovation - Technology Integration

The technology-enhanced DE math course offered access to online materials to all class participants. During the first two weeks, I taught the first module that covers descriptive statistics to analyze samples characteristics like mean, median, mode, standard deviation, variance, range, and building of statistical charts. I created videos of how to use JASP for the course's descriptive and inferential statistics content. A TI 84+ graphing calculator was expected to be used by all students to do all calculations following the directions from the course textbook. Then students were introduced to JASP, a computer statistical analysis software. For about a week, students were able to analyze extensive authentic databases using JASP, and then take the Module 1 posttest. A project for this module was introduced and was designed to give students practice with many of the calculations and charts that they had studied in the first module of this class. The project was displayed on the XYZ Homework platform. During the project, students found a real dataset online by visiting the Kaggle website or any government-owned website that contained real data sets in CSV format. Students then used Excel to calculate

the basic statistics and create some charts based on their calculations using Excel and JASP. Using Excel is a more convenient way because students were able to open the dataset in Excel and then perform the calculations rather than type them into the TI 84+ calculator. The students took the Module 1 Exam. Compared to the traditional course when the exam was paper-based, the module's exams were online. After time ran out, their access to the test was interrupted, and the test was automatically graded.

Module 2 followed, and students learned concepts of probability, conditional probability, multiplication, additional rules, counting principles, and probability distributions. The students learned how to calculate probabilities with the TI 84+ based on a standard normal distribution with two or four inputs, as well as the inverse normal distributions and the Central Limit Theorem. A second project, named The Law of Large Numbers, displayed in the XYZ Homework platform, was assigned to all students. In this project, students explored some fundamental concepts of probability theory using the PROB SIM App from TI 84+.

Modules 3 and 4, the Inferential Statistics Modules, covered the inferential statistics that draw concussions about a population. Students analyzed samples using the TI 84+ Apps and JASP for hypothesis testing, correlation, and regression. Students used various functions of TI 84+ such as 1-PropZInt, tcdf(), or t-test or the JASP features to do the third project named Hypothesis testing, designed by the instructor and available on Google Classroom's page. Students took the Module 3 exam at the end of March and the Module 4 Exam at the beginning of May. Students had a Mid-term exam covering Modules 1 & 2 and a final exam covering all concepts learned throughout the course.

Data Collection

Mixed method action research was used to study the effects of a technology-enhanced Dual Enrollment (DE) math course on student perception of college courses and the decision to follow a post-secondary education path (Cygan, 2014; Diggs, 2013). Quantitative data was collected via student pre- and post- surveys about students' perception of college courses and DE courses and students' intention to go to college. Semi-structured individual interviews were used to collect qualitative data. Table 3.1 provides the alignment between the research questions and each data source. Before taking any steps toward collecting the data, I sought a University of South Carolina Institutional Review Board (IRB) approval of the study (displayed in Appendix A). Approval from the School district was pursued after IRB approval was obtained (displayed in Appendix B).

Table 3.1 Research Questions and Data Sources

Research Questions	Data Sources
RQ1: How does participation in a technology-enhanced DE course influence high school students' perception of college courses?	• Perception of College Courses Survey • Semi-structured Interview
RQ2: How does participation in a technology-enhanced DE course influence high school students' intention of going to colleges?	• Intention of Going to College Survey • Semi-structured Interview
RQ3: What is the student's perception of the DE math course they participate in.	• Perception of DE Courses Survey • Semi-structured Interview

Dual Enrollment Student Surveys

The survey data informed me about students' perception of college courses and DE courses and students' intention to go to college. Besides the demographic questions about their gender and ethnicity, the DE Student Surveys included three instruments, one for each research question. The DE Student Survey was divided as follows: Perception of College Courses Survey adapted after Anderson's (2010) Central Wyoming Accelerated College Education (ACE/BOCES) Student Follow-up Survey and Smith's (2015) DE and Dual Credit Perspectives Survey, Intention of Going to College Survey adapted from Diggs' (2013) Detailed Student Assessment and Smith's (2015) DE and Dual Credit Perspectives Survey, and Perception of DE Courses Survey adapted from Gatlin's (2009) Student Perceptions Toward Dual Enrollment Courses And College Preparedness, and Midcap's (2003) DE Experience Questionnaire.

Perception of College Courses Survey

The survey was used to collect students' perceptions of college courses. I adapted items from Anderson's (ACE/BOCES) Student Follow-up Survey. Student Follow-up Survey used by Anderson was based on a survey obtained from the NACEP (2009) public domain resources. The Board of Cooperative Educational Services advisory committee members modified it with NACEP approval, including additional questions. The purpose of Andersons' study was to investigate student perceptions of academic preparation and college student role preparation through participation in dual enrollment community college courses as measured by the Student Follow-up Survey.

For the purpose of the present study, I used 13 items from this survey (see Appendix F, Table F.1). I assessed how students’ perception of their DE participation

prepared them academically for college challenges. The survey measured it by applying five points Likert-type scale, and the scoring was as follows: (5) Strongly agree, (4) Agree, (3) Neutral, (2) Disagree, and (1) Strongly Disagree. A sample question with five points Likert-type scale was: “As a result of taking college courses through the DE Program, I feel better prepared academically for the challenges of college.” The original question “As a result of taking college courses through the ACE Program, I feel better prepared academically for the challenges of college” was modified because the name of the MHS program is DE Program.

In addition to the above questions, I assessed how students’ perception of their DE participation prepared them academically for college challenges with three questions I created. An expert in mathematics education who teaches the Mat 120 course at TTC reviewed the face validity of the items. The survey measured it by applying five points Likert-type scale, and the scoring was as follows: (5) Strongly agree, (4) Agree, (3) Neutral, (2) Disagree, and (1) Strongly Disagree. A sample question with a five-point Likert-type scale was: “I gained more confidence toward taking college classes after taking the DE course.”

Intention of Going to College Survey

The survey was used to collect students' perceptions of college courses. I adapted items from Diggs' (2013) Detailed Student Assessment and Smith's (2015) DE and Dual Credit Perspectives Survey. Diggs’ (2013) Detailed Student Assessment ensured that the research outcomes were reliable and valid. The author aimed to find out the level and pathways through which a DE program shifted students’ appeal to continuing with postsecondary education.

For the purpose of the present study, I used 18 items from this survey (see Appendix F, Table F.2). I assessed how participation in DE influenced students' intention to go to college. The survey measured it by applying five points Likert-type scale, and the scoring was as follows: (5) Strongly agree, (4) Agree, (3) Neutral, (2) Disagree, and (1) Strongly Disagree. A sample question with five points Likert-type scale was: “My family has always expected me to go to college.” Some items were modified due to the duration of the DE program. The question “In the past 12 months, how many times did you talk to a school official (teacher, principal, or guidance counselor) about…” was modified because of the duration of the DE program to “In the past 5 months, how many times did you talk to a school official (teacher, principal, or guidance counselor) about…”

Smith’s (2015) DE and Dual Credit Perspectives Survey was obtained from the 2009 National Alliance of Concurrent Enrollment Partnerships (NACEP) public's domain resource center, developed to assist the DE programs to meet certification standards. The survey was “adapted with permission from the NACEP Student Alumni Survey Essential Questions One Year out of High School questionnaire” (p. 32). Smith's survey sought to view past DE and dual credit students' perceptions due to their participation in DE offered to them as high school students.

For the purpose of the present study, I used four items from this survey (see Appendix F, Table F.3). I assessed how participation in dual enrollment courses influenced students' intention to go to college. The survey measured it by applying five points Likert scale, and the scoring was as follows: (5) Strongly agree, (4) Agree, (3) Neutral, (2) Disagree, and (1) Strongly Disagree. A sample question with five points

Likert-type scale was: ”By taking college classes while still in high school, I developed more realistic expectations about college.”

In addition to the above questions, I assessed how participation in DE influenced students' intention to go to college with six questions created by myself. An expert in mathematics education who teaches the Mat 120 course at TTC reviewed the face validity of the items. The survey measured it by applying five points Likert-type scale, and the scoring was as follows: (5) Strongly agree, (4) Agree, (3) Neutral, (2) Disagree, and (1) Strongly Disagree. A sample question with five points Likert-type scale was: “After taking the DE class, I am confident that I have more chances to succeed in college.” This question was an adaptation of the question “By taking college classes while still in high school, I am confident that I have more chances to succeed in college.”

Perception of DE Courses Survey

The survey was used to collect students' perceptions of college courses. I adapted items from Midcap's (2003) DE Experience Questionnaire and Gatlin's (2009) Student Perceptions Toward Dual Enrollment Courses And College Preparedness. Midcap's study investigated DE students' academic satisfaction with the program and described students' view of the DE experience. The DE Experience Questionnaire was based on Halvorsen's model developed at the Halbert Robinson Center for the Study of Capable Youth at the University of Washington. Out of the 42 questions, nine questions determined potential variables such DE information sources, barriers to DE participation, gender, age, degree goal, and the other 33 questions provided data to answer the research questions regarding academic consideration, social experience, and satisfaction.

For the purpose of the present study, I used 14 items from this survey (see Appendix F Table F.5). I assessed how students perceived their DE course. The survey measured it by applying five points Likert-type scale, and the scoring was as follows: (5) Strongly agree, (4) Agree, (3) Neutral, (2) Disagree, and (1) Strongly Disagree. A sample question with five points Likert-type scale was: "Dual Enrollment is a more positive social experience for me than high school." In Midcap's study this question had a four points Likert-type scale that was changed by me to a balanced five-points Likert scale.

Gatlin's (2009) survey was tested for reliability using Cronbach's Alpha that has a value of .857. An acceptable range of reliability coefficient is from .70 to .90" (p. 50). For the purpose of the present study, I used five items from this survey (see Appendix F Table F.4). I assessed how students perceived their DE course. The survey measured it by applying five points Likert-type scale, and the scoring was as follows: (5) Strongly agree, (4) Agree, (3) Neutral, (2) Disagree, and (1) Strongly Disagree. A sample question with five points Likert-type scale was: "The DE classes challenge me more than my standard high school courses." None of the questions used from Midcap's study were modified.

In addition to the above questions, I assessed how students perceived their DE course with one question I created. An expert in mathematics education who teaches the Mat 120 course at TTC reviewed the face validity of the items. The survey measured it by applying five points Likert-type scale, and the scoring was as follows: (5) Strongly agree, (4) Agree, (3) Neutral, (2) Disagree, and (1) Strongly Disagree. A sample question with five points Likert-type scale was: "As a result of taking the DE Mat course I had a great experience."

DE Student Pre-Survey (see Appendix C) and the DE Student Post Survey (see Appendix D) were administered to all six students enrolled in the DE math course. The first time the Pre-Survey was administered was two weeks after the class started, Then, about two weeks before the course ended, the students received the Student Post-Survey containing the same subscales that addressed the three research questions. Table 3.2 contains the item utilization for the following subscales: Motivation to enroll, Determination to enroll, Support for college enrollment, Post-secondary Readiness, Attitude toward college, Intention to enroll, Satisfaction with academic preparation, Impact of technology, and Perception of technology.

Table 3.2 Surveys Questions Item Utilization for Pre and Post Surveys

Research Questions	Survey's Item Utilized	Constructs	Subscales
RQ1: How does participation in a technology-enhanced DE course influence high school students' perception of college courses?	• (ACE/BOCES) Student Follow-up Survey (Anderson, 2010)	• Perception of College Courses	• Motivation to enroll • Determination to enroll • Support for college enrollment • Post-secondary Readiness • Attitude toward college
RQ2: How does participation in a technology-enhanced DE course influence high school students' intention of going to colleges?	• Detailed Student Assessment (Diggs, 2013) • Dual Enrollment and Dual Credit Perspectives Survey (Smith, 2015)	• Intention of Going to College	• Support for college enrollment • Intention to enroll • Motivation to enroll • Attitude toward college • Satisfaction with academic preparation
RQ3: What is the student's perception of the DE math course they participate in.	• DE Experience Questionnaire (Midcap, 2003) • Student Perceptions Toward Dual Enrollment Courses	• Perception of DE Courses • Perception of Technology	• Post-secondary Readiness • Attitude toward college • Satisfaction with academic preparation

	And College Preparedness (Gatlin, 2009)	• Motivation to enroll • Support for college enrollment • Impact of technology • Perception of technology

The DE Student Survey items were not consecutively aligned with the subscales; therefore, navigation throughout the survey was engaging. Besides, interview questions inquiring about student demographics were included at the beginning of the interview.

Semi-structured Interview

The main purpose of the semi-structured interviews (see Appendix E) was to collect data about participant experience in the DE Mat 120 course, their perception about college courses, and the influence on their intention to continue post-secondary education. I chose to do a semi-structured interview because after I asked the specific questions, I had the option to follow with another question depending on the student's response since some of them might have had difficulty expressing their opinion about the intervention. The semi-structured interview provided insight into students' opinions regarding the influence of the intervention. It allowed me to ask specific questions and provided follow-up questions that built on their answers.

I conducted the semi-structured individual interview with all six students enrolled in the DE math course during the spring semester. The students were purposefully selected because I needed to use limited resources, and I intended to yield cases rich in information (Patton, 2001). It was important for my study that the participants were available, willing to participate, and communicated the experiences in the DE course with ease and in an articulate way (Bernard, 2002). The interviews lasted approximately 40 to 45 minutes each and took place two weeks before the end of the course. The individual

semi-structured interviews took place in a relaxed setting, allowing me to ask additional questions and add to the protocol specific to each individual. I scheduled it in advance at a designated time at the end of April. Two weeks before the interview, the study participants were informed about the location, date, and time. It was organized around predetermined open-ended questions (Mertler, 2019), followed by questions that might emerge from the dialogue (Whiting, 2008). Since the meeting took place after school, the participants received refreshments. The audio-video recording was announced to the participants, as well as the fact that I would be keeping the data confidential. In case a study's participant was unable to have a face-to-face interview, we would have met via the Google Meet platform, and the meeting would have been recorded. As a backup plan, a mobile device such as a smartphone was used to audio record the interview. The interview was transcribed, and a copy was provided to the interviewee to clarify any possible misunderstandings.

The one-to-one interview was adapted from the interview protocol used in two research studies: Ferguson's (2014) "Interview questions for students" and Lewis's "Interview Questions." The three constructs that addressed the research questions were addressed by both studies and by the seven questions I developed. An expert in mathematics education who teaches the Mat 120 course at TTC reviewed the face validity of the items. First, Ferguson's (2014) Interview Questions for Students study focused on how dual enrollment programs integrated rural students' academic, social, and institutional requirements into postsecondary environments. The DE math expert and I simulated the research study using the her observation notes and my reflective notes. My pilot study was that of an interview protocol, and I used the lessons learned to design the

interview protocol that included questions about college-like experience, reasons to participate in DE, classroom experiences. The interview questions were expanded as themes emerged. A sample question that addressed Research Question 1 is as follows: "What services are provided to you in the DE program? What college services do the DE students have access? How did you get assistance with DE matters such as tutoring, course changes, questions about class assignments?" Research question 2 was addressed by questions like "What did you think about college before enrolling in DE program? After enrolling in the DE program?"

Second, Lewis' (2009) Interview questions research was a descriptive and exploratory study that examined student perceptions of the DE process. A sample question that addressed Research Question 1 is as follows: "What personal and academic characteristics do you feel a student needs to be successful in dual enrollment courses?" Research question 3 is addressed by questions like: "Describe your feelings about each of the following aspects of dual enrollment courses: a. the location of the classes, b. characteristics of students in the classes, such as age, maturity level, etc. c. overall environment of dual enrollment courses taken".

Third, the questions developed by myself, addressed the perception of college courses "How would you describe your expectations about college before enrolling in DE math course?" The intention to go to college informed me through the answers to items like "Does the technology embedded in the course (JASP, XYZ-Homework platform, Microsoft Excel, Daily video lessons, D2L) encouraged you to want to go to college?" For the third research question that was looking to describe the student's perception of the DE math course they participated in, I developed questions like: "How was

JASP/Excel/TI84+ help you analyze large databases?" In table 3.3 the alignment between the research questions and each interview question is represented along with each questions' authors.

Table 3.3 The Alignment Between Interview Questions and Each Research Question

Research Questions	Interview Questions Utilized with authors
RQ1: How does participation in a technology-enhanced DE course influence high school students' perception of college courses?	• How would you describe your expectations about college courses before enrolling in DE math course? (Myself) • How did you develop that expectation for college courses? For DE courses? (Ferguson) • What motivate you to enroll in the DE program? Follow-up question: Why not enrolled earlier? (Ferguson) • What college services do you have access in the DE program? (Ferguson) • What characteristics do you feel a student needs to be successful in DE courses? Personal? Academic? (Lewis)
RQ2: How does participation in a technology-enhanced DE course influence high school students' intention of going to colleges?	• What would motivate you to attend college? (Ferguson) • What did you know about college before enrolling in the Mat 120 DE Course? How about after completing the Mat 120 DE Course? (Ferguson) • Did you plan to go to college before participating in the Mat 120 DE Course? (Ferguson) • Does the technology embedded in the course (JASP, XYZ-Homework platform, Microsoft Excel, Daily video lessons, D2L) encouraged you to want to go to college? Follow up question: If so, how do you think that technology embedded in the Mat 120 DE Course influence your intentions? (Myself) • How did technology embedded in the Mat 120 DE Course meet your expectation of college-level courses? (Myself) • After participating in the Mat 120 DE Course, will the experience encourage you to enroll in college? Please specify why? (Ferguson)

	• What technology skills do you think that you gained/refined by taking the Mat 120 DE Course? How will those technology skills help you in college? (Myself)
RQ3: What is the student's perception of the DE math course they participate in.	• What are the differences/similarities between the Mat 120 DE Course and regular high school courses? (Ferguson) Follow-up question: describe the teaching styles you have observed in DE class compared to the high school classes. Include comments about technology used in the DE course. (Lewis) • What factors contributed to your decision to participate in the Mat 120 DE Course? (Lewis) • How helpful was JASP/Excel/TI84+ for you to do meta-analysis? (Myself) • How helpful were the XYZ videos? How helpful were teacher-made videos? (Myself) • How helpful was Microsoft Excel for you to work with large databases? (Myself) • Describe your feelings about each of the following aspects of DE course: a. the location of the class b. characteristics of students in the classes, such as age, maturity level, etc. c. technology embedded in the course. (Lewis) • Is there anything you wish would have been different about the DE courses taken? If so, describe. (Lewis) • Why, in your opinion, would a high school student refuse to enroll in a DE course? (Lewis)

Since this was a semi-structured interview, there was flexibility within the design of the original questions to allow for other questions to be asked depending on the interviewee's responses (Buss & Zambo, 2014).

Data Analysis

A mixed-method study employed qualitative and quantitative data methods such as descriptive statistics, dependent t-tests, and inductive analysis to produce themes that were used to interpret the data from both sources, the DE survey and the semi-structured

interview. The following analysis is organized to demonstrate the collected data describing both quantitative and qualitative methods used in this research study. Table 3.4 shows the alignment between the research questions, data sources, and the data analysis methods.

Table 3.4 Research Questions, Data Sources, and Methods of Analysis

Research Questions	Data Sources	Methods of Analysis
RQ1: How does participation in a technology-enhanced DE course influence high school students' perception of college courses?	• Perception of College Courses Survey • Semi-structured Interview	• Descriptive statistics • Dependent t-test • Inductive analysis
RQ2: How does participation in a technology-enhanced DE course influence high school students' intention of going to colleges?	• Intention of Going to College Survey • Semi-structured Interview	• Descriptive statistics • Dependent t-test • Inductive analysis
RQ3: What is the student's perception of the DE math course they participate in.	• Perception of DE Courses Survey • Semi-structured Interview	• Descriptive statistics • Dependent t-test • Inductive analysis

Quantitative Data Analysis

Quantitative data was analyzed using descriptive statistics and inferential statistics. This study required that I conduct action research that helped explain the impact of DE math courses on student perception of college courses, post-secondary education, and DE courses. The quantitative data was collected from the DE survey administered to students enrolled in the technology-enhanced DE math course. The data

was collected in a Microsoft Excel spreadsheet, each of the three sections of the DE survey being placed on its sheet.

For the descriptive statistics, I analyzed quantitative data using the Microsoft Excel functions and JASP computer statistical analysis software that provided information about the means, standard deviation, and the range of scores for each variable (Creswell & Creswell, 2018). Each of the three sections of the survey contained Likert-type scale questions to express their agreement with the questions asked. Scale's internal consistency was tested using Cronbach's alpha value that optimally falls between 0.7 and 0.9 (Creswell & Creswell, 2018). The reliability for each of the three sections of the survey, Perception of College Courses Survey, Intention of Going to College Survey, and Perception of DE Courses Survey, was tested, and the results for the measurement of the internal consistency are presented in the Quantitative Analysis and Findings section of Chapter 4. For the inferential statistics, through JASP, I tested a few null hypotheses using dependent paired t-tests to test the hypothesis about whether data was as expected with an alpha level of significance $\alpha = 0.05$. One of the null hypotheses sought to find if there were statistically significant differences in the perception of college courses of the students enrolled in DE math courses before and after taking the DE course.

Qualitative Data Analysis

The interpretation of the data is the key to the whole process. I used Delve, a computer-aided qualitative data analysis software to assist me in analyzing the data. The analytical method that I used was an inductive qualitative analysis where the researcher collected the data and then formed themes (Creswell, 2013). I followed a three-step

process in conducting the inductive analysis: organization, description, and interpretation (Mertler, 2019).

The qualitative data analysis involved (1) the interview's transcriptions, (2) reading through data, (3) assigning codes for each sentence of text, (4) coding the text to form themes (grouping the codes into categories first).

Each interview was recorded as an .m4a file, and then I converted them to text using the Transcribe speech-to-text option in Microsoft Word. The interviews were coded in Microsoft Word, looking for words that reflect specific actions that repeat throughout the interview (Mills, 2011; Parsons & Brown, 2002). I used the Delve platform for the two phases of the first cycle of the coding process. The Delve program assisted me in storing, indexing, sorting, and coding qualitative data (Morse & Richards, 2002). I exported my Delve files as a Microsoft Excel spreadsheet to begin the second cycle. In the Excel file, each row identified a record, and each column represented a field as compared with the original database Microsoft file (Meyer & Avery, 2009). The next step was to group similar codes into categories that have the same meaning (Saldana, 2016) and color code all participants' entries in the Microsoft Excel spreadsheet for all categories. I grouped similar codes that had the same meaning into categories (Saldana, 2016). Then, I created categories in which all codes were grouped based on similarities and differences (Esterberg, 2002). The next goal of the data analysis was to aggregate the categories into five themes (Creswell, 2013). To illustrate my findings, I integrated the voices of the study participants using verbatim quotes from the semi-structured interviews (Grant, 2004). I provided all themes and the theme-related components in a

table, followed by the participants' statements supporting each theme-related component (Bazeley, 2009).

Procedures

The procedures for this research study were divided into three phases, as presented in Table 3.5. The following timeline: Phase 1: Distribution and completion of consent forms and identification of the participants based on the completion of a voluntary questionnaire, Phase 2: Participation in DE course and administration of the Survey, Phase 3: One-to-one interviews, Phase 4: Follow up interviews and Data Analysis.

Table 3.5. Study's Procedures

	Phase 1 **Week 1**	**Phase 2** **Week 2**	**Phase 3** **Week 14**	**Phase 4** **Week 15**
Participant's Role	Complete consent and assent forms Complete the Google form questionnaire	Participate in DE course Complete the voluntary Pre-survey	Participate to semi-structured interviews Complete the Post- survey	Participate in member checking
Researcher's Role	Distribute consent and assent forms Distribute the Google form questionnaire Select the participants	Teach the DE course Administrate the Pre-survey	Conduct semi-structured interviews Distribute the Post-survey	Data analysis

In the first phase, the researcher distributed the consent and the assent forms before the beginning of the semester in January 2022. Some students could have been under the age of 18, so assent forms were needed. The DE students completed the

voluntary Google Form questionnaire that presented the study's purpose and the voluntary nature of the study. The questionnaire was open for five days. I selected the study's participants based on the answers. The second phase began once the class started in the second week of January. I administrated the Pre-survey using a Google Form as well. The survey was available for a week, and then I checked for completion for reliability purposes. The third phase took place during the 14th week of the Mat 120 course and consisted of semi-structured interviews with the study's participants and the Post-survey. In the last phase, during the 15th week, the interviews were transcribed. Additionally, members reviewed the study's transcripts, and I adjusted/clarified any misconceptions to add insight and credibility.

Rigor and Trustworthiness

When collecting qualitative data from the survey and the interviews, my concern was to ensure the research's rigor and trustworthiness. As Connelly (2016) defines it, "trustworthiness or rigor of a study refers to the degree of confidence in data, interpretation, and methods used to ensure the quality of a study" (p. 435). The results from both types of data were used simultaneously (Creswell, 2005). Conditions of rigor introduced in the definition of mixed methods research include "adequate sampling, sources of information, data analysis steps" (Creswell, 2013, p. 266). Several methods were adopted to improve the rigor and trustworthiness in this study: triangulation, prolonged time, audit trial, peer debriefing, rich and thick description, and member reflections, helping me to fortify the trustworthiness of my analysis (Mertler, 2020). Two data sources were used in this study, a survey and a semi-structured interview; to ensure the rigor and trustworthiness of this research, I used six strategies: methodological

triangulation, prolonged time, audit trail, peer debriefing, rich, thick description, and member reflections.

Triangulation

To increase the trustworthiness, I triangulated the data since I was using surveys and semi-interviews. The triangulation of multiple sources of information established the themes, and therefore, greater credibility could be gained (Creswell, 2013). Figure 3.1 shows the triangulation of three sources of data obtained from a participant named Johnny. If Johnny expressed an opinion in the survey, which he maintained during the semi-structured interview, I was more confident in the trustworthiness of the data.

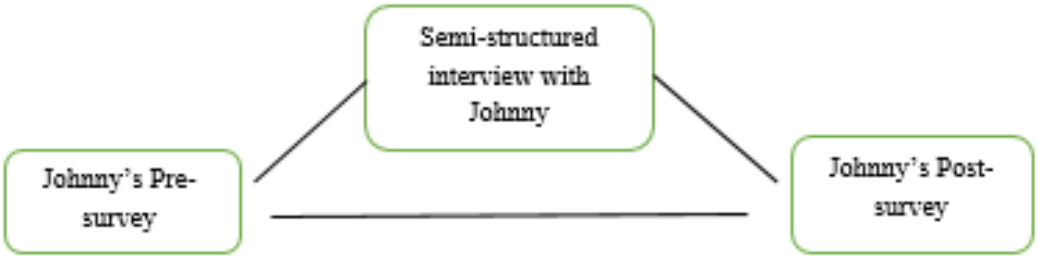

Figure 3.2 Triangulation of three sources of qualitative data for Johnny

Prolonged Time

The prolonged time spent at the study location within my school helped me develop an in-depth understanding of the school culture and population, therefore lending credibility to the study (Creswell, 2013). My frequent presence in the school and the fact that most of the participants were former students of mine helped me develop a closer relationship than usually develops between a researcher and the subjects of a typical study. I decreased the distance between the participants and me to increase the worth of findings (Krefting, 1991). Lincoln and Guba (1985) recommended shifting the neutrality of the research from the researcher toward the neutrality of the data. The prolonged

exposure may have become a threat such that I might have had difficulties separating my experiences from participants' experiences (Marcus & Fischer, 1986). As explained next, I could dissipate the threat of over-involvement in the audit trail by using a journal.

Audit Trail

In my researcher's journal, I documented the biases and decisions throughout the whole research process. By self-reflecting on how my interpretation of the findings was influenced by my gender, culture, nationality, background, and socio-economic origin, I clarified my bias to the study (Creswell, 2013). I encouraged participants to be sincere throughout the interviews, indicating that there were no right or wrong answers to my questions. Therefore, they could talk "without fear of losing credibility" (Shenton, 2004, p. 67). The journal included the daily schedule, a methods log, and notes that reflected my thoughts and feelings during the interviews, ideas, and hypotheses generated after the interviews. I documented how I collected the data, developed the codes, categories, and generated themes, and made the decisions (Merriam, 1998). The journal alerted me of my biases, helping me change my way of approaching the analysis and enhancing the credibility of the research, adding a layer of validity to my study (Lincoln & Guba, 1985).

Peer Debriefing

The scrutiny of the research study was done by experts in mathematics education, peers, and academics, as well as "feedback offered to the researcher at any presentation (e.g., at conferences) that take place during the project" (Shenton, 2004, p. 67). I met with my dissertation chair regularly in order to find answers to questions about the study and get feedback on my work (Mertler, 2019). Accepting the critique and the suggestions on how to improve my work was part of the strategy that I followed to ensure the study's

trustworthiness. When developing the semi-structured interview questions, I was working with an expert in mathematics education who teaches the Mat 120 course at TTC and another expert in mathematics who was teaching the DE course at MHS. They reviewed the qualitative part, and I answered their questions. Their perspective brought two pairs of fresh eyes that would help me avoid biases and see overlooked aspects. The interpretation beyond the researcher added validity to the qualitative part of the study, allowing me to make corrections that would not have been possible without peer debriefing (Shenton, 2014). The comprehensive review added validity and "enhanced the accuracy of the account" (Creswell, 2013, p. 252).

Rich, Thick Description

To ensure that the results reflected reality, I provided "detailed descriptions of the setting" in order to "offer many perspectives about a theme" (Creswell, 2013, p. 251). The abundance of the description painted a vivid picture of the qualitative methods used. Also, the verbatim quotes that validated the categories from which themes emerged illustrated the findings. As I better understood the significance of the qualitative data, the description expanded, becoming bigger and bigger (Gonzalez, 2000).

Member Checking

To increase the rigor and trustworthiness of the study, participants reviewed the study's transcripts from the semi-structured interview, "providing opportunities for questions, critique, feedback, affirmation, and even collaboration" (Tracy, 2020, p. 278). Member checking allowed the students to check for the interview transcript's accuracy and make the necessary changes (Creswell, 2008). After the semi-structured interview, I emailed the participants a copy of the interview transcript, allowing them to make

comments and verify the transcripts and that my interpretations reflected their thoughts. The emails were sent individually to assure anonymity. After the themes were developed, a second round of emails was sent. The response of the participants would assure me if I accurately reflected their thoughts, attitudes, and perceptions about the DE program, college courses, and their postsecondary plans during the semi-structured interview.

Plan for Sharing and Communicating Findings

In order to finalize the formal presentation and add a layer of validation to the findings, the results were first shared with all stakeholders.

Participants

The results of the study were shared with all participants through a PPP presentation given by me. I answered participants' questions and allowed them to make comments on the study's findings according to the action research model (Creswell, 2008; Mertler, 2017).

School Administrators and Colleagues

After this occurred, the findings were then presented to the school administrators in a face-to-face meeting and simultaneously through a Google Meeting to other administrators from nearby Rural High Schools interested in expanding the DE programs at their sites.

School Community

The data was also made available to future students and their parents during the annual Marvelous Early College High School Parent Night to help inform students' decisions on taking a DE course and share their peers' perceptions of DE and college courses postsecondary education.

Participants at Professional Conferences

The study results were presented to fellow teachers at the Annual South Eastern County School District Conference. By using pseudonyms, individual identification of the study participants was prevented to keep the participants' confidentiality (Mertler, 2019). During the presentations, all stakeholders had the opportunity to ask questions and provide any feedback by answering an anonymous Google Form survey (Creswell & Creswell, 2018). Finally, study participants and the Division of Academics and Innovation of the South Eastern County District Office were informed that they can request a copy of the abstract or the final study.

CHAPTER 4

ANALYSIS AND FINDINGS

The purpose of this mixed-methods action research study was to investigate the impact of new technology-enhanced Dual Enrollment math courses on student perception of college courses, post-secondary education, and students' perception of Dual Enrollment courses. The findings from this study helped understand the impact of new technology-enhanced DE math course. The data collection in the study was aligned to the following three research questions:

1. How does participation in a technology-enhanced DE course influence high school students' perception of college courses?
2. How does participation in a technology-enhanced DE course influence high school students' intention of going to colleges?
3. What is the student's perception of the DE math course that they participate in?

The data collection process involved gathering data from a group of six students enrolled in the Dual Enrollment math course. This analysis included the Dual Enrollment Pre and Post Surveys data and the Semi-Structured Interview data from all six participants.

This chapter was divided into two sections corresponding to the mixed methods used to collect and analyze the data. The first section represented the quantitative data

analysis of the Dual Enrollment Student (DES) Pre and Post Surveys while the second section comprised the qualitative data analysis from the Semi-Structured Interview. The last section of this chapter integrated the findings from both sources.

Quantitative Analysis and Findings

In this section, the quantitative results from the DES Pre and Post Surveys were analyzed subsequently. First, the descriptive statistics for the DES Pre-Survey's three sections corresponding to each subscale and the DES Post-Survey's three sections were presented, followed by inferential statistics.

Dual Enrollment Student Surveys

The DES surveys were given to the six participants at the beginning and at the end of the new technology-enhanced DE math course. The DES Pre-Survey included 22 demographic five-point Likert scale questions and multiple answers questions grouped in sections representing the three subscales of the three research questions (Perception of College Courses, Intention of Going to College, and Perception of DE Courses). Each five-point Likert scale question asked the students to indicate the level of agreement from 5 **(**Extremely well), 4 (Very well), 3(Well), 2 (Somewhat well), to 1 (Not well) or from 5 **(**Strongly Agree), 4 (Agree), 3(Neutral), 2 (Disagree), to 1 (Strongly Disagree). Both DES were tested for reliability (N = 6). A Cronbach's alpha coefficient below .60 is unacceptable, .60 to .69 is undesirable, .70 to .79 is respectable, and 80 or above is very good (DeVellis & Thorpe, 2021). The Cronbach's alpha for DES Pre-Survey (α = .893) and DES Post-Survey (α = .974) indicated very good reliability (DeVellis & Thorpe, 2021). The reliability of each subscale was also tested, and the results were presented in Table 4.1. Except for the DES Pre-Survey Perception of College Courses Cronbach's α

that was only .585, the other five values corresponding to the other subscales were above .734, indicating respectable or very good reliability (DeVellis & Thorpe, 2021). The low value of DES Pre-Survey Perception of College Courses Cronbach's α = 0.585 was explained by the small *N* value. As Berger and Hanze (2015) and Bretz and McClary (2014) justified, alpha statistics always relate to a particular administration of an instrument. The DES Post-Survey's Chronbach's alpha increased in our case to 0.828.

Table 4.1 Internal Consistency for Each Dimension (N = 6)

	Cronbach's α	
Subscale	Pre-Survey	Post-Survey
Perception of College Courses	0.585	0.828
Intention of Going to College	0.808 [a]	0.930 [b]
Perception of DE Courses	0.734	0.790
Total*	0.893	0.974

Note. Some component variables have zero variance and were removed from the scale.
[a] #14. [b] #11a, #13b, #14, #17a, # 20a, #20b, and #23.

Descriptive Statistics. The descriptive statistics for each dimension were presented in Table 4.2. In the DES Pre-Survey (*M* =3.752, *SD* = 1.171) to the DES Post-Survey (*M* = 4.154, *SD* = 1.042), participants overall mean perception and intention increased. When looking at the subscales, the largest increase was the Perception of Going to College, in which participants' mean perception increased by 8% between the Pre- and Post-Survey.

Table 4.2 Descriptive Statistics for Each Dimension (N = 6)

	Pre-Survey		Post-Survey	
Subscale	*M*	*SD*	*M*	*SD*
Perception of College Courses	4.083	0.589	4.417	0.589
Intention of Going to College	2.958	1.404	3.167	1.565
Perception of DE Courses	4.333	0.393	4.552	0.337
Total	3.752	1.171	4.154	1.042

The responses from the DES Pre-Survey and Post-Survey for each subscale were analyzed for normality using the Shapiro-Wilk test. Based on the results, a decision was made to either use a paired sample t-test or Wilcoxon signed-rank test.

Shapiro-Wilk normality tests. Each subscale and the total data were used to determine if the data was normally distributed. The averages for participants' DES Pre-Survey and Post-Survey five-point Likert scale answers were computed. The results were presented in Table 4.3, along with the calculated differences between Likert scale averages for each subscale, as well as the total from DES Pre-Survey and Post-Survey.

Table 4.3 Likert Scale Averages for Each Dimension

	Likert Scale averages		
Subscale	Pre-Survey	Post-Survey	Differences
Perception of College Courses	4.083	4.500	0.417
Intention of Going to College	3.513	3.983	0.470

Perception of DE Courses	4.340	4.642	0.302
Total	3.979	4.375	0.396

The differences were analyzed using Shapiro-Wilk test, as shown in Table 4.4. The data was found to be normally distributed for all 3 subscales and the Total ($p = 0.867$), while the subscales Perception of College Courses (P1) ($p = .421$), Intention of Going to College (P2) ($p = .837$) and Perception of DE Courses (P3) ($p = .099$), therefore for all three subscales and the Total $p > 0.05$ so paired sample *t*-tests were conducted on all three subscales. Cohen's d was calculated to determine the effect size for each.

Table 4.4 Shapiro-Wilk Normality Tests - DE Survey

Subscale	*W*	*p*	*df*
Perception of College Courses Difference	0.908	0.421	5
Intention of Going to College Difference	0.962	0.837	5
Perception of DE Courses Difference	0.826	0.099	5
Total Difference	0.966	0.867	5

Paired sample *t*-tests. Paired sample *t*-tests were conducted to compare the students' responses to the DES Pre-Survey and Post-Survey for all three subscales. To complete the paired sample *t*-tests, the students' average five-point Likert scale for each subscale was calculated on the DES Pre-Survey P1, P2, and P3 and post-Survey P1, P2, and P3, respectively. The results were presented in Table 4.5. The Alternative hypothesis

for all three tests was the claim that the average of Post-Survey five-point Likert scale answers would be greater than the average of Pre-Survey 5-points Likert scale answers **H1:** $\boldsymbol{\mu_1 < \mu_2}$. The Null Hypothesis was **H0:** $\boldsymbol{\mu_1 \geq \mu_2}$.

The paired sample *t*-tests revealed that Students' Perception of College Courses (P1) increased from the Pre-Survey (M = 4.083, SD = 0.585) to the Post-Survey (M = 4.500, SD = 0.316), $t(5) = -1.746$, $p = 0.071$ and Cohen's d =0.713. Since $p > 0.05$, there was not enough evidence to support the claim that the average mean after the intervention was greater than the average mean before the intervention. The Students' Intention of Going to College (P2) increased from the Pre-Survey (M = 3.513, SD = 0.444) to the Post-Survey (M = 3.983, SD = 0.459), $t(5) = -4.603$, $p = 0.003$ and Cohen's d =1.879. Since $p < 0.05$, there was enough evidence to support the claim that the average mean after the intervention was greater than the average mean before the intervention. The Students' Perception of Dual Enrollment Courses (P3) increased from the Pre-Survey (M = 4.430, SD = 0.276) to the Post-Survey (M = 4.462, SD = 0.260), $t(5) = -3.055$, p = 0.014 and Cohen's d =1.247. Since $p < 0.05$, there is enough evidence to support the claim that the average mean after the intervention was greater than the average mean before the intervention.

Table 4.5 Paired Sample t-tests – DE Surveys

	Pre-Survey		Post-Survey					
Subscale	*M*	*SD*	*M*	*SD*	*t*	*df*	*p*	*d*
Perception of College Courses	4.083	0.585	4.500	0.316	-1.746	5	0.071	-0.713
Intention of Going to College	3.513	0.444	3.983	0.459	-4.603	5	0.003* +	-1.879

Perception of DE Courses	4.340	0.276	4.642	0.260	-3.055	5	0.028*	-1.247

Note. Out of a five-point Likert scale
Note. For all tests, the alternative hypothesis specifies that measurement one (Pre-Survey) is less than measurement two (Post-Survey)
* Indicates the differences between the Pre-Survey and Post-Survey is significant $p < .05$
+ Indicates the differences between the Pre-Survey and Post-Survey was significant at Bonferroni correction level $p < .0125$

These results suggested that the new technology-enhanced DE math course impacted the Students' Intention of Going to College and their Perception of Dual Enrollment Courses. Specifically, as presented in Table 4.5, the overall increase was found to be statistically significant with the paired sample *t*-test $t(5)= 4.603$, $p < 0.05$ for Intention of Going to College and $t(5)= 3.055$, $p < 0.05$ for Perception of Dual Enrollment Courses. The effect size value was d =1.879 and d = 1.247, both exceeding Cohen's (1988) convention for a large effect (d = 0.80) for both subscales. Using the Bonferroni correction helped avoid reporting false positives (Streiner & Norman, 2011). I did the Bonferroni correction to minimize any Type 1 error inflation since multiple subscales had a higher likelihood for Type 1 errors. The subscale Students' Intention of going to College was significant at the Bonferroni correct level of $p < 0.0125$.

To summarize, The DES Pre-Survey and Post-Survey were analyzed based on the three subscales using the paired sample t-tests for normally distributed data based on the results obtained with the Shapiro-Wilk tests. Off the three subscales, P1, P2, and P3, P1 showed that the Post-Survey level of agreement was not significantly higher than the Pre-Survey agreement levels, while the P2's and P3's Post-Survey level of agreement were found to show that the level of agreement was statistical significantly higher than the Pre-Survey agreement levels. Both subscales P2 and P3 were found to have a large effect size (Cohen, 1988, Field, 2009).

Qualitative Analysis, Findings, and Interpretations

In this study, qualitative data was collected through semi-interviews with all six participants to provide participants' opinions about their perception of college courses and the influence the DE technology-enhanced course had on their perception of college courses and their intention of going to college. Another direction of the research was provided by the qualitative analysis regarding the influence the DE technology-embedded course had on students' opinions regarding mathematics. Table 4.6 presented the sources of the qualitative data and the information obtained. The purpose of this section was to present the data analysis and the interpretation of the themes that emerged. The following subsections presented (a) the selection and description of the participants, (b) a description of qualitative data analysis, and (c) themes and interpretations.

Table 4.6 Summary of Qualitative Data Sources

Type of the Qualitative Data Source	Number	Total number of Codes Applied	
Semi-structured Interviews	6	In vivo Codes	725
		Initial Codes	184
		Focused Codes	197
Totals	6		1106

Selection and Description of Participants

At the beginning of the study, all six students enrolled in the DE course were purposefully selected for the surveys and the individual interviews about their experience

in the DE technology-enhanced course. All six students agreed to participate in the study, and all participants and their parents signed a consent letter to be research subjects. The participants' demographic information was presented in Table 4.7. Pseudonyms were used for all six participants to protect the participants' identities.

Table 4.7 Interviewees' Demographic Information

Pseudonym	Gender	Age	Race	Class
Adam	Male	18	White	Senior
Alice	Female	17	White	Senior
Ella	Female	17	White	Junior
Gina	Female	17	African-American	Junior
Larry	Male	17	White	Senior
Mary	Female	18	African-American	Senior

Four of the six participants were female, and two were male. Two of the participants were African-American, while the other four were White. The participants were either juniors (2) or seniors (4) with an average age of 17 years and four months (*SD=0.52*). Half of the participants were previously enrolled in a high school course I taught, while the other half was never enrolled in any of my courses.

Description of Qualitative Data Analysis

An inductive thematic analysis (Braun & Clarke, 2012; Lockmiller, 2021) was used to analyze the qualitative data. The qualitative data were collected through six interviews recorded on my phone using the Voice Recorder built-in app. The individual interviews took, on average, about 30 minutes. They were conducted in my classroom during the class meetings after the students took the Final Exam and the intervention was completed. The interview questions were delivered through a semi-structured interview

format (See Appendix E). The interview questions were open-ended. After I asked the questions and listened to the participants' responses, I had follow-up questions in addition to the original interview protocol. Each interview was recorded as an .m4a file, and then I converted them to text using the Transcribe speech-to-text option in Microsoft Word. Once the transcripts were created, I checked their accuracy by comparing them with the audio files, making the necessary adjustments, and formatting the text files to correctly reflect each participant's responses. The introductory part of each interview was removed to protect the identity of each participant. The students' interviews were transcribed verbatim to maintain the authenticity of the interviews. After the interviews were transcribed, participants were invited during class to read their interview transcripts to guarantee accuracy through member checking (Lincoln & Guba, 1985). The participants confirmed the transcribed interviews, opening the path toward the coding process.

Coding was a problem-solving technique done cyclically to generate codes that link the data collection with the explanation of the meaning (Charmaz, 2001; Saldana, 2016). The cyclical nature of the coding process led me to two coding cycles, explained below. Before starting coding, I read the transcripts several times for a few weeks to get accustomed to their content. The first cycle consisted of two rounds of coding, while the second cycle was initially planned for one round, but I ended up doing a second round, too (Saldana, 2016). Both cycles and each round are described in the sections below.

For coding, I first uploaded all transcripts into Delve, an online software tool to analyze qualitative data (see Figure 4.1). A sentence-by-sentence analysis was employed to help me develop the codes. An inductive analysis process was used to reveal the codes (Mertler, 2017).

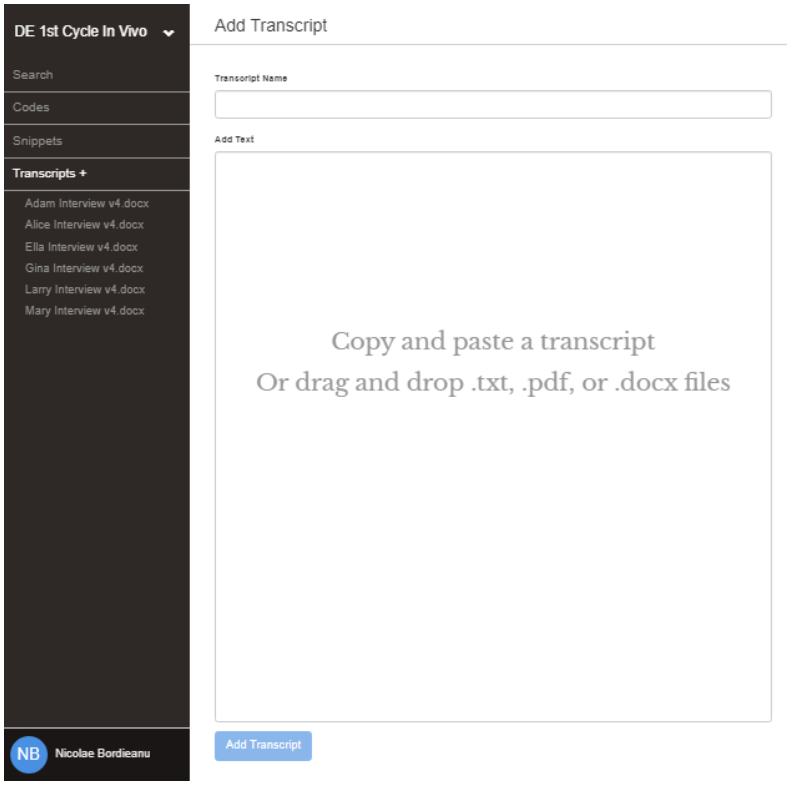

Figure 4.1 Transcripts Uploaded in Delve Web Tool

Before the first cycle of coding started, I realized that it would not be too easy to navigate in Delve from one transcript to another without losing precious time. Therefore, I decided to print all interviews and cut the participants' answers sentence-by-sentence. To easily differentiate them, I color-coded their pseudonyms and then arranged the answers by each interview question. The purpose was to easily identify similar codes generated by participants (see Figure 4.2) and keep them on my desk to quickly glimpse at all answers while coding.

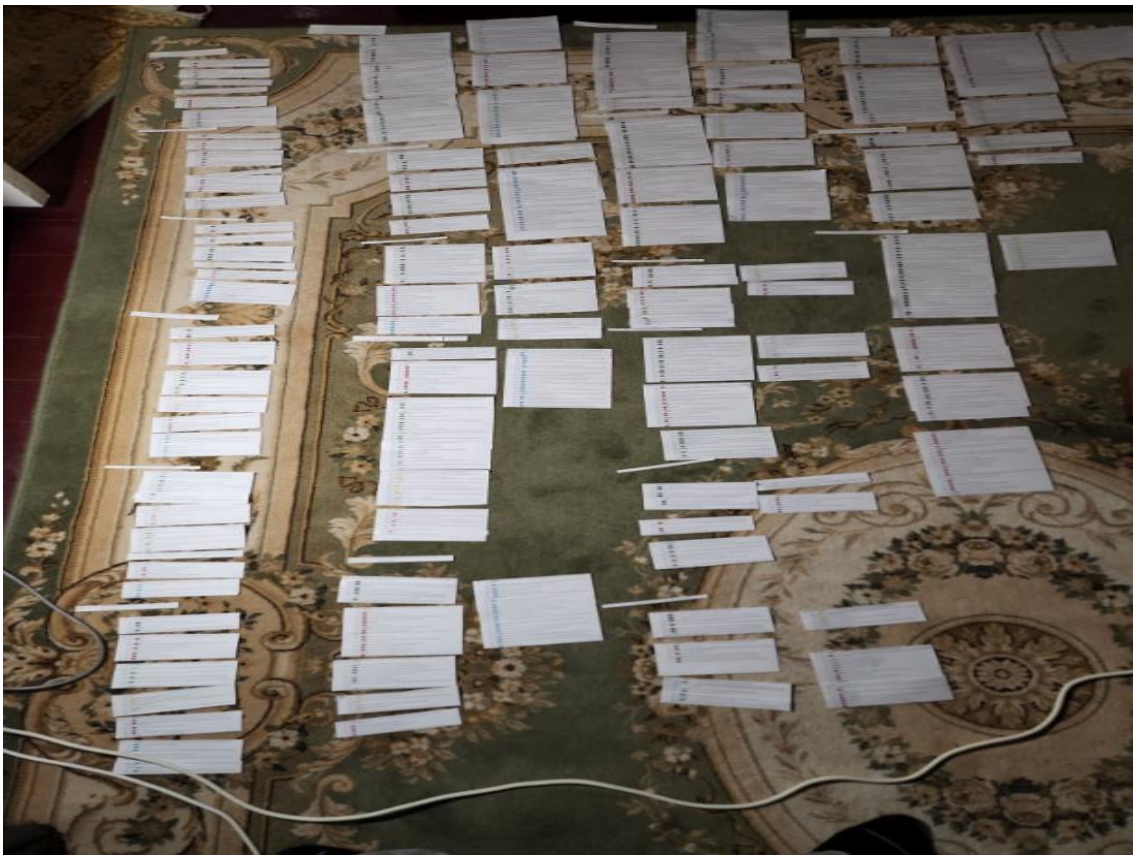

Figure 4.2 Sentence-by-Sentence Organized Answers for Each Interview Question

Notes on why some codes were used and then changed or why categories were created and then submerged in other categories were included in this audit trail. A linear timeline (Creswell & Creswell, 2018) was kept in my research journal, the class notes helped me keep my thoughts in order, and the events that were part of the intervention were documented periodically. The notes I took in my research journal during the intervention helped me confirm my perceptions by comparing them with the participants' answers. The notes were recorded on post-it notes during the four months of the intervention process (January to May 2022). They were also color-coded, with each participant receiving the color later used in the Excel spreadsheet when the categories were developed (See Figure 4.3). The notes unrelated to a specific participant were

recorded on white sticky notes. Once I finished the transcripts, I confirmed my perceptions with the participants' answers.

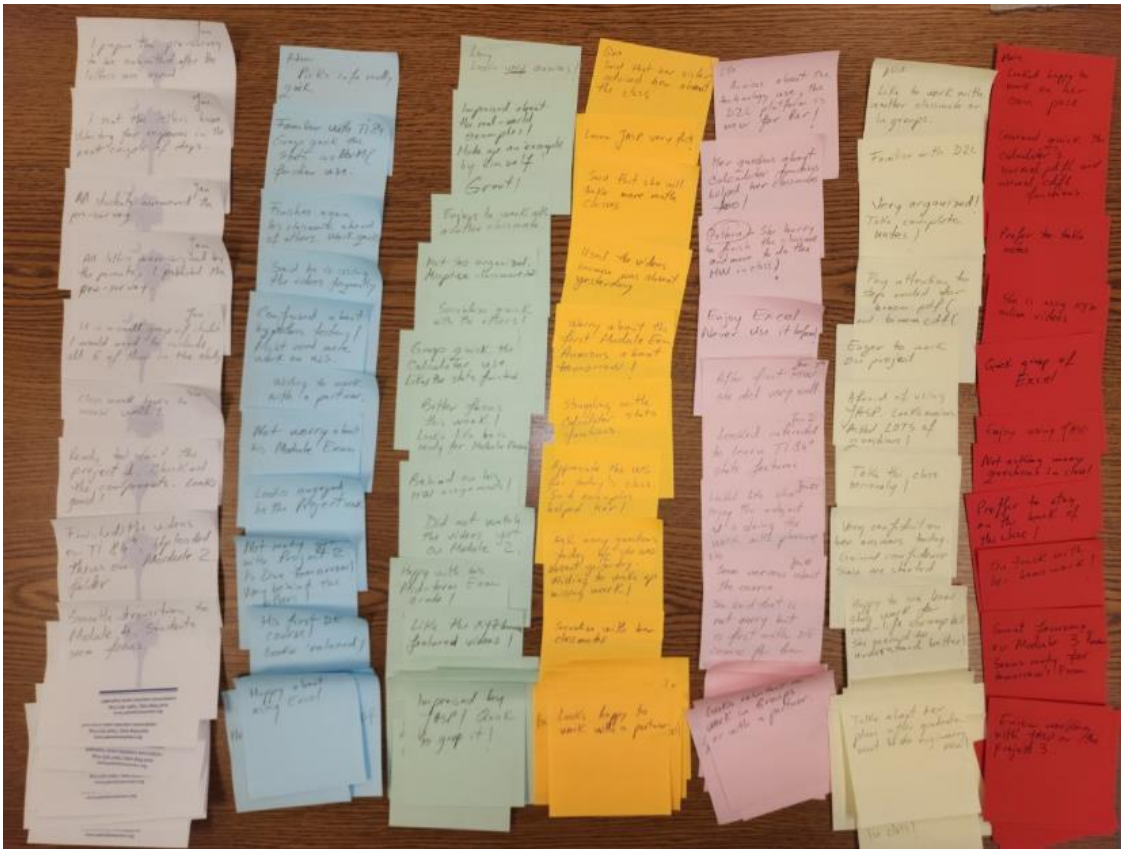

Figure 4.3 Post-it Notes from My Research Journal

Cycle One

In the first round of the first cycle, in vivo coding was used to "prioritize and honor the participant's voice" (Saldana, 2016, p. 106). Adhering to the Verbatim Principle, I tried to capture the real meanings of the participants' voices (Stringer, 2014). To conduct the first-cycle coding, I returned to Delve and created The DE 1st Cycle In vivo Codes Project (see Figure 4.4).

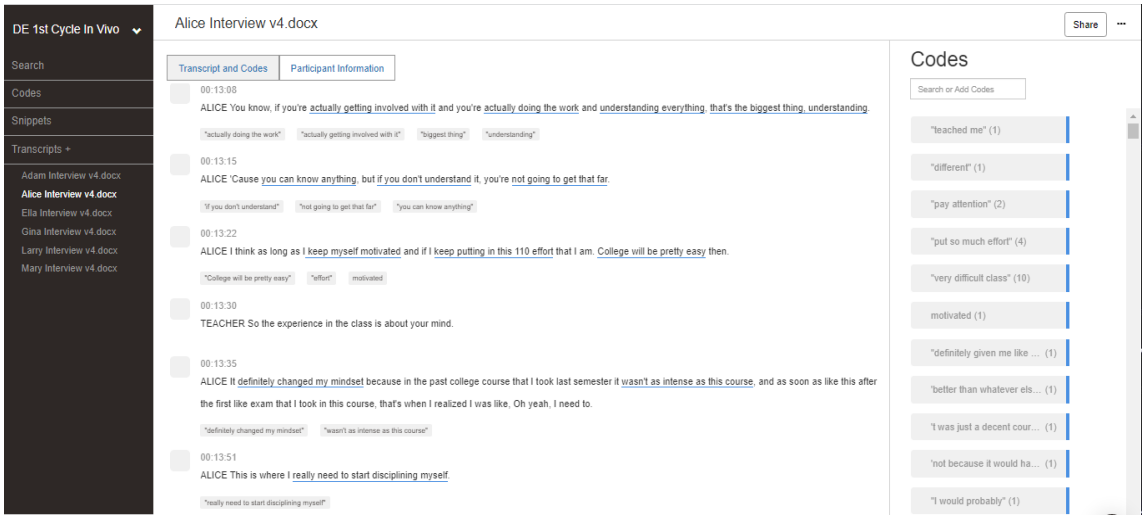

Figure 4.4 In Vivo Coding in Delve Web Tool

The 1st Cycle In vivo Codes Project included all six interview transcripts. The first round generated 1142 in vivo codes, such as “it will be easy,” “I gained a lot,” “needing to study,” “very difficult class,” or “always wanted to be successful.” The transcripts were analyzed sentence by sentence, and the associated codes were chosen to express the participants’ beliefs and perceptions. In some sentences, more than one In vivo code was generated. For example, the sentence in Figure 4.5 generated three In vivo codes through a process named splitting (Saldana, 2016).

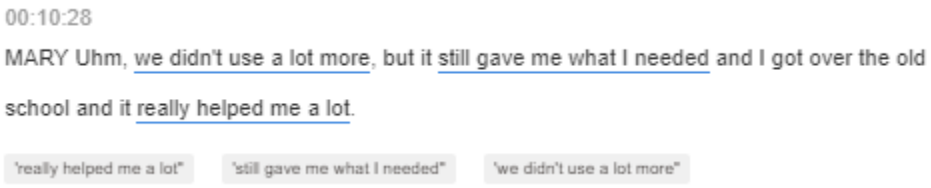

Figure 4.5 In Vivo Multiple Codes for One Sentence

After reviewing the In vivo codes, the number of codes decreased to 725, providing a reevaluation of my initial thoughts (Lincoln & Guba, 1985, Saldana, 2016; Shenton, 2004). In vivo codes such as Alice’s “That was definitely helpful.”, Gina’s

"That was definitely helpful.", and Larry's "Helped me to, it's helpful to me to understand" were all reevaluated under one In vivo code, "helpful", while Alice's "More involved in like helping their students" or Larry's "It was helping with my future plans" were all reevaluated under a different In vivo code, "helping." After discussions with my dissertation chair, I shortened the In vivo codes, eliminating parts of the codes like "I think" and "I see" and only keeping the most "meaningful units" of the codes, thus making them "more concise" (H. Tang, email July 7th, 2022). Later, when I did the initial coding, my review on the in vivo codes helped me create initial codes more easily.

For the second round, I chose to continue the coding process with initial coding, which Strauss & Corbin (1998) explained "breaks down qualitative data into discrete parts, closely examines them and compares them for similarities and differences" (Saldana, 2016, p.115). Initial coding also made use of in vivo coding. In addition, it identified participant actions to explain how they responded to the embedded technology and how their intentions changed throughout the intervention. After a period of "digesting and reflecting," as Clarke (2005) recommended, the second round utilizing Initial coding resulted in 184 Initial codes and 595 snippets (p. 84). Using *-ing* codes captured processes like in the coding of Mary's statement, "I have grown from, I have grown my vocabulary of technology." Since Mary referred to the technology skills she gained from the DE course, I assigned the code *Experience using technology* to capture Mary's perception of DE courses. During the initial coding process, many codes were assigned more than once (See Figure 4.6). For example, *Realizing the Necessity of DE* was assigned five times, *Gaining Technology Skills* 14 times, and *Embedding Technology* three times.

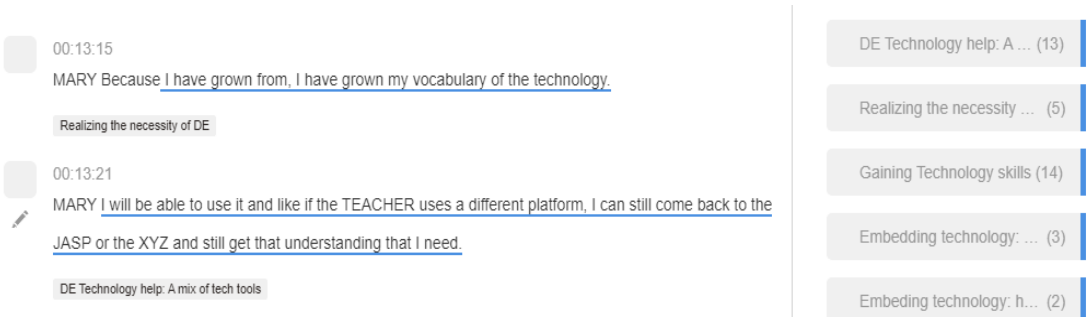

Figure 4.6 Example of Initial Coding

While communicating the work on the initial codes (H. Tang & H. Bice, September 2022), some of the codes were changed. Codes like *Dual Enrollment Influenced Intentions* were broken into more codes that better reflect the participants' actions, beliefs, or attitudes. Thus, the emerging codes were more detailed (see Table 4.8): *DE influencing intentions: focus on a major, DE influencing intentions: changing major, DE influencing intentions: reaffirmed intentions, DE influencing intentions: enjoying math more* and alike.

Table 4.8 Breaking the DE Influential Intentions Initial Code into More Codes

Initial Code	Participant	Interview sentence
DE influencing intentions: focus on a major	Mary	"I just knew I wanted to take dual enrollment classes because it would help me so that I can focus on my major and not just on basic classes."
DE influencing intentions: changing major	Alice	"At the beginning of the semester I was[influenced], I had it in my mind that I wanted to be a doctor."
	Larry	"The dual enrollment course, I wouldn't really say has changed, has made me think about changing my major.'
DE influencing intentions: reaffirmed intentions	Ella	"It reaffirmed what I already thought would happen."
	Ella	"I'm still certain I'll be using these things but, you know, I still plan on doing what I'm doing.'
	Gina	

		"I know I still have a good bit of math classes, so right now I'm still sticking with biology."
DE influencing intentions: enjoying math more	Alice	"I realized that math was something that I liked, and then I started exploring past that, including math."
	Alice	"I think the more math courses I take, the better understanding I'll have.'
	Gina	"I realized that I'm a lot better at math than Biology."
	Larry	"It encouraged me to work harder and push for further results in harder math courses."

Other initial codes that were dropped or changed into codes that included more details to enclose students' responses with better precision (Saldana, 2016) were: *Students' characteristics, DE motivation, DE expectations, Influencing participants, and Perception of College Courses*.

Cycle Two

Focused coding was selected for the second cycle of coding. The decision to use focused coding came naturally, as Saldana (2016) recommended this method for 'virtually all qualitative studies" (p.240) and because I used in vivo coding and initial coding. Following in vivo and initial coding (Saldana, 2016), Focused coding allowed me to search for the most relevant codes to develop the major categories in the data requiring "decisions about which initial codes make the most analytic sense" (Charmaz, 2014, p.138). This cycle was initially designed to contain one round of focused coding. Ultimately, after consulting with my dissertation chair, I did two rounds of focused coding to better explain each code's meaning and reorganize some of them.

I exported my Delve files as a Microsoft Excel spreadsheet to begin the second cycle. Each participant's answers were color-coded to help me better visualize the

collected data and the codes generated in the first cycle (Bogdan & Biklen, 1998; Delamont, 2012). The first sheet of the spreadsheet included the interviews' section number, questions' number, participants' pseudonyms, snippets' number, interviews' time stamps, the snippet, and the initial codes (see Figure 4.7).

Interview's Section #	Question #	Author	Note #	Time	Note	Code
1	Q1	Adam	1	0:26	going to be hard, but I guess I didn't quite expect how much	College expectations: hard
1	Q2	Adam	2	1:04	people who had been through college classes before	Influencing participants: college graduates
1	Q2	Adam	3	1:08	my mom went to Trident, so she gave me a pretty good idea	Influencing participants: Family
1	Q2	Adam	4	1:27	Oh yeah, some people who took dual enrollment last year I t	Influencing participants: Friends
1	Q2	Adam	5	1:37	I just talked to them about it before I got involved with it	Influencing participants: Friends
1	Q2	Adam	6	1:37	they gave me a pretty good idea of what to expect.	DE expectations: pretty good idea
1	Q3	Adam	7	1:54	I want to have a good, you know, a good life	College motivation: good life

Figure 4.7 Example of Initial Coding Exported from Delve in an Excel Spreadsheet

The next step was creating a second sheet by copying the first sheet and making a custom sort by the code's column. The focused codes were then created, and the second sheet was again sorted by the focused codes (see Figure 4.8). This process generated 197 focused codes by arranging similar Initial or In vivo codes and using the custom filter to rearrange the focused codes in alphabetical order.

Interview's Section #	Question #	Auth	Note #	Time	Note	Focused Codes
2	q9	Larr	36	11:03	Yeah, it's made me more comfortable about what I would e	College Classes: comfortable
2	Q12	Ella	41	11:25	it's a college class and you know, it's made me a little less w	College classes: less worried
2	Q9	Gina	34	10:10	Uhm, it did definitely because when I came into it I was thin	College classes: less worried
2	q8	Larr	23	8:05	Yeah, after completing the math 120D course I have come t	College Classes: less worried
2	q9	Larr	30	9:18	My parents talked about college as if it's like some big mons	College Classes: less worried
2	q12	Larr	48	14:20	The Math 120 course specifically has really helped because	College Classes: less worried
2	Q8	Mar	17	6:14	After completing the course, I'm glad that I took it because i	College classes: more insight
2	Q12	Ella	42	11:35	I know how the coursework will likely be. You know it's not t	College classes: not too scary
2	q9	Larr	29	9:15	The class changed my view of making college not seem as sc	College Classes: not too scary

Figure 4.8 Example of Focused Codes Generated in an Excel Spreadsheet

After generating the focused codes, I engaged in peer debriefing (H. Tang & H. Bice, October 2022). We reviewed the codes, and I answered questions regarding the

meaning of the codes; then, I listened to the feedback and took notes that guided my next steps. Following their advice, I created categories by grouping related focused codes (see Figure 4.9). This process took a long time since I constantly walked away and then returned and changed the categories. The more I re-arranged the codes, the more I thought I needed to better explain the meaning behind each category.

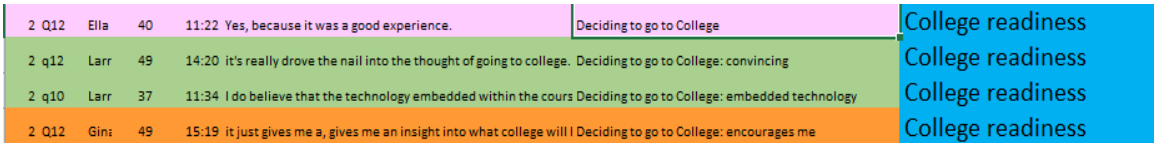

Figure 4.9 Example of a Category – College Readiness, Generated by Grouping Several Focused Codes

Following the advice from peer debriefing (H. Tang & H. Bice, December 2022), I decided to reword the focused codes to better describe their meaning. As a result, most focused codes were renamed or wholly changed (see Figure 4.10). Previously focused codes labeled "*College motivation: Lifestyle I dream of*, "*College motivation: better jobs*," "*College motivation: good life*," or "*Deciding to go to college: fell more comfortable*" were all grouped under a new focused code "*Aiming for a stable future*." After this second round of focused coding was finalized, the number of focused codes decreased from 197 to 128.

Reworded Focused Codes	Old Focused Codes
Gaining comfort in math College Classes	College Classes: comfortable
College classes made me less worried	College classes: less worried
College classes view change	College classes: less worried
Enjoying College Classes	College Classes: less worried
College Classes: less worried	College Classes: less worried
Comfortable in math classes	College Classes: less worried
Better prep for College classes	College classes: more insight
Better knowledge about College Classes	College classes: not too scary
College classes view change	College Classes: not too scary
College classes view change	College Classes: not too scary
Better knowledge about College Classes	College classes: technological advanced
Better knowledge about College Classes	College classes: technological advanced
Technology supporting learning in College Classes	College classes: technology experience
Technology supporting learning in College Classes	College classes: technology experience
Technology supporting learning in College Classes	College classes: technology experience
Technology supporting learning in College Classes	College classes: technology experience
Expecting difficulties	College expectations: a lot more difficult
Expecting difficulties	College expectations: a lot more difficult
Expecting difficulties	College expectations: a lot more difficult
Expecting difficulties	College expectations: a lot more difficult

Figure 4.10 Example of the Change of Focused Codes

Categories Development

Once the focused codes were finalized, I began organizing them into categories. Notes on why some codes were used and then changed or why categories were created and then submerged in other categories were included in this audit trail. To organize the focused codes into categories, I started by grouping the related ones. I assigned the same number code for each group. In the first group, the focused codes were number coded from 1.1 to 1.4 (see Figure 4.11). All other groups were coded similarly. I ended up with 30 groups that formed 30 categories.

Reworded Focused Codes	ID's
Achieving career goals	1.1
Achieving career goals	1.1
Achieving career goals	1.1
Achieving career goals	1.1
Aiming for a stable future	1.2
Aiming for a stable future	1.2
Aiming for a stable future	1.2
Aiming for a stable future	1.2
Aiming for a stable future	1.2
Aiming for a stable future	1.2
Aiming for a stable future	1.2
Aiming for a stable future	1.2
Stimulus to be successful	1.3
Offering great opportunities	1.4
Offering great opportunities	1.4
Offering great opportunities	1.4
Offering great opportunities	1.4
Stimulus to be successful	1.3
Stimulus to be successful	1.3
Stimulus to be successful	1.3
Stimulus to be successful	1.3
Stimulus to be successful	1.3

Figure 4.11 Organized Focused Codes in Groups

The process of grouping the codes into 30 categories was not a linear one. I went back and forth, changing or renaming the categories and regrouping the focused codes. When the categories emerged from the focused codes, the number of categories decreased to only 20. After a meeting with my dissertation chair (H. Tang & H. Bice, December 2022) to discuss the lack of enough explanations of the meaning of each category, I did a new reorganization of the categories dropping the final number to 15 (see Figure 4.12). For example, one category was "*Planning future*" and another one was "*Planning to enroll in college."* After I reviewed the codes associated with both, I realized that they could be grouped under one category named "*Life planning."* After

peer-reviewing them, I changed the name to "*Outlining goals for life"* since this description better explains the original codes.

Initial categories	2nd roud of grouping categorie	Final categories	
College motivations	College motivations	Incentives for pursuing a college degr	1.1
DE influencing intentions	DE influencing intentions	Motivation for DE participation	1.2
DE motivation	DE motivation		
Influencing participants	Influencing participants	Recognizing the acquaintances' influe	1.3
Embeding technology	Embeding technology	The embedded technology positively	2.1
Experience using technology	Technology influence		
Gaining technology skills			
DE technology help	DE technology help	Importance of exposure to DE technol	2.2
Deciding to go to college	College readiness	Acknowledging the influence of techn	2.3
Feeling prepared for college			
Helping with college			
Meeting college courses expectat	DE impact on college	DE influence on pursuing a post-secon	3.1
Perceiving College			
Realizing the necesity of DE			
Planning future	Life planing	Outlining goals for life	3.2
Planning to enroll in college			
Student's characteristics	Student's characteristics	Recognizing necessary attributes of a s	3.3
College Classes	College Classes	Impressions about College Classes Pro	4.1
College expectations	College expectations		
DE expectations	DE expectations		
Comparing DE vs HS	Comparing DE vs HS	DE vs HS courses' Characteristics	4.2
Criteria of DE	Setting criteria for DE		
DE charachteristics			
Experiencing DE courses	DE experience	Acknowledging DE course experience	5.1
Explaining DE course			
Explaining DE perception			
Perceiving DE atmosphere	Valuing DE ambience	Students' feelings on DE course ambie	5.2
Perceiving DE environment			
Mirroring a college course	Perceiving Post Secondary cou	Students' post-DE perception of colleg	5.3
Perceiving College courses			
Perceiving DE courses			
College services	College services	The usefulness of college services	5.4

Figure 4.12 The Three Rounds of Developing the Categories

Themes and Interpretations

Five primary themes emerged from the qualitative data analysis (See Tables 4.9 and 4.10). In the first stage of the qualitative analysis, I identified 20 categories that merged into six themes. By the end of the analysis, a few categories became sub-categories, and a new category emerged. At the same time, two of the themes were engulfed by other themes, and another new theme was created. Each theme is explained in detail in the following part of this section.

Table 4.9 The First Six Themes that Emerged from Qualitative Data – Early Stage

Themes	Categories	Focus Codes	In Vivo and Initial Codes
1.A Students' perception of college courses was influenced by their motivation to attend a postsecondary education institution.	• College motivations • DE motivation • Influencing participants • Student's characteristics	• Motivated by better jobs • Wanted college credits • Family and peers • Commitment and focus on a goal	• "I could get into engineering a lot quicker" • Dreamed for good jobs • "To get to where I want to be faster" • Getting prepared for college • Family, peers and school staff • "people repetitively telling me" • Positive mindset • Disciplined • "Push yourself to make sure you get your stuff done
1.B Students' expectations for postsecondary courses matched the DE course.	• College expectations • DE expectations	• A progression of schooling • Great opportunity	• "I just thought it would be difficult" • Grueling, Hard • "Didn't really have much to expect" • Provider of college credits

2.A Student's confidence in succeeding in college was influenced by the embedded technology	• Embedding technology • Technology influence • DE technology help	• Experience with technology • Gaining Technology skills • Easy usability	• Efficient • "Makes it easier with all the tools and functions" • Lack of technology experience • "I never use it [Excel] before this class" • "JASP was a lifesaver" • XYZ, TI 84+, Excel, D2L, Google Classroom, Videos
2.B Participation in DE positively influenced students' postsecondary future plans.	• DE impact on college • College readiness • DE influencing intentions • Life planning	• Perceiving college • Deciding to go to college • Reaffirming intentions • Channeling student's future	• "I'm no longer scared of going to college" • Much more difficult • "Encourage me to enroll in college" • Good experience • "I want to go into cybersecurity" • " I didn't know what I wanted to do" • Planning the future
2.C Contrast between DE and HS courses influenced student's intention of going to college.	• Understanding academic rigor • Contrasting secondary and postsecondary teaching styles and resources • Setting criteria for DE	• College classes • Comparing DE vs HS • DE characteristics	• "College seems a lot easier to me now" • Not too scary • "DE courses go into further depth" • Faster, deep knowledge, much more effort • "The teacher seems to care more" • One-on-one like, small class
3.A Experience in DE math course influenced students' perception of college math courses.	• DE experience • Valuing DE ambience	• Experiencing DE courses • Perceiving DE atmosphere and environment	• "This class put me in a new mindset" • Exceeding expectations • "We all pretty much had the same maturity level"

			• Less students, easier management
	• Perceiving Post Secondary courses	• Mirroring College courses • College services	• "Given me like a little more insight into college itself" • More complexity • Satisfaction • Help services, tutors

Table 4.10 The Final Five Themes that Emerged from Qualitative Data – Last Stage

Themes	Categories	Focus Codes	In Vivo and Initial Codes
1. Students' expectations about postsecondary paths were affected by motivation, incentives, and acquaintances.	• Incentives for pursuing a college degree	• Aiming for a stable future	• "I could get into engineering a lot quicker" • Stimulus to be successful
	• Motivation for DE participation	• Benefitting future academic plans	• "To get to where I want to be faster" • Curious about DE courses
	• Recognizing the acquaintances' influence on decision-making	• Influencing the prior perception of DE course	• Influencing participants: family, peers and school staff • "people repetitively telling me"
2. Technology supported student's learning in DE Math Class.	• The embedded technology positively influenced the learning process	• Making learning effective with the use of technology	• Perceiving college through technology • "Makes it easier with all the tools and functions"
	• Importance of exposure to DE technology for the learning process	• Using Apps in DE courses	• "JASP was a lifesaver" • Ease of use of technology
	• Acknowledging the influence of technology on pursuing math	• Technology simplified math workload	• "I have found it easier to do math with technology" • Math universality

3 Students' decision to enroll in DE courses affected their career aspiration.	• DE influence on pursuing a postsecondary degree	• Acknowledging the rigorousness of college courses	• "I'm no longer scared of going to college" • New college perspective
	• Outlining goals for life	• Channeling life dreams	• "I didn't know what I wanted to do" • Planning the future
	• Recognizing the necessary attributes of a successful DE student	• Success necessitating self-belief	• "Push yourself to make sure you get your stuff done" • Student's characteristics: committed, disciplined
4. Students' perception of college courses was influenced by the contrast between DE and HS courses.	• Impressions about College Classes Prior to and After DE enrollment	• Gaining better knowledge about college classes	• " I just thought it would be difficult" • Grueling, Hard
	• DE vs HS courses' characteristics	• Recognizing the difference in DE teaching style	• "The teacher seems to care more" • DE - higher level of independence
5. Students acknowledged the benefits of being enrolled in the DE course	• Acknowledging DE experience	• Positively experiencing the DE courses	• "This class put me in a new mindset" • Exceeding expectations
	• Students' feelings on DE course ambiance	• Perceiving a positive DE classmate atmosphere	• "We all pretty much had the same maturity level" • Fewer students, easier management
	• Students' post-DE perception of college courses	• Mirroring College courses	• "Given me like a little more insight into college itself" • More complexity
	• The usefulness of college services	• Using college services	• Help services, tutors • "I didn't get in the into the services"

Validating the themes

The themes emerged from the categories created by grouping them based on similar traits. The analysis used a thick, rich description, peer debriefing, an audit trail, and member checking to evaluate the themes' validity. To verify the correctness of the emerging themes, I allowed the participants to review the themes and check if they expressed their experiences and perceptions with accuracy. The verbatim quotes provided a thick, rich description of the findings in support of the themes (Creswell, 2013; Gonzales, 2000; Mertler, 2017). Peer debriefing with H. Tang and H. Bice focused on the themes' language and overall inclusiveness (Lincoln & Guba, 1985; Shenton, 2004). In my researchers' journal, I maintained an audit trail in the form of notes taken on post-it notes documenting the events during the intervention, the advice and the feedback from the dissertation chair, and the decisions I made during the study (Lincoln & Guba, 1985; Merriam, 1998). After having developed the final five themes, I used member checking to help confirm my work's accuracy (Creswell & Creswell, 2018; Maxwell, Delaney & Kelley, 2017; Mertler, 2017). I emailed the participants who were still students at my high school and the parents of the participants who had already graduated. In the email, I asked the students to review the themes and email me back if they had any suggestions to make changes. I asked the parents to forward the emails to their children. One of the parents emailed me back with her daughter's email from her postsecondary school, which I used to directly email her the request to review the content of the themes, reflect, and suggest any possible changes or disagreements on the themes. Out of the six participants, one student emailed me back to let me know that she had no change to the themes. I also spoke with another two, and both had nothing to add, while the other three did not answer

my email. I sent a second email to the parents of the three students who did not respond, and still, none of them emailed me back with any suggestions for change.

I created the five themes by grouping categories created from the focused codes. The aforementioned focused codes were created from the association of in vivo codes with initial codes identified from the semi-structured interviews with all six participants. Initial codes like *Stimulus to be successful* and in vivo codes like "*I could get into engineering a lot quicker"* were combined, creating the focused code *Aiming for a stable future,* encompassing participants' desire for a life goal. Combining that focus code with another three focused codes, *Achieving career goals*, *Stimulus to be successful*, and *Offering great opportunities,* I formed a category labeled *Incentives for pursuing a college degree*. This category summarized the participants' incentives that affected their postsecondary path. Later this category was integrated into the first theme *Students' expectations about postsecondary paths were affected by motivation, incentives, and acquaintances*. In the following sections, each theme is presented in detail, and the categories from which each theme emerged, and the focused codes are explained.

Theme 1: Students' Expectations About Postsecondary Paths Were Affected by Incentives, Motivation, and Acquaintances. This theme described how the participants' interview responses indicated the extent to which incentives, motivation, and acquaintances affected students' expectations about their career development. Lent et al. (1994) suggested that expectations employ a particular influence on career motivation. According to the Social Cognitive Career Theory (SCCT) framework, career expectations could be determined by the student's motivation to follow a postsecondary path and engage in their academics (Domene et al., 2011). The participants' motivations retained

various motifs like the desire to fast-track into the engineering program, being offered college credits, or the subject's impact on the college major. Incentives to pursue a college degree included achieving a personal goal and being at the right time in life (Megginson, 2008) or being interested in getting a job and getting through life by following postsecondary education. The participants in my study, similar to Jones et al. (2006), revealed that they were encouraged by their acquaintances to follow the most desired path and fulfill their dreams. This theme was comprised of three categories: (a) incentives for pursuing a college degree, (b) motivation for DE participation, and (c) recognizing the acquaintances' influence on decision-making.

Incentives for Pursuing a College Degree. This category was defined by grouping several focused codes that denoted aims to achieve career goals, offers of great opportunities, and the aims for a stable future. Chickering and Havighurst (1981) suggested that students' differing needs influence their postsecondary education or career goals. Among the needs described in the literature are interpersonal relationships, career preparation, and the assumption of social roles. The sixth environmental factor described by Chickering's (1969) theory, "developing purpose," of why a student would attend college varied and depended on each student's goal, life aspirations, and commitments to self (Chickering & Reisser, 1993; De Larrosa, 2000).

The incentives revealed throughout the interviews included desires to achieve a career goal by attending college. For example, Alice stated, "I've dreamed of being an engineer for like a hot minute so. It's been pushed enough for me to want to go to college and, I'd say, campus lifestyle that has to be a big one." This participant referred to one of her life aspirations as an incentive to enroll in college.

Aiming for a stable future was also one of the other participants' goals. They admitted that incentives like achieving their dream lifestyle, being a first-generation postsecondary student in their family, and succeeding early in life were among the reasons for pursuing a college degree as presented in their interview answers. Ella expressed her desire for a good life and a good job, saying "just trying to you know, get through life, get a job, survive you know, live on my own." She found this was obtainable by first going to college "I've been taking like you know, gifted courses, higher level courses throughout my entire life, so it's just kind of been expected that I'll go to college and nothing else really stands out to me." Her colleague Alice's desire was to "start succeeding early on in life and stuff like that, that was definitely a big one," which was a factor that contributed to her enrollment in the DE course. Similarly, Ella also stated she wanted "to have a good, you know, a good life." She looked forward to financial security, relaying "I don't want to be struggling paycheck to paycheck." Additionally, she acknowledged that "college was a good way to get yourself into better jobs than having no degree for what you want to do so." Larry was looking to differentiate from his peers. He noted, "something that would set me apart from my peers within life was having a college degree compared to those who do not and just have a high school degree." At the same time, Gina was pushed forward by her wish to attend college. She stated, "I always wanted to be successful and live the lifestyle that I always dreamed about." The four participants aimed for a better life, a stable future, and a reason that would set them apart, purposes that Chickering (1969) highlighted in his theory as being developing purposes for students to attend college. The fifth student, Ella, was always confident that academic

performance would help her in postsecondary education. Her desire to live independently once she graduates was an incentive she aimed for in addition to her academic success.

The great opportunities offered by the postsecondary environment were reasons for Larry, Mary, and Alice to pursue a college degree. The student-faculty relationship to which Alice referred was one of the three environmental factors of the developmental phase of college students (Chickering & McCormick, 1973). Larry's motivation was the opportunities that college graduates have. He noted, "[attending] college would be the opportunity, the great opportunities that going to college brings you." Mary had a similar reason to attend college. She relayed, "I know what I want to be in life, and the only way I can do that was if I go to college. Most people don't make it far without a college degree." At the same time, Alice's motivation came from the college lifestyle that she envisioned, "the lifestyle, as in like the teachers and stuff like that." All three students looked forward to the great opportunities ahead for undergraduate college students.

Motivation for DE Participation. This category grouped focused codes that provided motivation for high school students to enroll in DE courses in the form of benefits toward future academic plans, influences on career intentions, and meeting HS graduation credit requirements. Motivation and personal accomplishments were the basis of self-efficacy theory derived from Bandura's social cognitive theory (1986), grounded in academic self-efficacy. Bandura (1997) argued that people's motivation was based on their beliefs and could influence their actions. Self-efficacy and achievement motivation were identified as being the strongest effects in academic settings (Duncan & McKeachie, 2005).

The motivation for attending DE classes was exemplified by the participants who were looking for motives that would benefit their future academic plans. Alice shared her motivation to quickly get into college, saying:

> to get to where I want to be faster. I knew that if I started Early College in high school and I got out a lot of the basics out of the way…[I could] jump into my engineering track like almost as soon as like I got in touch with college. And that's what really pushed me to do these dual credit classes so that I could get into engineering a lot quicker.

Alice recognized personal benefits of getting an Early College credit, sharing that "I was like, oh, if I get this out the way I won't have to do as many math classes in college." She knew that many students go to college, but she "just knew that that's a part of my path. And I need to go to college, especially for what I want to do." The intention to get college credits before enrolling in college motivated another student, Gina. She expressed, "there's the classes that I took that I wouldn't have to take when I got to college. It will start me off kinda early and just getting me prepared for college when I go there." Getting the dual credits was a good motivation for her.

The three students' motives were related to their academic plans, while other participants in the study had motives explicitly related to the subject of the DE course. The HS credit requirements helped Mary decide to enroll in the DE course "Well, after I took my AP classes and I couldn't make the grades that were needed to get the credit, I just started to do the dual enrollment," and meeting the four math credits required to graduate from HS. Larry's curiosity about the math DE courses pushed him to enroll. He explained his reasoning to me, sharing because of "The need of math within the Major

that I plan to do." Larry wanted to pursue cybersecurity. However, he stated that he initially "didn't think that there was a ton of math in it." Only later did he realize that "Math was a key part in cybersecurity." Ella took the DE course because, for her, it was easier than other courses. She stated, "I like taking math classes because they're a lot easier to manage, and compared to other classes I have, it gives you more free time out of school." The students' voices proved their motivation for enrolling in the DE math course and the effects of their decisions on their expectations of postsecondary paths.

Recognizing the Acquaintances' Influence on Decision-Making. The third category that defined this theme was the effect acquaintances such as family members, school staff, or others had on the students' expectations about postsecondary plans. When students went to college, their development was influenced by parents, high school teachers, and peers, bringing strengths, weaknesses, feelings of pride, prejudices, and confusion to clarify their identity and develop acute purposes and high integrity (Chickering & McCormick, 1973). Participants' accounts about acquaintances' influence confirmed Erick Erickson's psychosocial theory of development that considered the impact of external factors, parents, and society on personality development.

The family members were the leading influencers of the study participants. Adam acknowledged his mom's influence saying, "my mom went to Trident, so she gave me a pretty good idea of what the classes would be like whenever I first enrolled in dual enrollment." Ella's mom was also the one who influenced her. She noted, "My mom has, you know, sort of, every so often she'll talk to me about how she what she went through during college, and she showed me her textbooks and stuff." Another study's participant, Larry, was influenced by his parents. He relayed, "I developed that expectation for

college courses would be due to my parents talking about how difficult college was and what to expect from them… and my dad also recommending it deeply to me." Gina was one of the students that was not influenced by her parents but learned from her sister about the DE courses, which influenced her decision. She shared, "I think I developed these [expectations] 'cause my sister took them [DE courses] last year, and it was a little hard for her, but I think it's mainly because she was an at-home student." Overall, with two exceptions, all four other students were influenced by a family member's decision to enroll in the DE course.

The school staff influenced two of the students. Alice's guidance counselor discussed DE with her. Alice shared, "Um, the guidance counselors told me that it was like a very difficult class." Teachers from other DE classes she took shared similar sentiments. Alice stated, "Every teacher in every dual enrollment class that I've taken, they always stress how difficult it was for a high school student to get through the course and to pass it with good grades." The obstacle presented did not discourage her from enrolling in the DE math course but "made me nervous about it." In the end, she got the courage to do it. She shared, "so I guess it's just people repetitively telling me that it was going to be very difficult, which made me think it was going to be difficult." Alice decided to enroll in the DE class even though she was convinced it would be difficult. Larry's guidance counselor also encouraged him to enroll. He shared, "my guidance counselor saying that it would be something great for me to do while in school" gave him the courage to enroll.

Their peers strongly influenced the students' decision-making, as the participants' voices confirmed during the interview. Adam talked with former college students, "I just

talked to people who had been through college classes before," as well as former DE students, "Oh yeah, some people who took dual enrollment last year I talked to them about it 'cause I didn't take dual enrollment last year." They all gave him a "pretty good idea of what to expect." All other students acknowledged acquaintances' influence on their expectations about postsecondary courses/paths except for one participant, Mary. The acquaintances included parents, sisters, guidance counselors, teachers, and friends who all had past college experiences.

Summary. The participants had a similar experience regarding acquaintances' influence on postsecondary decisions. At the same time, the motivation for DE participation and incentives for pursuing a college degree varied from one participant to the other. However, all three confirmed either the self-efficacy theory derived from Bandura's social cognitive theory (1986) or Chickering's (1969) theories' sixth environmental factor, "developing purpose." The three categories that were engulfed into the first theme included the strong voices expressed by the participants, which provided proof of the influence the motivation, incentives, and acquaintances had on the students' expectations about postsecondary education.

Theme 2: Technology supported student's learning in DE Math Class. This theme combined students' beliefs that embedded technology positively influenced the learning process, the importance of exposure to DE technology in supporting learning, acknowledging the influence of technology in pursuing math, and the student's concerns about the course. Participants' beliefs about the role technology played in supporting learning in DE math courses were drawn from the participants' interviews. The intervention in the DE course was designed from a constructivist approach to encourage

the students to learn, and develop student's ability to solve new problems, employ creativity, and nourish critical thinking through technology integration (Griest, 1996; Hoffman, 1997; Sadik, 2008). The participants' engagement in critical and reflective thinking was a constructivist strategy, as stated by Nanjappa and Grant (2003). The idea that students must be meaningfully engaged in the learning activity was fundamental to engagement theory (Kearsley & Shneiderman, 1998; Sadik, 2008; Shneiderman et al., 1995). The way technology was used in the intervention was more important than the type of technology, as Strommen and Lincoln (1992) determined to be relevant in a constructivist classroom. Learning valuable long-term skills through technology made Larry confess that "these technology skills will help me in college by helping me to understand that I do not have to do everything manually." Lim and Tay (2003) classified technology tools as (a) informative tools, applications that store in formations like databases or web resources, (b) situating tools, systems that place students in different environments, like games and simulations, (c) communicative tools that facilitate communication between actors involved in the learning process like emails or discussion boards, and (d) constructive tools, technology tools that are used to construct knowledge like PowerPoint or projects that involve use of technology. The importance of exposure to such technology tools was another category that grouped codes like Alice's opinion, Gina's acknowledgment of embedded technology, and other participants' opinions. This paved the way for creating the third category embedded in this theme. This second theme was comprised of three categories: (a) the embedded technology positively influences the learning process, (b) the importance of exposure to DE technology for the learning process, and (c) acknowledging the influence of technology on pursuing math.

The Embedded Technology Positively Influenced the Learning Process. This category was defined as grouping together focused codes that aimed to highlight technology advantages regarding the gain of valuable long-term skills through technology, joy of learning, usefulness, effectiveness, meaningfulness, and accessibility of the use of technology, and college perception through the technology influence.

Integrating technology in the learning process was defined by how and why it was used, not by the amount or the type of technology (Earle, 2002; Sadik, 2008), and students' voices proved this. Adam recognized the lack of interaction with some of the technology tools embedded in the DE course. He said, "Oh, I've never even heard of JASP before this class, and I really didn't use the Texas instrument calculator very much before this class either." Included in his comment was the TI 84+ graphing calculator, which was the most widely used tool in HS math classes. He believed that using such tools made him successful. He noted, "I think they'll make me more successful because now that I have an idea of things like how to use that calculator." He was convinced that technology would help him succeed in college, saying "I have access to the Internet, it'll make me more successful in college and I'll have more tools to help me be successful." One of his colleagues, Alice, mentioned her big accomplishment in the DE course, learning the TI 84+ calculator functions, because as she said, "it's important that [students] know how to use a calculator." Learning the calculator influenced her learning process. She relayed to me, "that's definitely one of the most defined things that I did this semester, was learning that calculator inside now." Gina also confirmed her gains in the technology area. She stated, "Oh, I gained a lot of technology skills," including the same skills that helped her use the TI 84+ functions successfully. She elaborated, "or like

learning how to find the probability of things, I can do it on a calculator." She had never worked with most of the tools embedded in the course. Gina stated, "like I said, I didn't work with Excel before so I definitely know how to take data off and put it in there and then got the data back by putting that in JASP." She concluded by acknowledging her gains: "We learned a lot, but those are the main ones." Larry confessed that "these technology skills will help me in college by helping me to understand that I do not have to do everything manually." He believed that the technology made a difference in his focus on the subject. He stated, "I believe that the technology did make a good bit of difference and the course being easier. I find it easier to work with technology than just staring at a paper and writing on the paper the entire time." Larry also mentioned the higher involvement in class activities when technology was embedded. He explained, "Because it feels like you're more involved with using the computer. And I seem to not get as distracted as much when it's just a piece of paper." Mary's input on the discussion of the technology integration brought into discussion the necessity of such integration because as she noted, "the world was changing basically, so I had to basically get with the technology." For her, it was not a hard task to use the new tools. She stated, "it wasn't hard, and the influence and the intentions of it really helped me when we had to use big data 'cause I can't do it on my own." The student's experience in the embedded technology DE course was voiced; Adam and Gina both brought strong evidence about the gain of useful long-term skills through the use of JASP. Alice and Adam mentioned that learning was easier when TI 84+ was used, while Gina and Mary mentioned the benefits of using Excel in analyzing big data files making learning effective.

Importance of Exposure to DE Technology for the Learning Process. The use of technology with constructivist methods, like the projects the participants did in the DE math course, made the learners more responsible and helped them realize the benefits of being active in the learning process with new capabilities being possible through the use of technology (Grant, 2002). This category grouped focused codes that characterized the abundance of the technology used in the DE class, such as JASP, Excel, online Stats Apps, TI 84+ Stats apps, XYZ platform, D2L, and Google Classroom learning management systems, teacher-created videos and Metadata projects. Duffy and Cunningham (1996) mentioned that such an abundance of technology provided "a richer and more exciting (entertaining) learning environment" (p.187).

The study participants voiced the results of their exposure to technology for an authentic learning environment (Nanjappa & Grant, 2003). Adam was pleased with the technology embedded in class. He stated, "I like using technology, especially whenever it's helpful. You know, like all the things JASP, XYZ. The video lessons D2L." The help he had through the use of technology made the learning process effective. This was evident when he said "It really helped me like break down the lessons and stuff we went over in class, and now that I know that there's always going to be technology that can help me with whatever I'm struggling with it." Gina brought into discussion the use of JASP and the help she had with testing the different hypotheses. She stated, "Yeah, it's a lot. Learn how to create a hypothesis and cleans and yeah cleans and how to form a hypothesis. I'm trying to think about all the lessons was a lot." She also mentioned the projects from each course module. She said, "We did a project for every module we learned that would tie everything together. So that definitely helped as well, "each project

involved different technology tools. Larry was also impressed by the advantage that the use of JASP gave him in understanding the course material. He noted, “The JASP program was honestly, really surprised with how much it helped me better understand.” The use of JASP for projects with a huge amount of data proved the learning process's efficiency and usefulness, as Larry said:

> Using it for systems like metadata with the amount of, what's the word, information that you would have versus you just using it and doing it manually because there's just too much for you to manually do, and the JASP program. Really helps and it's clear for you to understand using the JASP program.

All three students, Adam, Gina, and Larry mentioned JASP, the Stats Open-Source Program that made a difference in analyzing the metadata they had to interpret through different projects. Alice was so fascinated by the projects she did in class that she felt the need to share with her friends the experience of becoming a “capable and mature learner.” (Nanjappa & Grant, 2003, p.46) The authenticity of the JASP projects was critical for the students’ ability to use their ideas to make meaning of the concepts presented (Brown et al., 1989; Ertmer & Newby, 2013). Alice followed her colleagues and agreed that “the metadata was my favorite. It was my favorite project looking at all the data, it just all of it looked so fascinating, and I love that I was able to understand it.” She was so impressed by the JASP program that she felt the need to discuss it with her friends outside the class, saying, “I remember showing my friends the project. I was like yeah I got to do this really cool project. Do you want to see? No one knew what it meant.” For her, it was a huge help throughout the learning process. She stated, “it was just like a kind of like personal achievement for myself, knowing that I knew what it

meant, and I was able to understand it, and it felt amazing." Ella referred to the difference between the use of JASP and the possibility of using the spreadsheets. She noted, "Very useful that out, but it has all the data organized, and it makes it's a lot easier to find a certain type of data than if it was just out and not in Excel." Referring to her projects about the salaries of CEOs of different companies she said, "I think it was salaries." She acknowledged the huge amount of data that could not be easily analyzed outside Excel and JASP, stating "Yeah, it was a ton of data, definitely. I definitely would not have been able to handle it outside of Excel." Mary felt similarly to her classmates, saying about the calculator "I mean, I gained a lot even on just the regular calculator… I learned a lot more." Her comments acknowledged the level of learning from the calculator. Inevitably, she also mentioned JASP and the fact that she can rely on technology:

> With the JASP and other stuff I've learned that you know I don't have to do everything by myself. I can also rely on technology and the XYZ Platform everything that we have in there, yes. It also helped me because the videos I could go back even if it was just to study.

All students were enthusiastic about the ease of use of the technology, characterizing it as Larry did "JASP was a lifesaver." As Witfelt (2000) observed, the constructivist theoretical framework determined me to assume the facilitator role helping the students construct knowledge through problem-based and project-oriented work. As a facilitator, I had equal responsibility and authority with the students whose "own effort to understand at the center of the educational enterprise" (Prawat, 1992, p. 357).

Acknowledging the Influence of Technology on Pursuing Math. This category was defined as grouping focused codes that identified the pursuit of mathematics among

the benefits of participating in a technology-rich DE math course. Recognizing the inclination toward math, simplifying math workload, and the technology influence in shaping intentions to attend college and support learning in college classes were grouped to help define this category. Cuthell (2006) found a strong correlation between computer technology, student engagement, and mathematics improvement. Since the invention of computers, the number of tools used to integrate technology in math classes has increased, and applications' ease of use and success in helping students learn math increases faster every day (McCulloch, 2018).

Participants' detailed and thick descriptions of their experiences in the DE math course, like Alice's, were an excellent source for future studies. She stated, "But the more we got into this class, I didn't realize how much I enjoyed math. How naturally it came to me and just how easy it was for me to get into the flow with it." Alice described technology's great influence in changing her desire to follow a medical field major toward engineering after realizing how much she enjoyed math. She explained, "I'm going to heavily focus on the math portion now whenever I get to college. That's definitely going to be one of my favorite things that I'm excited for, was to take those math courses." Experience in the class made Alice realize the math universality. She noted, "the class it showed me how, what was it. How math influenced, we don't realize the math behind everything." This increased Alice's desire to take more math classes when in college.

The integration of technology made the classwork easier for Larry. He stated, "with the integration of technology I have found it easier to do math with technology versus just manually trying to do everything. And it really refined the idea of computer

understanding." Larry realized that the computers had many capabilities that he had never used before. He said, "I didn't think that you could use the computer to help you with as much math as you can actually use it for." He realized that he would be more efficient by using technology. He explained, "I can use technology to help me with my math work, and it will allow me to be more efficient within my mind, my math work." Alice discovered that math helped make jobs easier, realizing that math is everywhere "the math behind the car that you use, the math behind the food that you eat, and math was behind everything. And that's what really got me to take to want to take these courses." By taking more math classes, she expected to better understand the world around us. Alice elaborated, "because the more I take these math courses, the more I understand the world and how it works. So I think the more math courses I take, the better understanding I'll have." She hoped that after college graduation, she would "just have like a deeper understanding of like everything behind the scenes." Larry looked into following a cyber security career after taking the DE class. He stated, "I believe that technology skills that I have gained or refined was the ability to use technology better with my math. Because I always believed that doing math manually was the proper way to do something." He was convinced that technology would help him with the math classes.

Other participants' encounters with the technology presented a similar outcome for them: they believed that technology supported learning in DE math classes, acknowledging the influence of technology in pursuing future math classes. Gina realized that math was shaping her college intentions. She stated, "I realized that I'm a lot better at math than Biology, but I know I still have a good bit of math classes, so right now I'm still sticking with biology." Her statements revealed she was considering a different

direction in case she changed her mind about her original major. She elaborated, “but I think in the future if I had to change the Major, it would be based around some type of math.” Mary knew that technology would shape her college intentions, saying “I knew it was going to be like high technology, but it also helped me to understand that.” Students’ exposure to the technology-rich DE course allowed them to describe the influence the technology had in the learning process and their beliefs about math.

Summary. The participants' impressions that technology supported learning in the DE math class was exemplified in this theme by the student’s descriptions of the influence of the embedded technology, including the use of programs like JASP, Excel, online Stats Apps, TI 84+ Stats apps, XYZ platform, D2L, and Google Classroom learning management systems, teacher-created videos, and Metadata projects. The students’ reactions to the course intervention confirmed the importance of exposure to the above technologies. The course's influence on the pursuit of math declared by most participants (n=5) was strong proof that the use of technology supported learning in the DE math class.

Theme 3: Students’ Decision to Enroll in DE Courses Affected Their Career Aspiration. This theme described the participants’ responses that specified the DE influence on pursuing a postsecondary degree, outlining students’ goals for life and recognizing the necessary attributes of a successful DE student. The quality of a high school curriculum was mentioned by Hossler and Gallager (1987) as being positively related to college matriculation. Studies by Hearn (1984), Kolstad (1979), and Peters (1977) also mentioned the positive correlation between attending a postsecondary school and graduating from a high school that offered more math and science courses. This

study's innovation involved integrating technology in a probability and statistics DE college course taught in a rural high school. Students' decisions to go to college, the DE influence on their career, the reaffirmation of college plans, channeling their life dreams, the power of hard work, self-belief, and a positive mindset on future success all affected participants' career aspirations. This theme was comprised of three categories: (a) DE influence on pursuing a postsecondary degree, (b) outlining goals for life, and (c) recognizing the necessary attributes of a successful DE student.

DE Influence on Pursuing a Postsecondary Degree. This category was developed by grouping focused codes about postsecondary plans regarding the decision to enroll in college, course expectations, reaffirmation of college plans, and acknowledging the rigorousness of college courses' influence on shifting the attitude towards DE. Research findings of studies like those conducted by Peterson et al. (2001) focused on DE programs to learn about student perceptions of DE programs and students' decision to attend college confirmed students' satisfaction with the DE courses.

The DE experience influenced students' postsecondary plans, and Adam's decision after attending the DE course proves it. He said, "this class really helped me, like, had decided that I need to pick what I'm going to do now." Larry's encounter with the DE course helped him to want to go to college. He explained, "After participating in the Math 120 dual enrollment course, the experience I have had would encourage me to enroll in college. It's prepared me a lot for what I will have to do." Taking the course crystalized his post-secondary plans.

For some participants, the course expectations were exceeded. For example, Gina's experience in the DE math course spoke highly about how the course reality

topped her expectations. She stated, “My expectations were pretty low. I mean, if they weren't that low like I knew, I could have done it, but I did have doubts, but I think working with everything definitely exceeded my expectations.” Students encountered an unexpected class environment in the DE course. Larry concluded, “college seems a lot easier to me now versus the expectations that I first had before doing any college courses.” In Adam’s testimonial, he was more specific about his encounter with DE courses that helped him to understand better how the college courses would help him get a degree. He stated, “Now that I've been through this class and other college classes I've taken, you know, it really helped me out with understanding college courses and how much work it goes into getting a degree and things like that so.”

For Gina, the course reaffirmed her college plans of following a science major. She said, “I realized that I'm a lot better at math than Biology, but I know I still have a good bit of math classes, so right now I'm still sticking with biology.” However, she was thinking about possibly changing toward a much heavier math major in the near future, saying “I think in the future if I had to change the Major, it would be based around some type of math.” Similarly, Ella’s career plans were not changed but rather reaffirmed by her participation in the DE course. She stated of the course meeting her expectations: “It reaffirmed what I already thought would happen. You know, with coursework and content and speed. But you know, still positive.” It seemed that both participants were satisfied with the reconfirmation of their initial post-secondary plans.

The acknowledgment of the rigorousness of college courses was immediately realized by Alice, who decided that stepping into that class, she needed to change her approach. She noted, “This was where I really need to start disciplining myself.” The

influence of shifting the attitude towards DE was witnessed by Alice, whose attitude toward DE courses and college was changed after the intervention. She said, “It definitely changed my mindset because, in the past college course that I took last semester, it wasn't as intense as this course.” Supporting the same idea, Alice confirmed her classmates' feelings about the class influence regarding their view on college classes, saying “I think because of me taking this class, I'll truly be better off in college than I was before because I would have been just trudging through.” But this class taught me what I needed to do.” Overall, the course's influence on students’ postsecondary degree pursuit was heavily witnessed by their experiences in the DE class.

Outlining Goals for Life. Participation in the DE course helped students revise or channel their life goals. The theory of planned behavior was an essential conceptual framework for studying human action, guided by behavioral, normative, and control beliefs (Ajzen, 2001). The perceived behavioral students’ control of their goals in life was more like the perceived control over the performance of their behavior. This could be measured by asking the students direct questions about their capacity to perform a specific behavior or based on beliefs about their ability to deal with deterrent or facilitating factors. The students’ beliefs that they would continue on a postsecondary path after graduating high school got confirmation, and some felt encouragement for their educational plans after attending the DE course. Attendance of the DE course was seen as a facilitating factor, while some inhibiting factors, like the inability to submit the college application, were factors that were not under their control and might still have deterred their intentions.

Four of the participants experienced changes in their life goals after taking the DE course. Larry mentioned that his goal before enrolling in the DE course was to go to college. He said, “I did plan to go to college before enrolling in the dual enrollment course.” However, he was afraid. He expressed this when he said, “like some big monster that if I fall behind will just swallow me up.” After the whole experience, he realized the DE course facilitated his goal of continuing his education. He said of the experience: “I feel more prepared for college than I ever have been before.”

In the case of another study’s participant, Adam’s goal was not defined before enrolling in the DE course. He stated, “I didn't really know what I wanted to do.” The course definitely helped him define his goal of becoming a computer engineer. He noted, “Now I want to be a computer engineer.” His thought was crystallized by the course experience that played a role in his belief that postsecondary education was now feasible. He explained, “After taking these classes and seeing how successful I was in here and other classes, it made me … actually truly want to go to college. Now I go to. I'm enrolled in Clemson.”

The DE course had a major contribution to Gina’s future plans. When coming to the DE class, she was convinced of pursuing a major in biology, saying “I'm going into college as a biology major and I was also I'm taking anatomy and physiology.” After realizing how good she was at math, the course experience played a major role in opening a new option to her initial plan. The experience in the DE course made her think that a possible change in her major would be toward a major that required more math. Even though she did not decide to change her major, the experience gave her a future option by teaching her to have more trust in her math skills.

The most remarkable impact the DE course had on one of the participant's life goals was Alice's change in her college plans, switching from a dream of becoming a doctor. Alice's confession about her decision to steer the boat toward an engineering path from a medical direction was eloquent: "At the beginning of the semester, I was. I had it in my mind that I wanted to be a doctor and take the medical field route and everything like that", realizing that a new possible future path is opening for her "then I found engineering. So yeah, it definitely changed. Because if I didn't take this course, I would still be trying to be a doctor, and I'm glad I took this course." She concluded that now she knows what she wants to do.

The change in her desire for a medical field toward an engineering career resulted from her exposure to the technology-embedded DE math course and the elimination of her fear for math upon enrolling in the DE class. As the class progressed, she was more and more convinced to change her mind and switch toward the engineering direction, motivated by her newly discovered love for math:

> But the more we got into this class, I didn't realize how much I enjoyed math. How naturally it came to me and just how easy it was for me to get into the flow with it. Unlike with science, I feel like I'm always fighting it like I'm always trying to beat it. But with math, I can just go with it. It's just I realized that math was something that I liked, and then I started exploring past that, including math.

While most of the participants had their life goals change after taking the DE course, two participants' goals were reaffirmed. Ella's plan to go to college was already one of her goals before enrolling in the DE course. She noted, "I have always planned to go to college. It was probably planned for me to go to college before I even made the

decision myself, you know." External factors influenced her decision to go to college, and her participation in the DE course did not change her plans. She stated, "I still plan to work in IT, so it didn't change that." Mary, the sixth study participant, had a similar experience: the DE course experience reaffirmed her life goal of going to college. Mary said, "I realize you know I'm on the right path that I want and the amount of studying and the procrastination and stuff that I need to do. It has helped me a lot." Four of the study participants had their goals for life changed, while for two, participation in the DE course reaffirmed their plans.

Recognizing the Necessary Attributes of a Successful DE Student. The study's participants highlighted the main characteristics that DE students should possess: commitment, discipline, focus, hard work, a positive mindset, self-belief, and necessary study skills. The above-focused codes grouped academic and personal characteristics to underline the importance of such attributes of successful students.

Ella was adamant about the ability to focus and pay attention. She explained, "I'd say like the ability to be able to focus enough and pay enough attention to get the grades they need to." The amount of effort a student was willing to put into the study was a personal characteristic that she identified. She said, "Like whether it's just paying a decent amount of attention or putting all, putting a lot more effort into it depends from person to person." In Mary's opinion, the main characteristic was the desire to succeed. She relayed, "Well, I feel like they have to want it…. It's not mostly about your grade or GPA, but if you actually want it then you'll do it." The personal characteristic highlighted by Mary was constant class attendance and absence avoidance. She elaborated, "As long as you can keep a steady grade and you're not missing class and skipping, you'll do fine."

Gina brought into the discussion more personal characteristics, such as time management and organization skills that were overseen by some students in their preparation for college. She stated, “because it's definitely time management and organization skills, and I feel like those are personal because you can use those skills with really anything.” Motivation was the attribute that she recommended as completing the main personal characteristics of a successful college student. She stated, “Yeah, just take a lot of motivation to be on top of your work.” Regarding the academic attribute, Gian’s suggestion was the need for study skills. She explained, “I would say studying. You need to have the study skills for sure.” Larry’s personal characteristics were dedication and hard work. He said, “I believe that a person should be dedicated, hardworking, and believe in themselves enough to succeed in order to excel.” The academic standing for rigor and honor were two other attributes mentioned by Larry. He noted, “I believe they should have a great academic standing, or a dual enrollment course might hurt them a little bit.” An important characteristic, in Alice’s opinion, was self-discipline. She explained that in her opinion discipline is a very important characteristic “ 'cause if you're not disciplined, you're not going to get the work done 'cause the workload. If you can't push yourself to make sure you get your stuff done, you're not going to get far in the class at all.”

For the sixth student, Adam, a hard-working attitude was needed in the college courses to succeed. He said, “[students] definitely need to be hard working 'cause there's a lot of work that goes into these dual enrollment classes.” The positive mindset was an attribute that Adam was convinced was needed to help college students to commit for hard working. He stated that when coming to school a student should have “a positive

mindset because if you're just negative about the classes you take, you know you're not going to want to do your work in them and it's going to result in you getting a low grade." To summarize, the attributes identified by the participants were characteristics similar to those brought into light in various studies: clear goals, strong motivation, learning-study strategies, a drive to succeed, the ability to manage external demands, and self-empowerment (Grimes, 1997; Martin et al., 2014; Schreiner et al., 2020). None of the students mentioned the ability to work in groups and the willingness to work with people from different backgrounds, which was a surprising omission to me since these were considered important parts of the course activities.

Summary. The participants recognized the DE influence on their plans to pursue a postsecondary degree. Their decision to follow a desired postsecondary major was deviated by the DE course participation, and the mindset with which the students entered the course was changed. The participants' better understanding of college courses and identifying the main attributes to succeed in a DE course played an essential role in their career aspirations. The changes they made in their plans for college or the reaffirmation of existing plans resulted from implementing the technology in the DE course.

Theme 4: Students' Perception of College Courses Was Influenced by the Contrast Between DE and HS Courses. This theme was focused on DE students' perceptions of "college academics, and academic rigor students hold prior to and after enrolling" (Meyer et al., 2009, p. 1070). Student perception of postsecondary education was defined as the level of awareness, lack of, and influence that DE courses have regarding students' decision to pursue a postsecondary education path. The contrast between the DE and HS courses was among the contributing factors the students

perceived to influence their future educational goals. The categories developed by grouping the focused codes included the challenges and contributing factors they perceived as helping or hindering their future educational goals, impressions about college classes prior to and after DE enrollment, the rigor and the requirements of DE and HS courses, and the DE course highlights that included teaching style and embedded technology in DE courses. By recognizing how students' experiences in dual enrollment courses influenced their educational goals, students' perceptions could be defined concerning the career opportunities postsecondary education offered and the improved standard of living (Artman, 2017; Lile et al., 2018). The following categories are described below: (a) prior and after DE enrollment impressions about the college classes, (b) DE vs. HS courses' characteristics.

Impressions About the College Classes Prior to and After DE Enrollment. This category was formed by focused codes that grouped the students' expected course difficulties regarding the level of effort needed in a DE course, the pace of the course, view of college classes, and DE gained knowledge.

The study's participants had pre-course concerns about the level of effort needed to succeed in a DE course. Initially, Alice shared an expectation of a demanding course, which would require a great deal of effort to keep up with the work needed to succeed. After the course, she concluded that her fear exceeded reality. She stated her expectation of the course "to be like a lot more difficult than it really was so." Larry shared similar expectations regarding the higher level of difficulty a DE course would employ as compared to a regular HS course. After completing the course, he concluded that his fears were exaggerated and that participating in the course was helpful in his academic career

and a source of enjoyment. Larry's pre-course perception of DE courses was invalidated. He stated of his participation in the course: "[it] changed my expectations of the regular college course because it's not as hard as I thought it would be compared to a regular course. It was just a little bit more was demanded of you." His statements led to the conclusion that the DE course represented what a college course would look like. Three other participants voiced a similar opinion to Alice and Larry, as they expressed pre-course concerns. Initially, Mary did not pinpoint her concern, but she did expect the DE course to be different from the HS course she had previously taken due to the difference in level. After discussing more about her post-course experience, she expressed her pre-course concern in terms of the difficulty of the class, similar to her classmates, but her post-course impression was different. She stated that "I thought college classes were going to be very hard and very draining, but this class was not bad at all." Adam's knowledge about the DE course also changed his view of the DE course. He mentioned, "I knew they were going to be hard, but I guess I didn't quite expect how much work really goes into it. But I mean, if you put enough work into it, you know, it actually becomes pretty easy." Most of the study participants ($N = 5$) showed a consensus, expressing the same concern regarding the course's difficulty level.

The participants' academic view of the DE course changed during the semester. Ella's pre-course expectation was that the DE course followed a logical next step in the education sequence. She noted, "[the DE course] just kinda was like a natural progression of schooling, you know, like as I've gone through school, it's gotten harder." That made the next step (class) more challenging for her than the previous one. She said of the next class, "it would be more content, you know a little harder." After the dual enrollment

experience, her impression changed. She relayed, “I know how the coursework will likely be. You know it's not too scary on the academic side of things.” The dual enrollment course experience did not validate her concerns, concluding that she feels academically prepared for future college classes.

Regarding the course pacing, Gina confessed that she expected a fast-paced course. She said of the course, “[it would be] a little hard and fast-paced…. I expected them to be a little difficult…I just thought it would be difficult.” After the course, Gina’s impression was similarly changed. She declared that she “was thinking it was going to be hard and stressful, but it was honestly not bad at all, the complete opposite.” All six participants had pre-course concerns, and they voiced them, and the DE impressions were, in most cases (N = 4) confirmed. The common denominator for all six participants was the difficulty level; words like hard, grueling, and difficult described their concerns about the DE course. Ella explained her expectations as a natural progression between HS and DE-level courses.

DE vs. HS Course Characteristics. Students’ participation in the HS and DE courses allowed them to compare the requirements, rigor, and teaching style in both environments. The academic rigor of HS courses was essential for preparing students for college-level coursework (Adelman et al., 2003). There was a direct relation between the academic rigor of HS college credit-earning courses and enrollment in college work (Morgan et al., 2018; Wyatt et al., 2011).

Requirements like a higher level of effort and more assignment flexibility were among the differences between DE and HS courses that influenced students’ perception of college courses. The differences that Gina noticed between the HS and DE courses

refer to the class organization and the level of independence. This was evident when she said, “everything [is] just organized differently, and I like that, and I feel like we're more independent in the college courses than the high school courses…. we were more independent in the dual credit classes.” The level of independence in choosing the projects and the path toward solutions was another difference that Gina experienced in the DE courses, stating that “we could have chosen what we want to see what we want it to work, what we want to use when [in] a high school course was kind of given to you.” Adam mentioned that there was more time to do the homework in the XYZ platform since the due date for all homework assignments was at the end of the course and not spread during the course. The same requirement was mentioned by Ella, too. She said, “like with homework, it did help, first, you have like more time to do it.” Another difference the students identified in the course requirements was the technology element. In contrast, most of the work was required on paper in the HS courses. The students agreed on the technology's role in the DE course. Ella compared the work she did in high school classes, saying “I did, most of the work on paper, you know, most of the assignments were just on paper.” However, with the dual enrollment course most of the work was done using technology. The requirement to watch the videos and take short quizzes embedded in the videos was mentioned by Mary. She stated, “Well, the differences are that we actually have videos to go back and to look at, which was very helpful to me because sometimes I would understand, but I would like to switch them, and so I needed that.”

The rigor of the DE course was mentioned by Alice, who considered that the course explored the material further in-depth compared with the HS courses. She noted,

“I believe the college dual enrollment courses go into further depth than normal high school courses. I remember taking regular math in high school, and it just felt very basic, like it was just skimming the top.”

The study participants mentioned appreciable differences between the DE course's teaching style and the HS courses. Alice mentioned the higher level of teacher involvement and the availability to answer any questions the students had. She stated:

> The high school teachers that were teaching those math classes didn't seem all that into it, like in 9th grade, when I was taking algebra, the teacher just did his lesson and gave kids work, and that was it, but with this class that you were very involved with each and every one of us and you made sure like everyone knew what they were doing.

She appreciated the stress-free class regarding the need to teach herself the material, as in the DE course, the teacher did a proper job of covering the material. Regarding teacher involvement, Alice also mentioned the constant push for students to stay on track and keep them accountable for their academics saying, “you make sure all the students put in effort and you holding me to that accountability of being where I need to be, doing what I need to do.” The result was compelling. Alice reported her satisfaction with the results, saying “that helped me get to where I am right now” and “I did not expect to get 100 on my final Exam. That was like the biggest surprise.” Furthermore, Alice appreciated the pacing guide and planning, as it clarified the direction of the course. This led to a great understanding of the material for her. She noted, “That was very rewarding considering how scared I was for this course. Finishing on top was astonishing for me because I never thought I'd be able to do that.” Larry identified a remarkable teaching style difference, as

the HS course imposed heavy memorization of the content. In the DE course, students were asked to discover the new content, and the teacher facilitated the access along the way. Larry stated:

> Regular high school math courses that I've took that it seems they want you to have more memorization of the content versus actually knowing how to do it like I'm taught in math 120. Because back when I took Algebra 2, I believed it was just memorizing everything and the teacher told you a lot of the information versus you having to figure it out yourself.

Most students (N = 4) had a consensus regarding the teacher's level of involvement and seemed to care more about the student's performance in the DE course, a difference that Larry had seen between the two courses. He mentioned "[teachers] seems to care more about how the students perform within their class, and they are more focused, I guess you could say, on the material with the students." Gina's opinion contradicted the other participants since she saw no difference between the HS course and the DE course. She stated, "besides the different websites we were using, you know it was that's, I think that's the only difference. The material that we use and learning different material. But other than that, it felt pretty much the same." She elaborated,

> We go over the objective, and then we get into like what lesson we will be doing and then the examples because the examples actually help us in getting to doing it by ourselves and then the class, worksheets that we get after the lesson.

Gina admitted that the DE course worksheets and homework requirements were different. She liked that difference, stating "we do those [worksheets] I like that, and then our homework that we do in our own time." All six participants reported their opinions about

the differences between the HS and DE courses. The students noticed differences in the teacher's focus on the student's performance, the class organization, a higher level of effort, less memorization, greater independence, and more flexibility with assignments in the DE course.

Summary. The participation influenced the students' perception of college courses in the integrated technology DE course. The students' experience in the DE course helped them better understand what to expect from a college course. All participants ($N = 6$) expressed their belief that from now on, the college courses were not as scary for them as they were before enrolling in the DE course. The realization that their fear was exaggerated came from fully embracing the DE experience, the rigor, requirements, and the teaching style of a college course. Critics of DE programs like Andrews (2000) and Johnstone and Del Genio (2001) feared that the quality of the college courses offered on college campuses might decline since high school students would influence academics. Most of the deans and faculty with whom Johnstone and Del Genio (2001) discussed expressed their opinion that "it was an ignorance and an opposition that was not likely to be alleviated without more transparency and acknowledgment on the part of those colleges sponsoring school-based courses" (p. 28). The students' encounter with the embedded math DE course did not confirm their expectations when thinking about the course's requirements, rigor, and teaching style.

Theme 5: Students Acknowledged the Benefits of Being Enrolled in the DE Course. The beneficial factors that led to enrolling in a postsecondary program consisted of the opportunity offered by DE programs to earn tuition-free college credits before HS graduation (Farrell & Seifert, 2007; Hoffman et al., 2009; Struhl & Vargas, 2012). The

students who participated in the DE courses at the local technical college earned college credits. However, they had to take additional exams that validated the dual credit if they needed to transfer to a university (Karp et al., 2004). The students enrolled in the DE math course were from low-income, rural areas, and preferred staying at home while enrolled in the local technical college for two years. They planned on transferring their credits to a four-year college and minimizing their after-college tuition debt. Therefore, the technical college services, the DE course ambiance, and the overall DE experience contributed to their decision to continue their secondary education. This theme was comprised of three categories: (a) acknowledging the DE experience, (b) students' feelings on DE course ambiance, (c) Students' post-DE perception of college courses, and (d) the usefulness of college services.

Acknowledging the DE Experience. The DE courses were developed to help students close the gap between high school and college. Pursuers of Associate Certificates from technical colleges needed fewer semester credits to gain accreditation (Arnold et al., 2017; Hoffman et al., 2009; Jones, 2014; Kanny, 2015; Karp & Hughes, 2008; O'Gara et al., 2009). Focused codes from which this category emerged grouped together codes that (a) presented students' positive experience in DE courses explaining the DE perception and experience with technology, and (b) witnessed the shift in attitude towards DE and the state of preparedness for college.

The students' positive experience in the DE course was one of the focal points of discussion with the study's participants. Alice's experience in the DE course helped her change her mindset and discipline. She became ready to put enough effort into coursework, saying that "I think as long as you have the right mindset and you can

discipline yourself, and you're ready to put in the work and the effort, it'll be fine." Learning to stay dedicated and on track helped her avoid dragging her feet and trudging through the course materials. Despite her fear, Alice decided to enroll in the DE course, but she got "enough courage to jump out of the box to cross the line." Her participation led to her concluding that her future academic and career options seemed endless. This course changed Alice's career path, and she acknowledged the benefits of the experience she had in the DE course:

> OK, so if I knew how this class would have been and I decided not to take it, I would be so upset at myself. I mean 'cause, considering that this class was the class that changed my career path, I cannot tell you how upset I would be with myself if I hadn't jumped the line if I hadn't pushed myself to do better to do this course I wouldn't be who I am right now and I know.

All of Alice's positive attitudes also matched the course goal. She stated that "this class should be put on a pedestal compared to the others." Similarly, Gina had a positive experience; her expectations were exceeded by the DE course, and she stated that she would have been upset if she had not taken the class. Experiencing the DE course before going to college was what Mary appreciated. She noted, "[the course] gives you that experience like before you're not just dropped into college, so I know, like with the college atmosphere and what my teachers expect of me and from me." Furthermore, she wished that she would have taken more DE courses. Another study participant, Larry, initially did not believe that the DE course experience would match his expectations for a college course in terms of difficulty, only to reverse his statements at the end of the course, concluding that he felt better prepared for the college course. Larry additionally

acknowledged the course benefit of helping him with the real-life application of math concepts. He stated, “It was helping with my future plans, and you know a little bit more than that…it's helped me to understand the way that math can be involved with life.” Ella’s opinion about the benefits of taking the DE courses was not so categorical. She acknowledged, “With the taking the college courses, [it] has definitely given me a little more insight into college itself.” She stated that the course development met her expectations in regard to the similarity to college courses.

The technology-rich DE course allowed the participants to experience a multitude of tools. Gina acknowledged the helpfulness of these tools, stating “I could say the technology was very helpful…we wouldn't be able to get a lot of things done without the technology that we use.” Another acknowledgment of the positive experience with the technology was brought by Ella. She stated, “I think it was very positive, I liked the technology, [it] made things a lot easier.” Ella recognized the usefulness of the technology tools. This was evident when she said, “I am glad it was there; it’s definitely something that should be there, something that I'm glad was there.” Her statements acknowledged the appeal of using technology. Contrary to her classmates, Mary was expecting more use of technology. She noted, “well, it isn't as much as I really thought it was going to be.” However, she recognized that it was enough for her to be able to grasp it, saying “but it still was a lot for me.”

The students’ shift in their beliefs toward the DE course helped recognize the emotions they experienced before enrollment in the DE course, and the impact the DE course had in this change. The previous DE classes did little to nothing to give Alice an

understanding of the college courses, an aspect which had now changed, and the course gave her “courage and bravery.” This change boosted her ego. She stated:

> And honestly, if I hadn't have taken this class, I don't think I would be who I am right now. I don't think I would have as much courage and bravery as I do right now 'cause finishing on top of the class. That definitely boosted my ego in a good way because I was never confident before this class.

The course changed Alice into a new person, which she enjoyed. She noted, “This class definitely put me in a new mindset, and with a new mindset comes a new person, and I definitely love the person that I've become because of this.” She elaborated that she had become a person with “the courage to do anything.” Adam’s acknowledgment of his experience in the DE course spoke loudly about how beneficial the course was for him. He stated, “Without dual enrollment, I really don't know if I'd be successful, like going straight into college.” Even though he was conscious of the difference between the DE courses and college courses, he stated that he had a picture in mind of what to expect in college. His time in class was painted as the great time he had in high school. He said, “I had a great time in dual enrollment.” Another study participant, Larry, initially did not believe that the DE course experience would match his expectations for a college course, only to conclude that “it matches the expectations I would have for a college course really well, I believe it's prepared me more for college than descriptions that people give.” As seen with other students, Larry acknowledged that the course helped him with the real-life application of math concepts in addition to having prepared him for his post-secondary classes. In conclusion, all six participants in this study highlighted the positive benefits of enrolling in the DE course.

Students' Feeling on the DE Course Ambiance. Hoffman et al. (2009) defined DE programs as programs that "allow high school students to enroll in college-level course work and earn credit for it while they are still in high school" (p. 45). This definition did not distinguish between the location delivery; the focus of this study was courses taught inside the high school campus. The DE course ambiance refers to focused codes about (a) classmate's relationship and (b) the DE environment regarding the location and costs.

The classmates' relationship-focused codes grouped characteristics of the classmates such as age and maturity level. Adam perceived a positive classmate atmosphere and mentioned that most of his classmates were "all similar in age." The classmates' behavior was not an issue because, according to Adam, "Most of us are pretty mature" and "in this class, maturity level really wasn't a problem." The atmosphere was adequately kept, Adam remembered that "we talked and all that, but whenever you asked us to be quiet, you know focus we did." He noted that he felt the atmosphere was good, saying "so I felt like specifically, in this class, we had, it was a good class, yeah."

Gina had a similar impression about the level of her classmates' maturity and pace. When needing help, Gina stated that she could rely on her classmates, which created positive feelings towards them. She stated, "[I] feel pretty good about the people I spent the semester with." Expanding on that, Gina noted that "overall we had a good student relationship." Similarly, Alice's impression was that all her classmates were mature, which led to everyone taking the classwork seriously. She noted, "we all still like had like a sense of humor and like everyone was able to joke in the class" She concluded that "it was like a perfect mix really because I'd be able to make some jokes, but I also

knew I'd get a lot of work done too." Only one participant, Ella, had a different opinion about her classmates. She shared, "they acted like high school students and not college students." In the end she concluded, "they were still, you know, people that I'm used with." In conclusion, most participants (N = 5) felt that their classmates acted maturely, and the class atmosphere was good, which allowed them to have a good experience in the DE class.

Some studies reported that students were not entirely satisfied with the DE experience when the courses were taken on college campuses, as they felt isolated from the rest of the students, judged by classmates, and reported discomfort due to lack of familiarity within this context of learning (Azimzadeh et al., 2015; Kanny, 2015; Smith, 2007). As a positive characteristic of the DE course, participants mentioned the course's location inside the high school building. Larry pointed out the convenience of the location, saying "I really like [it] because I don't have to go anywhere special…[because] the dual enrollment course takes place within my high school." He was happy to take the course in the HS location. He compared this to taking college courses, saying "a course like they do in college, how there's multiple different buildings…my classes are focused within a close proximity of each other." Alice was satisfied with the location of the DE course because of the costs to travel to the Technical College building location. She stated, "being at HS that made it like so easy because if I had to go to Technical College to take those early college costs…I feel like would be a lot more difficult considering how I have to take my siblings to school." The time she would have spent to travel back and forth to the Technical College would prohibit her from picking up her siblings from school. The ability to have taken the DE course in the HS location made Alice's daily

schedule bearable. She noted, “these courses being offered here makes my life 10 times easier.” The location of course in her high school was a deciding factor. She stated, “I don't think I would have been able to take these courses if they were not held at this school.” Compared to Larry, Alice identified two benefits. She was not only thinking about the cost of traveling back and forth to the technical college but also the need to pick up her siblings from school, making the location a deciding factor for her. For Mary, too, the location's convenience helped her save time every day. It was important, she noted, “because I wouldn't have to travel 30 minutes from my regular classes just to go and then have to come back to school, and also I'm still getting the same experience.” The students’ experience confirmed that the high amount of work, commuting to college, and the high pressure would add stress to students' daily lives even though many agreed that it was worth it (Azimzadeh et al., 2015; Kanny, 2015; Smith, 2007). In the end, all six participants perceived the location as a convenient characteristic that helped them save time, while only one referred to the cost of travel back and forth from HS to College.

Students’ Post-DE Perception of College Courses. Students’ perception was defined as the ability to become aware of the academic preparedness for post-secondary education and their attitude toward post-secondary education viewed through the lenses of the DE program (Anderson, 2010; Chenoweth & Galliher, 2004). This characteristic emerged from focused codes such as (a) DE mirroring a college course, (b) the positive post-DE perception of college courses, and (c) the perception of fear from enrolling in DE courses.

The students’ post-DE perception of the academic preparedness for college courses offered them familiar feelings about the college courses. Alice was previously

taking other DE courses saying that “all the other college courses I've taken it just felt like it was another high school class” because “the work was repetitive like high school classes.” But this DE math course made her feel like she was in college. She explained, “it definitely felt professional like this class felt like I was in college.” She further noted that the class gave her insight on what a college course would be like. Following Alice’s perception, Larry’s opinion was even stronger, as he stated the course closely mirrored a college course. He made the comparison based on his DE experience and the videos of college classes that he had previously seen. He stated, “because I have seen like videos of a college lecture and the environment that the class gives, I think it really matches the college course courses.” Gina matched her classmates’ perception because she took the class seriously. She acknowledged that “this was what college would be like so I took it a lot more seriously, and it just got me prepared.” She stated that the DE course mirrored a college class: “they do mirror college classes because I was still taking high school classes and I think there was definitely a difference in the maturity level and just different.” The DE course content influenced another participant’s perception of the DE course. Ella stated, “it had content that was more complex or challenging than what I would expect in a high school course.” Therefore, she also had the perception that the class would mirror a college course. She noted, “Jesus, it's definitely what I would expect, you know, was what I would expect to happen in a college course.” Mary’s input about her DE perception was concise. She relayed, “If all my college classes are like this, I know I'm on a good foot.” Adam, the last participant, perceived the DE math course in a similar fashion to the other students. He stated, “Yeah, I think it gave me a pretty good idea of what to expect going into college as a freshman, so yeah.” He was also aware that

the college courses would still be different because he was preparing to apply to a big university and expected a different setting. He said, “I mean because don't get me wrong, I know that college was gonna still be different than dual enrollment because there's just gonna be a whole new different like new different setting.” Overall, all of the participants’ (N = 6) post-DE opinions of the college courses acknowledged the benefits of enrolling in the DE course and expressed a strong belief that the DE course indeed mirrored a college course.

The students expressed positive perceptions of the DE course. This was confirmed by Larry when he said, “no matter how hard I think about the dual enrollment course, I am really satisfied.” He continued, “[I’m] satisfied with the course and I do not believe there was anything that I wish would have been different.” Gina’s perception was the peak of appreciation. When asked if she would change anything about the course, she replied, “Honestly? I don't think I would change anything. Umm, the class was perfect.” Ella had nothing negative to say about the course, but she was more objective. She stated, “Nothing stands out to me as having been really bad or negative.” She elaborated that “everything was good, everything you know, either it was good, or it was something that I just didn't notice in the first place which you know definitely fine by itself.” Ella concluded, “so you know everything was good about these courses…it was just a decent course, it's probably better than whatever else I could have taken.” The students’ positive perception was illustrated in their opinions acknowledging the benefits of their dual enrollment experience.

When the students expressed their perception of the fear of enrolling in DE courses, they were somewhat abrasive in their comments. Adam was straightforward,

saying “I think it's stupid that they wouldn't take this class.” He was unable to find a good reason why other students should not take the course since he perceived it as being valuable. He stated, “I don't understand why people would refuse to enroll in these classes, they're so beneficial in so many different ways.” His only explanation was that “they think they don't need classes like this, or it's just extra work.” Mary also perceived the other students’ refusal to enroll in the DE course as a result of their fear of higher-level courses. She explained, “most people would refuse because they're like, oh, it's too hard, and I can barely pass the CP class, and I can't even pass the AP class, so why would I join.” Larry thought about the reason why the other students feared the DE courses. He offered this: “the reason I believe that a high school student would refuse to enroll in a dual enrollment course was because they…believe the course would be too hard for them.” He thought a solution might be to have a discussion with DE students in order to dissipate their fears. Larry suggested, “talk to somebody that took dual enrollment courses.” He felt the discussion would help them “realize it's not as hard and threatening as they believe it too.” Alice's input in the matter also highlighted the fear students felt when refusing to enroll in the DE course. She stated, “I think they're just scared because that's what we're told, I mean…. they are really just scared to leave the comfort zone.” She recommended putting away the fear and “stepping out of our own boundaries” as she did. All students felt that the DE courses should not be feared, and enrollment in the DE course was a natural step in pursuing post-secondary education.

The Usefulness of Online College Services. The perception that DE offered an opportunity to use the internet during class time to enhance course content had a score of 3.44 on a scale of 1 to 5, a positive aspect reported by DE participants (Birkholz, 2004).

Online access to the homework assignments and videos, the online tutoring offered, and online access to the library network were services offered by the technical college or the course intervention that I made. This category consisted of the focused codes determined by the above three opportunities offered by the technology-embedded math DE course to the study participants.

All six participants praised the online access to the XYZ online homework assignments and videos. Larry saw the homework and the course learning from a different perspective as a result of the access to the XYZ platform, noting "XYZ videos gave a different perspective, so it was like taking the things that I learned from one teacher and comparing it to another, to find where I rest within the middle to really help me do the work computations." Alice also confirmed the usefulness of the XYZ platform for the success of her exams. She stated, "since we used XYZ throughout the entire semester, using it for the exam was a breeze." Gina agreed with Alice about the advantage the videos from the XYZ platform gave her when doing the homework, confirming the usefulness of the XYZ videos saying that they were helpful when she was doing the homework because when she couldn't get help from me being at home or in another class "I could just go to the video and see how they solved it."

Adam was thrilled by the online access to the XYZ platform. He noted, "So being able to go back and do the review for the whole unit gave me a, you know, refresher almost on the whole unit, and it made the tests a lot easier too." His statement confirmed my observations made in my journal about his joy of working on the online XYZ platform. Overall, all six participants had a positive experience working on the online XYZ platform and acknowledged the usefulness of the platform.

Four of the six participants recognized the online access they used to the tutoring service offered by the technical college or the XYZ homework. Mary relayed her experience accessing tutoring help, saying "the help center, and I also had the XYZ, yeah, and they helped me a lot." She acknowledged the impact that this service had on her course success. Alice also mentioned the help she got from the college services. She stated, "They have like help centers. They have like tutor, section stuff and stuff like that, so if you're like really caught up in a class, they'll help you." Larry used the tutoring online service when needed. He noted, "I have used the tutoring session a handful of times." One of the two students that did not take advantage of the online tutoring system was Gina, who only used the online access for her XYZ assignments. She said, "I didn't get in the, into the services, I just went on there for my assignments. I didn't really look into it."

The online library system was the one online college service that half of the students accessed. Adam mentioned that the library system offered him textbook access. He relayed, "Oh yeah. [I used] the online library for like textbooks and stuff like that." Mary also mentioned the library system, saying "Well, I had the library system," but she failed to say if she ever used it. Ella was honest, acknowledging the existence of the online library offered, but stating that she never used it: "I mean, it's got like, you know, library, tutoring standard stuff, I don't really pay much attention to be honest." Larry mentioned the use of tutoring, but when thinking about other online services, he could not recall using the online library system. He stated, "I do not believe anything else comes to mind currently." All six participants did not fully acknowledge the usefulness of the online library system.

Summary. The categories that led to the emergence of the fifth theme all brought valuable input into the acknowledgment of the study's participants regarding the benefits of enrolling in a DE course. The findings of Bailey et al. (2002) Wisconsin, Bowling (2015) Kentucky, Johnson, and Brophy (2006) Washington, Fergusson (2010) South Carolina, Robinson (2015) Louisiana, and Yan (2002) Pennsylvania were confirmed. The students felt that the DE programs positively influenced their post-secondary aspirations given that there was a connection between their career goals and the coursework offered.

Chapter Summary

This mixed method action research study used quantitative and qualitative data to investigate the impact of new technology-enhanced Dual Enrollment math courses on student perception of college courses, post-secondary education, and students' perception of Dual Enrollment courses. The quantitative analysis suggested that the new technology-enhanced DE math course influenced the students' intention to go to college and their perception of dual enrollment courses. The qualitative analysis of the data collected through interviews with all six study's participants led to the development of five themes: (1) Students' Expectations About Postsecondary Paths Were Affected by Motivation, Incentives, and Acquaintances, (2) Technology supported students' learning in DE Math Class, (3) Students' Decision to Enroll in DE Courses Affected Their Career Aspiration, (4) Students' Perception of College Courses Was Influenced by the Contrast Between DE and HS Courses, and (5) Students Acknowledged the Benefits of Being Enrolled in the DE Course. The next chapter presents the quantitative, the qualitative findings and their integration, which provided a comprehensive understanding of the impact of new technology-enhanced DE math course and the implications for the local community.

CHAPTER 5

DISCUSSION, IMPLICATIONS, AND LIMITATIONS

This concurrent mixed-methods action research study aimed to investigate the impact of new technology-enhanced Dual Enrollment math courses on student perception of college courses, postsecondary education, and students' perception of DE courses. This study used an action research approach defined by Mertler (2017), linking action and research by critical reflection. Both quantitative and qualitative data was collected and subsequently analyzed following the requirements of the mixed-methods research design (Creswell & Creswell, 2018; Creswell & Plano Clark, 2017). The quantitative data was collected through the pre-intervention and post-intervention surveys, while the qualitative data was collected from post-intervention semi-structured individual interviews with each of the study's participants. Qualitative data revealed five themes which, together with the quantitative findings, answered the following three research questions:

1. How does participation in a technology-enhanced DE course influence high school students' perception of college courses?
2. How does participation in a technology-enhanced DE course influence high school students' intention of going to college?
3. What is the student’s perception of the DE math course that they participate in?

This chapter combined the findings of this research study with previous research and presents the following information in three sections: (a) discussion, (b) implications, and (c) limitations.

Discussion

To answer the proposed research questions, it was essential to situate the study's findings in the larger context of the scholarly literature, which combined the constructivist learning theory and the decision-making process that followed through the lens of Chickering's (1969) theory of student development and Hossler and Gallagher's (1987) general model of college choice. The discussion of findings was organized around the study's three research questions.

Research Question 1: How Does Participation in a Technology-Enhanced DE Course Influence High School Students' Perception of College Courses?

Scholar literature revealed studies such as that of Peterson et al. (2001), which examined DE programs to gather and look into student perceptions of DE programs and students' decision to attend college, concluding with students’ positive satisfaction with the DE courses. Alternatively, Kim and Bragg (2008) relayed that Nitzke's (2002) study came to the opposite conclusion of DE programs negatively impacting students' completed credits. Student perception was defined as the ability to become aware of the academic preparedness for postsecondary education, while students’ attitude toward postsecondary education was viewed through the lenses of the DE program (Anderson, 2010; Chenoweth & Galliher, 2004). By recognizing how students' experience in DE courses influenced their educational goals, students' perceptions could be defined in terms of career opportunities and the improved standard of living caused by

postsecondary education (Artman, 2017; Lile et al., 2018). For this study, student perception of postsecondary education was defined as the level of awareness, lack of, and influence of DE courses regarding students' decision to pursue a postsecondary education path. It included the challenges and contributing factors they perceived as helping or hindering their future educational goals. The intervention implemented in this study integrated technology in a DE math course to study students' perception of college courses, among other goals.

Quantitative Findings

Analysis of the quantitative data evaluated the shift in the participants' perception of college courses, evaluating the pre-intervention and post-intervention surveys' answers. The Perception of College Courses subscale had the most important increase between the Pre-Survey (M = 4.083, SD = 0.589) and Post-Survey (M = 4.500, SD = 0.316), with an increase of 8%. However, $p > 0.05$, therefore, was not enough evidence to support the claim that the average mean after the intervention was greater than the average mean before the intervention. The Post-Survey level of agreement was not significantly higher than the Pre-Survey agreement levels. The students placed great importance on using technology in the DE course to strengthen their understanding of what a college course looks like (M = 4.667, SD = 0.516) and the influence on changing their perception of college courses (M = 4.500, SD = 0.837). The lowest mean score was for the influence of technology on the ability to keep the students academically focused (M = 4.333, SD = 0.516). Even though the mean was high, showing an appreciable influence, it was the lowest mean among the items checked. These findings suggested that the technology-embedded DE course influenced students' perception of college

courses. Even though that was not enough evidence to support the claim that the post-intervention average means were more significant than the pre-intervention average means, the qualitative analysis that followed brought evidence to support the claim.

Qualitative Findings

The qualitative data analysis generated two themes supporting the idea that participation in a technology-embedded DE course influenced students' perception of college courses. The first theme analyzed the influence that the difference between DE and HS courses had on students' perception of college courses, while the second theme discussed the students' acknowledgement of the benefits of being enrolled in a dual enrollment college course.

The study's participants provided statements that expressed their prior and after DE enrollment impressions about the college classes, compared the DE vs. HS courses' characteristics, discussed their post-DE perception of college courses, and made statements about the usefulness of college services.

The pre-course concerns about the level of effort, the pace of the course, the college class view, and the post-course gained knowledge were all part of the students' impressions about the college classes. Most of the study's participants expected a demanding course requiring much effort to succeed. Their statements documented the awareness of their expectation to struggle. Most participants ($N = 5$) expressed the same concern regarding the difficulty level. The intervention provided them with the necessary technological tools to overcome their concerns, and they came to a similar conclusion as Larry, one of the study's participants, that the course "changed my expectations of the regular college course because it's not as hard as I thought it would be." Identifying an

outcome expectancy with respect to a statistics college course and the intervention's effect on their expectancy was one of the non-cognitive factors identified in the literature that affect the learning of statistics at the college level (Budé et al., 2007).

Regarding the course pacing, the students' concerns were also invalidated by the course experience concluding that in the end, they would not be afraid of college courses from now on. The common denominator for all six participants was the difficulty level; words like hard, grueling, and difficult described their concerns about the DE course. However, that was a normal reaction of students, statistics anxiety being defined by Onwuegbuzie and Wilson (2003) as "anxiety which occurs when a student encounters statistics in any form and at any level" (p. 196). The positive influence that the course had on the student's perception of the college course was documented by their statements.

Students' participation in the HS and DE courses allowed them to compare the requirements, rigor, and teaching style in both environments. Among the differences they noted in the course requirements were the higher level of effort and more flexibility with assignments in DE courses. The level of independence in choosing the projects and the path toward solutions was different from what students experienced in the DE courses. There was more time for doing the homework in the XYZ platform since the due date for all homework assignments was at the end of the course and not spread during the course. Another difference in the course requirements was the technology element that played a considerable role in the DE course. In contrast, most of the work was required on paper in the HS courses. The requirement to watch the videos and take short quizzes embedded in the videos was another difference documented by the participants. The academic rigor of HS courses was essential for preparing students for college-level coursework (Adelman

et al., 2003). One student's opinion was that the course explored the material in depth compared with the HS courses. He stated, "I believe the college dual enrollment courses go into further depth than normal high school courses. I remember taking regular math in high school, and it just felt very basic, like it was just skimming the top." There was a direct relation between the academic rigor of HS college credit-earning courses and enrollment in college work (Morgan et al., 2018; Wyatt et al., 2011). The students also mentioned an important difference in the teaching style between the DE and HS courses, specifically highlighting the teacher involvement and the availability to answer any questions the DE students had. The results of keeping the students accountable for their work and the lack of need for memorization of the content versus discovery of the content built a strong rapport between the students and faculty as well as between the students themselves, making the content meaningful (Hughes & Edwards, 2012). The students noticed differences in the teacher's focus on the student's performance, the class organization, a higher level of effort, less memorization, greater independence, and more flexibility with assignments in the dual enrollment course that influenced their perception of college courses.

Critics of DE programs like Andrews (2000) and Johnstone and Del Genio (2001) were afraid that the quality of the college courses offered on college campuses might decline since high school students would influence academics. The opinion of most of the deans and faculty with whom Johnstone and Del Genio (2001) discussed expressed their opinion was that “it was an ignorance and an opposition that was not likely to be alleviated without more transparency and acknowledgment on the part of those colleges sponsoring school-based courses” (p. 28). The students’ encounter with the embedded

math DE course did not confirm their expectations when considering its requirements, rigor, and teaching style.

The students' post-DE Math perception of the academic preparedness for college courses offered them familiar feelings about the college courses. The post-DE course perception of all six participants was that the intervention offered them the chance to participate in a course that mirrors a college course. Unanimously, they agreed that now they had a good idea about what to expect from a college course, acknowledging the fact that even if they had applied to a big university, the classes would be different, but now they felt prepared for it. One participant stated, "Yeah, I think it gave me a pretty good idea of what to expect going into college as a freshman." Overall, all of the participants' (N = 6) post-DE opinions of the college courses acknowledged the benefits of enrolling in the DE course and strongly believed that the DE course indeed mirrored a college course. Well-implemented dual enrollment courses reflect the academic component, the content, and the pedagogical structures of equivalent first-rate courses mirroring those of on-campus college courses (Karp, 2012). The students' positive perception of the DE course was confirmed by Larry, who said "no matter how hard I think about the dual enrollment course, I am really satisfied." Being completely pleased with the DE experience, he stated he was "satisfied with the course and I do not believe there was anything that I wish would have been different." All students felt that the DE courses should not be feared and enrolling in the dual enrollment course was a natural step to take in their pursuit of postsecondary education.

The perception that DE offered an opportunity to use the internet during class time to enhance course content had a score of 3.44 on a scale of 1 to 5, a positive aspect

reported by DE participants (Birkholz, 2004). The online access to the XYZ online homework assignments and videos was praised by all six participants, seeing the homework and the course learning from a different perspective as a result of the access to the XYZ platform. Four of the six participants recognized the online access they used to the tutoring service offered by the technical college. Most of the research studies done on the participation of rural high school students in DE programs were focused on specific states, Wisconsin (Bailey et al., 2002), Kentucky (Bowling, 2015), Washington (Johnson & Brophy, 2006), South Carolina (Fergusson, 2010), Louisiana (Robinson, 2015) and Pennsylvania (Yan, 2002). Their findings suggested that the students felt the DE programs positively influenced their postsecondary aspirations if there was a connection between their career goals and the coursework offered. Statistics was a required college course, and the study participants wanted to major in areas directly connected with statistics. The study's participants were from a rural high school, and the findings concurred with the findings of the above studies.

Summary

Integrating the quantitative and qualitative data explained that the embedded-technology DE math course influenced the students' perception of college courses. The descriptive statistics supported the findings, while the paired sample t-test was inconclusive when analyzing students' responses to the Pre- and Post-Intervention Survey, but the qualitative data confirmed the influence. The student experiences in the DE course helped them better understand what to expect from a college course.

Research Question 2: How Does Participation in a Technology-Enhanced DE Course Influence High School Students' Intention of Going to College?

Rural high school students going to college were usually disadvantaged (Gagnon & Mattingly, 2016; Lapan et al., 2003; Yan, 2002). One way to combat such disadvantages was participation in DE programs, which allowed the opportunity to receive college credits before graduating from high school. Research on rural students enrolled in postsecondary education confirmed that they attended DE programs in various forms while enrolled in high school. Gibbs (2000) and Karp et al. (2007) found that low-income students succeeded tremendously as DE program participants. Studies by Hearn (1984), Kolstad (1979), and Peters (1977) also mentioned the positive correlation between attending a postsecondary school and graduating from a high school that offered more math and science courses. The integrated technology in a DE math course was the intervention in this study aimed at examining the influence on students' intention to pursue a postsecondary path. The quality of a high school curriculum was mentioned by Hossler and Gallager (1987) as being positively related to college matriculation. Studies by Hearn (1984), Kolstad (1979), and Peters (1977) also mentioned the positive correlation between attending a postsecondary school and graduating from a high school that offered more math and science courses.

Quantitative Findings

Analysis of the quantitative data evaluated the shift in the participants' intention of pursuing a postsecondary path by evaluating the pre-intervention and post-intervention surveys' answers. The Students' Intention of Going to College subscale increased from the Pre-Survey (M = 3.513, SD = 0.444) to the Post-Survey (M = 3.983, SD = 0.459), p = 0.003, and Cohen's d =1.879. Since $p < 0.05$, there was enough evidence to support the claim that the average mean after the intervention was greater than the average mean

before the intervention. The subscale was found to be significant at the Bonferroni correct level of $p < 0.0125$. The Post-Survey level of agreement was statistically significantly higher than the Pre-Survey agreement levels. These results suggested that the new technology-enhanced DE math course impacted the Students' Intention of Going to College. The effect size value was d =1.879 exceeding Cohen's (1988) convention for a large effect (d = 0.80). The students acknowledged the fact that the most important influences in their decision to enroll in college classes were the opportunity to earn college credit while in high school (100%) and the teachers and guidance counselors (100%). The second most remarkable influence was from their parents or family members (80%). In comparison, the lowest influence was the influence of their friends (16.667%). A considerable change was in the students' opinion regarding their level of academic preparedness for the challenges of college from the Pre-Survey (M = 4.500, SD = 0.548) to the Post-Survey (M = 5.000, SD = 0.000). The exact change was recorded regarding their level of motivation and positive attitude toward college from the Pre-Survey (M = 4.500, SD = 0.548) to the Post-Survey (M = 5.000, SD = 0.000). Regarding the desire to enroll in a 2-year or 4-year college/university due to using the embedded technology in the DE math course, the results also confirmed the course influence (M = 4.833, SD = 0.408). These findings suggested that the technology-embedded DE course influenced students' Intention of Going to College; there was enough evidence to support the claim that the post-intervention average means were greater than the pre-intervention average means. The qualitative analysis that followed also brought evidence to support the claim.

Qualitative Findings

The qualitative data analysis generated two themes supporting the idea that students intended to attend college by participating in a technology-embedded DE course. The first theme analyzed if students' expectations about postsecondary paths were affected by motivation, incentives, and acquaintances, while the second theme looked into how students' decision to enroll in DE courses affected their career aspirations.

Incentives to pursue a college degree included achievement of a personal goal and being at the right time in life (Megginson, 2008). As one of the participants mentioned, he knew that college was a good way to get himself into better jobs instead of getting a job that required having a degree. In one of the students' opinions, looking for financial security was an excellent reason to pursue a postsecondary path, stating "I don't want to be struggling paycheck to paycheck." In another student's view, "college was a good way to get yourself into better jobs than having no degree for what you want to do." Another participant aimed to "get a job, get through life" by following postsecondary education. Throughout the interviews, several incentives were revealed by the study's participants, such as the desire to achieve a career goal by attending college as one of the student's life aspirations and an incentive to enroll in college. Aiming for a stable future was another goal. The participants admitted that incentives like the lifestyle they dream of, being a first-generation postsecondary student in the family, and succeeding early in life were among the incentives for pursuing a college degree presented in the interview answers. Larry wanted to differentiate himself from his peers, noting "something that would set me apart from my peers within life was having a college degree." The participants' aim for a better life, a stable future, and a reason that would set them apart were all purposes

Chickering (1969) highlighted in his theory as developing purposes for students to attend college. The sixth environmental factor described by Chickering's (1969) theory, "developing purpose," of why a student would attend college varied and depended on each student's goal, life aspirations, and commitments to self (Chickering & Reisser, 1993; De Larrosa, 2000). The great opportunities the postsecondary environment offered were reasons for participants to pursue a college degree. The student-faculty relationship to which Alice referred was one of the three environmental factors of the developmental phase of college students (Chickering & McCormick, 1973).

Motivation and personal accomplishments were the basis of self-efficacy theory derived from Bandura's social cognitive theory (1986), grounded in academic self-efficacy. The motivation for attending DE classes was exemplified by the participants who were looking for motives that would benefit their future academic plans. Participants stated they wanted to quickly get into college, with one saying "to get to where I want to be faster" or get an Early College math credit before college. All students' motives were related to their academic plans, and some of the participants' motives were explicitly related to the subject of the DE course. Bandura (1997) argued that people's motivation was based on their beliefs and could influence their actions. Self-efficacy and achievement motivation were identified as being the most substantial effects in academic settings (Duncan & McKeachie, 2005). The students' voices proved their motivation for enrolling in the DE math course and their decision's effect on their expectations of postsecondary paths.

When students went to college, their development was influenced by parents, high school teachers, and peers, bringing strengths, weaknesses, feelings of pride, prejudices,

and confusion to clarify their identity and develop acute purposes and high integrity (Chickering & McCormick, 1973). Participants' accounts about acquaintances' influence confirmed Erick Erickson's psychosocial theory of development that considered the impact of external factors, parents, and society on personality development. Overall, all students were influenced by a family member's decision to enroll in the DE course or by school staff. In all situations, the obstacles the acquaintances presented did not discourage them from enrolling in the DE math course.

The quality of a high school curriculum was mentioned by Hossler and Gallager (1987) as being positively related to college matriculation. Studies by Hearn (1984), Kolstad (1979), and Peters (1977) also mentioned the positive correlation between attending a postsecondary school and graduating from a high school that offered more math and science courses. Research findings of studies like those conducted by Peterson et al. (2001) focused on DE programs to learn about student perceptions of DE programs and students' decision to attend college confirmed students' satisfaction with the DE courses. The DE experience influenced students' postsecondary plans. One of the students made a major change in her postsecondary degree. Her decision to steer the boat toward an engineering path from a medical direction resulted from her exposure to the technology-embedded DE math course and eliminated her fear of math upon enrollment in the DE class. In his testimonial, another participant was more specific about his encounter with DE courses, which helped him better understand how the college courses would help him get a degree. The influence of shifting the attitude toward DE was witnessed by Alice, whose attitude toward DE courses and college was changed after the intervention. Even though two of the students did not change their college plans, the

reaffirmation of their college plans was experienced, and both were still clinging to their initial desire but wanted to keep an eye on a possible change toward a much heavier math major in the near future. It seemed that both participants were satisfied with the reconfirmation of their initial postsecondary plans. Overall, the course's influence on students' postsecondary degree pursuit was heavily supported by their experiences in the DE class.

Participation in the DE course helped the students channel their life goals. The theory of planned behavior was an essential conceptual framework for studying human action, guided by behavioral, normative, and control beliefs (Ajzen, 2001). The students' belief that they would continue on a postsecondary path after graduating high school received confirmation, and some felt encouragement for their educational plans after attending the DE course. Attendance of the technology-enhanced DE math course was considered a facilitating factor. In contrast, some inhibiting factors, like the inability to submit the college application, were factors not under their control and might have still deterred their intentions. The perceived behavioral students' control of their goals in life was more like the perceived control over the performance of their behavior. This could be measured by asking the students direct questions about their capacity to perform a specific behavior or based on beliefs about their ability to deal with deterrent or facilitating factors. After the whole experience, one of the students realized the "feasibility of doing the DE course," which facilitated his goal of continuing his education because he felt "more prepared for college than I ever have been before." In the case of another study's participant, Adam's goal was not defined before enrolling in the DE course. The course helped the students to define their life goals, one of them

dreaming of becoming a computer engineer. His thought was crystallized by the course experience that played a role in his belief that postsecondary education was now feasible after taking the DE course. Seeing how successful Adam was here determined him to "actually truly want to go to college," and he later enrolled at Clemson University. Four of the study participants had their goals for life changed due to the DE experience, while for two, participation in the DE course reaffirmed their plans.

The study's participants highlighted the main characteristics that DE students should possess: commitment, discipline, focus, hard work, a positive mindset, self-belief, and necessary study skills. The students were adamant about the ability to focus and pay attention, the amount of effort a student was willing to put into the study, the need for study skills, and more personal characteristics, such as time management and organization skills that were overseen by some students in their preparation for college. Motivation was the attribute that one participant recommended as completing the main personal characteristics of a successful college student. The academic standing for rigor and honor were two other attributes also brought into the discussion. Self-discipline, a positive mindset, and a hard-working attitude completed the characteristics the study's participants identified as needed in college courses to succeed. To summarize, the attributes identified by the participants were characteristics similar to those brought into light in various studies: clear goals, strong motivation, learning-study strategies, a drive to succeed, the ability to manage external demands, and self-empowerment (Grimes, 1997; Martin et al., 2014; Schreiner et al., 2020). The acknowledgment of all these characteristics among the necessary attributes of being successful in college added value to the participants' better understanding of college courses and what they recognized as

accomplishments of the participation in the DE course that played an essential role in their career aspirations.

Summary

The participants had a similar experience regarding acquaintances' influence on postsecondary decisions. The motivation for DE participation and incentives for pursuing a college degree varied from one participant to the other. However, all three confirmed either the self-efficacy theory derived from Bandura's social cognitive theory (1986) or Chickering's (1969) theories' sixth environmental factor, “developing purpose.” The findings suggested that the technology-embedded DE course influenced students' intention of going to college; there was enough evidence to support the claim that the post-intervention average means were greater than the pre-intervention average.

Research Question 3: What was the Student's Perception of the DE Math Course that They Participate in?

Technology integration in education includes students’ using technology as a tool to complete their assignments, as opposed to a source of learning, enhancing instruction and learning as students' motivation and engagement are amplified (Rykard, 2020; Sang et al., 2011). The technology implemented in the course employed a variety of tools that influenced the learning process and students’ understanding of the course material. Acquiring technology without knowing how and why to use it has not lead to effective technology integration but instead inhibited it (Hew & Brush, 2007; Polly et al., 2010; Roblyer, 1993). The way technology was used in the intervention was more important than the type of technology, as Strommen and Lincoln (1992) determined to be relevant in a constructivist classroom. Learning valuable long-term skills through technology

made one of the participants confess that the technology skills he gained during the intervention will help him in college by helping him to understand that “I do not have to do everything manually.” The literature classified technology integration based on the use of technology as student-centered vs. teacher-centered (Cennamo et al., 2010; Hixon & Buckenmeyer, 2009; Hughes et al., 2006; Moersch, 1995; Puentedura, 2014; Reinking, 1997; Salomon & Perkins, 1996). The participants' engagement in critical and reflective thinking is a constructivist strategy, as stated by Nanjappa and Grant (2003). Engagement theory specified that students must be meaningfully engaged in learning (Kearsley & Shneiderman, 1998; Sadik, 2008; Shneiderman et al., 1995). Other studies claimed the importance of the class environment and the support of the teachers in integrating technology into their daily routine (Baylor & Ritchie, 2002; Ertmer, 1999; Ertmer, 2005; Hew & Brush, 2007; Zhao et al., 2002). In this study, technology integration was defined as the use of technology as a tool to achieve skills that include critical thinking, reasoning, interpretation, perseverance, synthesizing information, and analysis that would help them to solve real problems through collaborative learning (Bransford et al., 2000; Ertmer & Ottenbreit-Leftwich, 2010; Jonassen et al., 2008; Koh, 2019). Students' beliefs that embedded technology positively influenced the learning process, the importance of exposure to DE technology in supporting learning, acknowledgment of the influence of technology in pursuing math, and the student’s concerns about the course, received validation from the collected data. The influence of technology in pursuing math is acknowledged by McCulloch (2018), who noted that teachers participating in his research integrated technology when they felt it was beneficial for a particular lesson.

The teachers started the integration depending on their class time, the topic, and their ability to manage the activity with graphic calculators or Virtual Manipulatives, Desmos, GeoGebra, Fathom, TinkerPlots, Kahoot!, Quizlet, Mastery Connect, and many other computer programs. Cuthell (2006) found a strong correlation between computer technology and students' engagement and improvement in mathematics.

Quantitative Findings

Analysis of the quantitative data evaluated participants' Perceptions of DE Courses by interpreting the pre-intervention and post-intervention surveys' answers. The Perception of DE Courses subscale increased from the Pre-Survey (M = 4.340, SD = 0.276) to the Post-Survey (M = 4.642, SD = 0.260), p = 0.014, and Cohen's d =1.247. Since $p < 0.05$, there was enough evidence to support the claim that the average mean after the intervention was greater than the average mean before the intervention. The Post-Survey level of agreement was statistically significantly higher than the Pre-Survey agreement levels. These results suggested that the new technology-enhanced DE math course influenced the Perception of DE Courses. The effect size value was d =1.247 exceeding Cohen's (1988) convention for a large effect (d = 0.80). The student's opinion about the level of satisfaction with the DE math course was at the maximum level (M = 5.000, SD = 0.000), the second higher level being their opinion regarding "The influence of the use of embedded technology in the DE course on keeping the students academically focused" (M = 4.667, SD = 0.516), and on "The recommendation, the students would suggest other students to enroll in the DE math course during HS" (M = 4.667, SD = 0.516). The change in "The student's opinion about their academic preparedness for the DE math class before enrolling in the course" registered a drop from

the Pre-Intervention Survey (M = 4.000, SD = 0.633) to the Post-Intervention Survey (M = 3.833, SD = 0.753). The result was justifiable by the students' over-confidence before registering for the course and the realization that came after the course that the course employs a high level of rigor and other attributes which the students thought that they all have it. These findings suggested that the technology-embedded DE course influenced the Perception of DE Courses; there was enough evidence to support the claim that the post-intervention average means were greater than the pre-intervention average means. The qualitative analysis that followed also brought evidence to support the claim.

Qualitative Findings

The qualitative data analysis generated two themes that supported the idea that participation in a technology-embedded DE course influenced students' perceptions of the technology-embedded DE math course they participated in. The first theme explored the students' belief that technology supported learning in the DE math class. The second theme discussed the students' acknowledgment of the benefits of enrolling in a DE college course.

The study's participants provided statements that expressed their opinion about the influence on the learning process that the embedded technology had, as well as the importance of exposure to class technology for the learning process, acknowledged the DE experience and the influence of technology on pursuing math as well as the students' feelings about the DE course ambiance.

The study's participants acknowledged their lack of interaction with most technology tools used in the DE math course. They believed that using such tools made them successful. Students gained knowledge by using TI 84+ calculators' functions,

interacting with the Excel spreadsheets, using JASP, daily access to the XYZ homework platform for homework, short quizzes, watching the integrated videos, and the D2L learning management system was acknowledged by their testimonies. Integrating technology in the learning process was defined by how and why it was used, not by the amount or the type of technology (Earle, 2002; Sadik, 2008), and students' voices proved this. Learning the calculator influenced students' learning process. One student said, "definitely, one of the most defined things that I did this semester was learning that calculator inside now." The students had never heard about JASP, and most of the students used the TI 84+ only for basic computations. They believed that using such tools made them successful. Mary's input of the embedded technology in the DE course brought into discussion the necessity of such integration because "the world was changing basically, so I had to basically get with the technology." The student's experience in the embedded technology DE course is voiced, bringing strong evidence about gaining useful long-term skills through using JASP, using Excel in analyzing big data files making learning effective, and mentioning how learning was easier when TI 84+ was used.

The use of technology with constructivist methods, like the projects the participants did in the DE math course, made the learners more responsible. The participants realized the benefits of being active in the learning process, and the use of technology facilitated access to new capabilities (Grant, 2002). A richer and more exciting learning environment was made possible through the abundance of the technology used in the DE class, such as JASP, Excel, online Stats Apps, TI 84+ Stats apps, XYZ platform, D2L, and Google Classroom learning management systems,

teacher-created videos, and Metadata projects (Duffy & Cunningham, 1996). All students mentioned JASP, the Stats Open-Source Program that made a difference in analyzing the metadata they had to interpret through different projects. Alice was so fascinated by the projects she did in class that she felt the need to share with her friends the experience of becoming a "capable and mature learner" (Nanjappa & Grant, 2003, p.46). Some of the students were so impressed by the JASP program, one of them felt the need to discuss it with her friends outside the class, sharing "I got to do this really cool project. Do you want to see? No one knew what it meant." For her, it was a massive help throughout the learning process, a personal achievement for herself. Some students characterized the experience as Larry did when he said, "JASP was a lifesaver." The authenticity of the JASP projects was critical for the student's ability to use their ideas to make meaning of the concepts presented (Brown et al., 1989; Ertmer & Newby, 2013). As a facilitator, I had equal responsibility and authority with the students whose "own effort to understand at the center of the educational enterprise" (Prawat, 1992, p. 357). As Witfelt (2000) observed, the constructivist theoretical framework determined me to assume the facilitator role helping the students to construct knowledge through problem-based learning and project-oriented work.

Students' recognition of technology's influence on simplifying math workload and its influence in shaping intentions to attend college and support learning in college classes are detailed and thick descriptions of their experiences in the DE math course proved the influence of technology on pursuing math. Cuthell (2006) found a strong correlation between computer technology, student engagement, and mathematics improvement. Since the invention of computers, the number of tools used to integrate

technology in math classes has increased, and applications' ease of use and success in helping students learn math has increased faster every day (McCulloch, 2018). The integration of technology made the classwork easier for the students helping them to say, "I have found it easier to do math with technology versus just manually trying to do everything. And it really refined the idea of computer understanding." The computers have many capabilities that the study's participants had never used. Students' encounters with the technology in the DE course helped them describe the technology's influence on the learning process and their beliefs about math.

The students' positive experience in the DE course was one of the focal points of discussion with the study's participants. The intervention in the DE math course was also developed to help students to close the gap between high school and college. The pursuers of Associate Certificates from technical colleges need fewer semester credits to gain accreditation (Arnold et al., 2017; Hoffman et al., 2009; Jones, 2014; Kanny, 2015; Karp & Hughes, 2008; O'Gara et al., 2009). One of the participants' experiences in the DE course helped her to change her mindset and discipline and become ready to put enough effort into coursework. The positive experience that the participants had determined them to declare that "this class should be put on a pedestal compared to the others," or "I wish I took more [classes]," or "it's prepared me more for college than descriptions that people give," or "it's helped me to understand the way that math can be involved with life." The benefits they identified were all rich descriptions of their DE experience. The embedded technology helped the students recognize its usefulness and acknowledged their pleasure in using it.

The students' shift in their beliefs toward the DE course helped them recognize the emotions they experienced before enrolling in the DE course and the impact the DE course had on this change. The previous DE classes did little to nothing to give Alice an understanding of the college courses, after the course she was changed, recognizing in herself "courage and bravery." The course changed Alice into a new person, which she enjoyed, saying "this class definitely put me in a new mindset, and with a new mindset comes a new person, and I definitely love the person that I've become because of this." Another participant was straightforward and acknowledged how beneficial the course was for him, saying "without dual enrollment, I really don't know if I'd be successful, like going straight into college." All six participants in this study highlighted the positive benefits of enrolling in the DE course, benefits that exceeded their expectations.

The definition of Hoffman et al. (2009) for the DE program did not distinguish between the location delivery. This study focused on courses taught inside the high school campus. The student's feelings on the DE course ambiance included opinions about classmates' relationships, the course delivery location, and associated costs. All six participants confirmed a positive classmate relationship. The reasons were the fact that most of the classmates were of similar age and maturity level. Additionally, participants felt the class moved at the pace and they had good relationships with one another. To conclude, one of the students declared that "it was like a perfect mix really because I'd be able to make some jokes, but I also knew I'd get a lot of work done too." Participants felt that the class atmosphere was good, allowing them to have a good experience in class.

As a positive characteristic of the DE course, the course participants mentioned the location of the course inside the high school building. Some studies reported that

students were not entirely satisfied with the DE experience when the courses were taken on college campuses, feeling isolated from the rest of the students, being judged by classmates, and reported discomfort because of the lack of familiarity within this context of learning (Azimzadeh et al., 2015; Kanny, 2015; Smith, 2007). All six participants mentioned the convenience of the location. The rich description included opinions of participants who "really like it because I don't have to go anywhere special" or "these courses being offered here makes my life ten times easier." Other students were happy with the location because there were no costs involved. The offer of the dual enrollment course in the HS location made Alice's daily schedule bearable since she needed to pick up her siblings from school. The student's experience confirmed that the high amount of work, commuting to college, and the high pressure would add stress to students' daily lives even though many agreed that it was worth it (Azimzadeh et al., 2015; Kanny, 2015; Smith, 2007).

Summary

The participants' belief that the technology supported learning in the DE math class was exemplified by the student's description of the influence of the embedded technology. The student's reaction to the course intervention confirmed the importance of exposure to the above technologies. The discussion around the quantitative and the qualitative findings provided a detailed description of the student's perception of the DE math course they participated in. The students believed that exposure to various technology tools in the DE math course truly influenced the learning process, helping them pursue math.

Implications

This study's findings have practical implications as this action research aimed to remodel the practices of teaching DE math courses at MHS, help the administrators and colleagues understand the importance of change, and explain the conditions under which the new practices occur. Since the purpose was to inform educators within the same organization, this aligned with the definition of action research given by Kemmis and McTaggart (1986), which stated that action research aims to understand and change practices and the surrounding conditions. The findings and the following discussion have implications for me, the students and the whole rural community where the HS is located, and the other researchers in their similar areas of study. Like Bailey et al. (2002), this study confirmed that DE students' better academic or emotional preparedness resulted from their participation in DE programs. The discussion that follows is organized into three sections: (a) personal implications, (b) implications for practices, and (c) implications for future research.

Personal Implications

Identifying the problem inside my organization was the first step in the long journey of this action research. The findings of this study confirmed that the innovation improved the perception of students enrolled in the Mat 120 course about college courses. They are personal since they helped me grow as an educator, corroborating my long-term belief that technology in math classes positively influenced the learning process. The personal lessons I learned during the intervention, data collection, data analysis, and while I examined the findings will help me make informed decisions about implementing technology into the math curriculum. The following sections will address the personal

implications: (a) implementation of technology into the math curriculum, (b) reflections on the role of Math DE courses, and (c) action research experience.

Implementation of Technology into the Math Curriculum

Embedding technology into a math class was a personal goal because I am responsible for educating the young generation for the 21st Century. Dockstader's (1999) definition of technology integration in a 21st Century class mentioned the use of computers and necessary software to enhance student learning, permitting the use of computers flexibly, purposefully, and creatively to enhance student learning. The student's responses to both pre-and post- Surveys, the interviews, and the observations made during the intervention showed me the effectiveness of the new technology tools on the teaching and the learning process and the influence on the student's life. I understood that while teaching the required content was an important aspect of the curriculum, doing it by integrating available technology permitted the students to achieve skills that included critical thinking, reasoning, interpretation, perseverance, synthesizing information, and analysis that helped them to solve real problems by collaborative learning (Bransford et al., 2000; Ertmer & Ottenbreit-Leftwich, 2010; Jonassen et al., 2008; Koh, 2019).

Reflections on the Role of Math DE Course

The student's post-DE perception of the academic preparedness for college courses offered familiar feelings about them. Reflecting on the effects the Math DE course had on the students' perception of college courses, I needed to be aware of both the beneficial and detrimental factors. The students enrolled in the DE course had free tuition only if they also enrolled in another DE course. This detrimental factor made

some of my high school students avoid the DE program. After the interviews, I discussed with the school administration, and for next school year, they are looking for a solution to offer a free ride even for students who want to only enroll in one DE course. The enrollment in the DE math course that last school year was the subject of this study was very low (N = 6). This school year, the enrollment increased by 350% to 21 students. The student's participation in the study acknowledged the benefits, “after participating in the Math 120 dual enrollment course, my experience would encourage me to enroll in college. It's prepared me a lot for what I will have to do." This experience crystallized their postsecondary plans.

This research confirmed that rural high school students valued their DE experience and liked to be challenged by college-level courses, indicating that the technology-embedded DE course positively influenced their decision to enroll in college. Thus, a district-wide presentation of the results of this study to DE faculty members who taught rural students should explain the benefits of embedding technology in DE courses and offer the opportunity to participate in course-specific workshops during the school year. DE faculty should meet regularly and design best practices to embed technology in their courses. Reflecting on the implementation, I have considered introducing more technology in the other Math DE course I am teaching, College Algebra. I have also considered embedding technology in any future DE math course I will teach.

Action Research Experience

My experiences during the action research were exhilarating. The learning curve was very steep and rewarding. I conducted a literature review on studies that helped to position myself correctly and have an educated approach to the problem of practice I

discovered in my organization. Learning about the mixed methods, data collection, and data analysis completely absorbed a lot of time, but the results were rewarding. The whole process permitted me to keep a close relationship with my students, allowing me to hear what they had to say. This knowledge helped me reposition myself and correct how I present the material to my students. The students experienced the DE Math course in a way that their classmates have not, so they were more engaged and benefited more from the DE experience.

Implications for Practices

My school's culture encouraged changes, and the results of this action research study would help to make educated changes. The data collected during the study add to the literature about DE programs. More importantly, the literature about Math DE programs implemented in rural high schools is scarce, and this study has helped to fill that gap. The implications of this study for my school will help educate all stakeholders on what degree DE prepares students for a first-year college math course and the effect in getting students ready for their entire college career, from both an academic and a readiness point of view. As a systematic inquiry into my practice that leads to educational transformations inside the DE classroom (Johnson, 2008), this study sought to enhance the stakeholders' lives (Mills, 2018). Authors like Kuh et al. (2007) and McClanahan (2004), who focused on postsecondary students' success, examined DE students' academic outcomes in Florida and New York, concluding that low-income students were more likely to enroll in college as a result of DE program participation.

The MHS school administration and the dual enrollment teachers and college adjuncts could also celebrate the successful dual enrollment students and acknowledge

their efforts district-wide to enrich the dual enrollment program's educational experiences and proficiency.

A recommendation for my organization is to create a club-like organization only for DE students inside the HS premises. The activities should involve the HS student body with local community colleges, transforming the club members into advocates for DE to stress the importance of DE enrollment and the benefits of graduating from such courses. The existing annual DE orientation should be mandatory for students whose academic potential is identified by teachers/guidance counselors. Club members can create a network to help close the gaps in student misconceptions and perceptions of DE and collaborate with district-wide similar clubs from other high schools. Sharing their experiences with students from the local community college and students from universities is another way to facilitate access to the benefits of DE and enrich student knowledge about post-secondary education early on.

Parents and extended family greatly influence students' decisions; therefore, implicating the parents and siblings with a college experience to share with the student's body might also help change the perception about enrollment in dual enrollment courses and further in college. The parents should be involved in determining the courses for the DE program of study. The findings confirmed Yan's (2002) results which reported that 95 percent of rural college students said that their mothers expected them to enroll in college. Similarly, former students could participate in the presentation of the DE program to new students, providing more knowledge to the rural student audience about current college information.

Implications for Future Research

Authors like Kuh et al. (2007) and McClanahan (2004), who focused on postsecondary students' success, examined DE students' academic outcomes in Florida and New York, concluding that low-income students were more likely to enroll in college as a result of DE program participation. The intention is to influence the school administration to collect data about the students' postsecondary enrollment and compare the results with data I intend to collect from students in the next few years. The plans for my future research would involve expanding the intervention to all math DE courses I will teach. Running the Pre-Intervention and Post-Intervention surveys, the quantitative data collected should provide a better view into students' experiences in the DE courses. The next school year, sophomores will be allowed to enroll in the DE courses; therefore, the pool of participants would vary more, allowing me to interview students whose goals for life are not yet crystalized. Besides offering a free ride to sophomores, the application process was also changed. The Accuplacer Exam requirement is exempt if the student's GPA is 3.)) or higher. This change is opening the door toward DE math courses not only to math-ready students but also to students who only want to see what a college math course looks like. The hope is that replicating the study with a larger sample size, bigger age gap, and more diverse population with different math skills would bring more insight into students' experiences.

Another future research direction would implicate an experimental design in which data from a control group would be compared with the results I got from this action research study. The intervention effectiveness can be evaluated in the context of TPB (Ajzen & Schmidt, 2020).

Limitations

Action research, as mentioned by Mertler (2020), is not a "haphazard trial-and-error exercise or stabs in the dark" (p. 3). Even though the study findings are promising, like with many, action research studies are subject to limitations. The systematic inquiry follows specific steps, starting with identifying a problem that needs to be corrected, collecting data, analyzing and interpreting the data, and making a practical data-informed decision that "leads to highly effective professional growth" (Mertler, 2021, p. 4). The study results cannot be generalized since they are specific to my organization and the study participants, as the study was centered around my teaching practices within my organization's specific context (Mertler, 2020).

Another limitation of the study related to the small number of study participants. Since only six students were enrolled in the course, the quantitative data was collected from only six participants. For this reason, some component variables with zero variance were removed from the scale. With more participants, the risk of experiencing such problems should be diminished. Because of the small number of study participants, I had to include all of them in the qualitative data collection stage. The small size might not represent the students enrolled in the DE math courses; therefore, the generalization of the findings beyond the study is not permitted (Creswell & Creswell, 2018).

The third limitation is the possibility of bias since I implemented the intervention, I interviewed the study participants, and as a facilitator, I may be subjective while interpreting the data based on my experience and reporting my practice (Kopcha & Sullivan, 2007). The students might feel challenged to be objective since I was both the instructor and the interviewer, tempting them to give me answers that might please me

(Creswell & Creswell, 2018). This limitation might not be relevant because four of the six students were seniors on their way to graduation. The student's desire to please me might have been nullified because the interviews were conducted after the Final Exam, and their grades were finalized by the time they were conducted.

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APPENDIX A

USC IRB APPROVAL

UNIVERSITY OF SOUTH CAROLINA

OFFICE OF RESEARCH COMPLIANCE

INSTITUTIONAL REVIEW BOARD FOR HUMAN RESEARCH

APPROVAL LETTER for EXEMPT REVIEW

Nicolae Bordieanu, MS
1418 Gravel Hill Road
St. Stephen, SC 29479
Re: **Pro00117623**

Dear Mr. Nicolae Bordieanu:
This was to certify that the research study ***IMPACTS OF TECHNOLOGY-ENHANCED DUAL ENROLLMENT MATHEMATICS COURSE ON RURAL HIGH SCHOOL STUDENTS' INTENTIONS OF GOING TO COLLEGE*** was reviewed in accordance with 45 CFR 46.104(d)(1), the study received an exemption from Human Research Subject Regulations on **1/4/2022**. No further action or Institutional Review Board (IRB) oversight was required, as long as the study remains the same. However, the Principal Investigator must inform the Office of Research Compliance of any changes in procedures involving human subjects. Changes to the current research study could result in a reclassification of the study and further review by the IRB.
Because this study was determined to be exempt from further IRB oversight, consent document(s), if applicable, are not stamped with an expiration date.

All research related records are to be retained for at least three (3) years after termination of the study.

The Office of Research Compliance was an administrative office that supports the University of South Carolina Institutional Review Board (USC IRB). If you have questions, contact Lisa Johnson at lisaj@mailbox.sc.edu or (803) 777-6670.

Sincerely,

Lisa M. Johnson
ORC Assistant Director and IRB Man

APPENDIX B

BCSD STUDY'S APPROVAL

BERKELEY COUNTY

Dr. Anthony Dixon, Chief Academic & Innovation Officer

TO: Mr. Nicolae Bordieanu

FROM: Dr. Anthony Dixon, Chief Academic & Innovation Officer AD 1-13-2022

DATE: January 12, 2022

RE: Research Request Approval

This memorandum serves as official permission to conduct your research study in the Berkeley County School District. Please keep in mind this will be on a volunteer basis and potential subjects do not have to participate. Unless otherwise specified in your request, all information regarding individuals, school names, and the name of the district will remain confidential.

Please note, appropriate COVID-19 safety protocols and procedures will be required when in-person research is conducted. BCSD Health & Safety Protocols can be found at bcsdschools.net.

I look forward to receiving and reviewing your findings. If I can be of further assistance in your research, please let me know.

APPENDIX C

DUAL ENROLLMENT STUDENT PRE-SURVEY

Dual Enrollment Program. All three parts of this survey can be completed online at: *The link to a Google Form will be provided here.*

Hello, I'm a graduate student at the University of South Carolina in their Doctor of Education program, and this assessment was part of my Action Research Study on Students' Perceptions and intentions of going to college and DE students' perceptions. I would like to know how the DE program, your school, friends, and family affect your plans for what you plan to do after high school. I hope the results of this study will help school administrators understand students' needs and improve the DE program. Please note that your participation was voluntary, confidential, and no compensation will be awarded. I hope you will answer all questions. The more complete the evaluation, the better the results will be. Please know that this assessment was not a test. There are no right or wrong answers—only honest ones. Parent or guardian means the person whom you consider most like a parent to you. For instance, this could be your parent, stepparent, foster-parent, guardian, parent's live-in partner, grandparent, etc. Postsecondary was used synonymously and means the same as college, any formal education that occurs after graduating from high school.

Directions: Please indicate one response for each question.

There are no incorrect answers.

Instructions: Please complete the entire survey by checking the appropriate boxes and filling in the blanks with your responses.

1. I am 18 years old (or older) and agree to allow the information provided in this survey to be used for research purposes that may be published. (Your name and all other personally identifying information will be removed.)

□Yes □No

2. Please indicate your gender:

a. Male

b. Female

c. Other (please specify)_____

d. Do not respond

3. Are you: **(Check only one.)**

□African-American/Black □American Indian/Alaska Native

□Asian-American/Asian □Caucasian

□Hispanic of any race □Native Hawaiian/Pacific Islander

□Other: _____

4. How would you rate your comfort level of using technology (e.g., Browsing the internet, Using spreadsheets from Microsoft Excel, Navigating through a website)?

□ Excellent □ Good □ Satisfied □ Poor □ Very Poor

5. How would you rate your comfort level when trying to use a new computer application?

□ Excellent □ Good □ Satisfied □ Poor □ Very Poor

Part 1 - Perception of College Courses Survey

6. What/who influenced your decision to enroll in college classes while in high school? **(check all that apply):**

□ Parents and/or family members

□ Opportunity to earn college credit while in high school

□ Friends

□ Free college classes

□ Teachers/Guidance Counselors

□ Opportunity to take classes not offered at high school

□ Opportunity to gain career skills

□ Degree of difficulty/challenges of DE math courses

□ Self-confidence in your math skills

7. While in high school how many college courses did you take?

   1 □ 2 □ 3 4 5 or more □

8. How would you describe your level of preparation for college coursework when you started the MHS DE Program.

   □ Excellent □ Good □ Satisfied □ Poor □ Very Poor

9. I am confident toward succeeding in college classes.

   □ Strongly Agree □ Agree □ Neutral □ Disagree □ Strongly Disagree

Part 2 - Intention of Going to College Survey

10. Respond to the following statements by placing an (X) to indicate your response as Never, Once, Twice, or Three or more times.

In the past 6 months, how many times have you talked to a school official (teacher, principal, or guidance counselor) about

	Never	Once	Twice	Three or more
a. Your long-term educational plans	□	□	□	□

b. Choosing a college □ □ □ □

c. College applications □ □ □ □

d. Career counseling □ □ □ □

e. Getting letters of recommendation □ □ □ □

f. Applying for financial aid □ □ □ □

g. Arranging job interviews □ □ □ □

11. Respond to the following statements by placing an (X) to indicate your response as Strongly disagree, Disagree, Neutral, Agree, or Strongly agree.

Please tell me how you feel about the following statements.

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. My family has always expected me to go to college.	□	□	□	□	□
b. My high school was helping me be prepared for college.	□	□	□	□	□

12. How far would you like to go in school? (choose only one option)

a. Less than high school graduation

b. High school graduation only

c. Less than 2 years of college, vocational, or business school

d. Two or more years of college, including a 2-year degree

e. Finish college (4- or 5-year degree)

f. Master's degree or equivalent

g. PhD., MD, or other professional degree

13. Respond to the following statements by placing an (X) to indicate your response as Strongly disagree, Disagree, Neutral, Agree, or Strongly agree.

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

a. I feel supported by my teachers and school to go to college. □ □ □ □ □

b. I am motivated and have a positive attitude regarding college. □ □ □ □ □

c. I know what to expect when it comes to the college experience. □ □ □ □ □

14. What was your level of interest to attend college within one year after graduating from high school?

a. Very interested

b. Somewhat interested

c. Neutral

c. Not very interested

d. Not interested

15. Please rate how well you perceive yourself to be prepared for college courses in each of the following areas with 1 being extremely well, 2 very well, 3 well, 4 somewhat well and 5 not well

	Extremely well	Very well	Well	Somewhat well	Not well
a. Statistics knowledge	□	□	□	□	□
b. College Academic Rigor	□	□	□	□	□
c.. Motivation to attend college	□	□	□	□	□
d. Overall readiness for college	□	□	□	□	□

Part 3 - Perception of DE Courses Survey

16. Did the DE program help you decide on a college major or career path?

□ Yes, my college classes helped me determine a college major or career path.

□ No, my college classes did not help me choose a career path or college major.

17. As a result of taking college courses through the DE Program:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. I was better prepared academically for the challenges of college.	□	□	□	□	□
b. DE strengthened my study habits (test-taking, time management, note-taking skills, etc.)	□	□	□	□	□
c. I strengthened my math skills	□	□	□	□	□
d. I strengthened my technical skills	□	□	□	□	□
e. I strengthened my computer skills.	□	□	□	□	□
f. I strengthened my critical thinking skills	□	□	□	□	□

18. Respond to the following statements by placing an (X) to indicate your response as Strongly disagree, Disagree, Neutral, Agree, or Strongly agree

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. The dual enrollment classes challenge me more than my standard high school courses.	□	□	□	□	□
b. DE classes kept me motivated to strive for better grades in high school.	□	□	□	□	□
c. DE classes kept me motivated to stay in school	□	□	□	□	□
d. DE classes kept me motivated to stay focused during my senior year.	□	□	□	□	□
e. I would recommend that all students take DE classes while in high school.	□	□	□	□	□

19. Respond to the following statements by placing an (X) to indicate your response as Strongly disagree, Disagree, Neutral, Agree, Strongly agree,
Please indicate how much you agree with the following statements:

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. When I began Dual Enrollment, I was well prepared academically for the class(es) I took.	□	□	□	□	□
b. Dual Enrollment was a more positive social experience for me than high school.	□	□	□	□	□
c. Dual Enrollment was a positive academic experience for me.	□	□	□	□	□
d. While in DE, I fell more like a community college student than a high school student.	□	□	□	□	□
e. Overall, I am glad that I took the decision to join DE.	□	□	□	□	□

20. Respond to the following statements by placing an (X) to indicate your response as Excellent Good Satisfied Poor Very Poor
Please rate your satisfaction with the following aspects of your DE experience:

	Excellent	Good	Satisfied	Poor	Very Poor
a. Course content	□	□	□	□	□
b. Quality of instruction	□	□	□	□	□
c. Social environment	□	□	□	□	□
d. Overall DE satisfaction	□	□	□	□	□

21. What was the factor that most motivated you to become a DE student? **(check all that apply):**

O I wanted to see what college was like.
O I wanted to start building up college credit
O I was bored in high school.
O My parents encouraged me to start DE
O My high school guidance counselor encouraged me to start DE
O Other

22. How frequently do you seek help from Trident Tech College adjuncts outside of class time (office hours, appointments, etc.)?

O Once a week or more
O Once every two weeks
O Once a month
O Once a semester
O Never

23. Looking back, rate your overall experience satisfaction with the DE Mat 120 course.

□Excellent □Good □Satisfied □Poor □Very Poor

APPENDIX D

DUAL ENROLLMENT STUDENT POST-SURVEY

Dual Enrollment Program. All three parts of this survey can be completed online at: *The link to a Google Form will be provided here.*

Hello, I'm a graduate student at the University of South Carolina in their Doctor of Education program, and this assessment was part of my Action Research Study on Students' Perceptions and intentions of going to college and DE students' perceptions. I would like to know how the DE program, your school, friends, and family affect your plans for what you plan to do after high school. I hope the results of this study will help school administrators understand students' needs and improve the DE program. Please note that your participation was voluntary, confidential, and no compensation will be awarded. I hope you will answer all questions. The more complete the evaluation, the better the results will be. Please know that this assessment was not a test. There are no right or wrong answers—only honest ones. Parent or guardian means the person whom you consider most like a parent to you. For instance, this could be your parent, stepparent, foster-parent, guardian, parent's live-in partner, grandparent, etc. Postsecondary was used synonymously and means the same as college, any formal education that occurs after graduating from high school.

Directions: Please indicate one response for each question.

There are no incorrect answers.

Instructions: Please complete the entire survey by checking the appropriate boxes and filling in the blanks with your responses.

1. I am 18 years old (or older) and agree to allow the information provided in this survey to be used for research purposes that may be published. (Your name and all other personally identifying information will be removed.)

   □Yes □No

2. Please indicate your gender:

a. Male

b. Female

c. Other (please specify)_____

d. Do not respond

3. Are you: **(Check only one.)**

□African-American/Black □American Indian/Alaska Native

□Asian-American/Asian □Caucasian

□Hispanic of any race □Native Hawaiian/Pacific Islander

□Other: _____

4. How would you rate your comfort level of using technology (e.g., Browsing the internet, Using spreadsheets from Microsoft Excel, Navigating through a website)?

   □ Excellent □ Good □ Satisfied □ Poor □ Very Poor

5. How would you rate your comfort level when trying to use a new computer application?

   □ Excellent □ Good □ Satisfied □ Poor □ Very Poor

Part 1 - Perception of College Courses Survey

6. What/who influenced your decision to enroll in college classes while in high school? **(check all that apply):**

□ Parents and/or family members

□ Opportunity to earn college credit while in high school

□ Friends

□ Free college classes

□ Teachers/Guidance Counselors

□ Opportunity to take classes not offered at high school

□ Opportunity to gain career skills

□ Degree of difficulty/challenges of DE math courses

□ Self-confidence in your math skills

7. While in high school how many college courses did you take?

   1 □ 2 □ 3 4 5 or more □

8. How would you describe your level of preparation for college coursework when you started the MHS DE Program.

   □ Excellent □ Good □ Satisfied □ Poor □ Very Poor

9. I am confident toward succeeding in college classes.

   □ Strongly Agree □ Agree □ Neutral □ Disagree □ Strongly Disagree

Part 2 - Intention of Going to College Survey

10. Respond to the following statements by placing an (X) to indicate your response as Never, Once, Twice, or Three or more times.

In the past 6 months, how many times have you talked to a school official (teacher, principal, or guidance counselor) about

	Never	Once	Twice	Three or more times
a. Your long-term educational plans	□	□	□	□

b. Choosing a college □ □ □ □

c. College applications □ □ □ □

d. Career counseling □ □ □ □

e. Getting letters of recommendation □ □ □ □

f. Applying for financial aid □ □ □ □

g. Arranging job interviews □ □ □ □

11. Respond to the following statements by placing an (X) to indicate your response as Strongly disagree, Disagree, Neutral, Agree, or Strongly agree.

Please tell me how you feel about the following statements.

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. My family has always expected me to go to college.	□	□	□	□	□
b. My high school was helping me be prepared for college.	□	□	□	□	□

12. How far would you like to go in school? (choose only one option)

a. Less than high school graduation

b. High school graduation only

c. Less than 2 years of college, vocational, or business school

d. Two or more years of college, including a 2-year degree

e. Finish college (4- or 5-year degree)

f. Master's degree or equivalent

g. PhD., MD, or other professional degree

13. Respond to the following statements by placing an (X) to indicate your response as Strongly disagree, Disagree, Neutral, Agree, or Strongly agree.

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. I feel supported by my teachers and	□	□	□	□	□

school to go to college.

b. I am motivated and have a positive attitude regarding college. □ □ □ □ □

c. I know what to expect when it comes to the college experience. □ □ □ □ □

14. What was your level of interest to attend college within one year after graduating from high school?

a. Very interested

b. Somewhat interested

c. Neutral

c. Not very interested

d. Not interested

15. Please rate how well you perceive yourself to be prepared for college courses in each of the following areas with 1 being extremely well, 2 very well, 3 well, 4 somewhat well and 5 not well

	Extremely well	Very well	Well	Somewhat well	Not well
a. Statistics knowledge	□	□	□	□	□
b. College Academic Rigor	□	□	□	□	□
c.. Motivation to attend college	□	□	□	□	□
d. Overall readiness for college	□	□	□	□	□

Part 3 - Perception of DE Courses Survey

16. Did the DE program help you decide on a college major or career path?

□ Yes, my college classes helped me determine a college major or career path.

□ No, my college classes did not help me choose a career path or college major.

17. As a result of taking college courses through the DE Program:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. I was better prepared academically for the challenges of college.	□	□	□	□	□
b. DE strengthened my study habits (test-taking, time management, note-taking skills, etc.)	□	□	□	□	□
c. I strengthened my math skills	□	□	□	□	□
d. I strengthened my technical skills	□	□	□	□	□
e. I strengthened my computer skills.	□	□	□	□	□
f. I strengthened my critical thinking skills	□	□	□	□	□

18. Respond to the following statements by placing an (X) to indicate your response as Strongly disagree, Disagree, Neutral, Agree, or Strongly agree

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. The dual enrollment classes challenge me more than my standard high school courses.	□	□	□	□	□
b. DE classes kept me motivated to strive for better grades in high school.	□	□	□	□	□
c. DE classes kept me motivated to stay in school	□	□	□	□	□
d. DE classes kept me motivated to stay focused during my senior year.	□	□	□	□	□
e. I would recommend that all students take DE classes while in high school.	□	□	□	□	□

19. Respond to the following statements by placing an (X) to indicate your response as Strongly disagree, Disagree, Neutral, Agree, Strongly agree,
Please indicate how much you agree with the following statements:

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. When I began Dual Enrollment, I was well prepared academically for the class(es) I took.	□	□	□	□	□
b. Dual Enrollment was a more positive social experience for me than high school.	□	□	□	□	□
c. Dual Enrollment was a positive academic experience for me.	□	□	□	□	□
d. While in DE, I fell more like a community college student than a high school student.	□	□	□	□	□
e. Overall, I am glad that I took the decision to join DE.	□	□	□	□	□

20. Respond to the following statements by placing an (X) to indicate your response as Excellent Good Satisfied Poor Very Poor
Please rate your satisfaction with the following aspects of your DE experience:

	Excellent	Good	Satisfied	Poor	Very Poor
a. Course content	□	□	□	□	□
b. Quality of instruction	□	□	□	□	□
c. Social environment	□	□	□	□	□
d. Overall DE satisfaction	□	□	□	□	□

21. What was the factor that most motivated you to become a DE student? **(check all that apply):**

O I wanted to see what college was like.
O I wanted to start building up college credit
O I was bored in high school.
O My parents encouraged me to start DE
O My high school guidance counselor encouraged me to start DE
O Other

22. How frequently do you seek help from Trident Tech College adjuncts outside of class time (office hours, appointments, etc.)?

O Once a week or more
O Once every two weeks
O Once a month
O Once a semester
O Never

23. Looking back, rate your overall experience satisfaction with the DE Mat 120 course.

□Excellent □Good □Satisfied □Poor □Very Poor

Part 4 –Perception of Technology

24. As a result of using technology embedded in this Mat 120 course (JASP, XYZ-Homework platform, Microsoft Excel, Daily video lessons, D2L):

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. I kept focused academically.	□	□	□	□	□
b. I changed my perception about college courses.	□	□	□	□	□
c. I strengthened my understanding of what a college course looked like.	□	□	□	□	□

25. My understanding of the relevance of statistics as a result of using technology embedded in this Mat 120 course (JASP, XYZ-Homework platform, Microsoft Excel, Daily video lessons, D2L),

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. Positively motivated me to focus on my future college education	□	□	□	□	□
b. Enhanced my desire to go to college	□	□	□	□	□
c. Strengthened my understanding of why I want to go to college.	□	□	□	□	□

26. Respond to the following statements by placing an (X) to indicate your response as Strongly disagree, Disagree, Agree, Strongly agree, or Does not apply (i.e., I don't plan to go to college)

As a result of using technology embedded in this Mat 120 course (JASP, XYZ-Homework platform, Microsoft Excel, Daily video lessons, D2L):

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. I developed more realistic expectations about college.	□	□	□	□	□
b. I am more confident about my ability to succeed in college	□	□	□	□	□
c I considered, for the first time, enrolling in college	□	□	□	□	□
d. I am confident that I have more chances to succeed in college	□	□	□	□	□
e. I plan to enroll on to a 2-year or 4-year college/university.	□	□	□	□	□

27. As a result of using JASP through the DE Mat 120 course:

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. I strengthened my math skills	□	□	□	□	□
b. I strengthened my technical skills	□	□	□	□	□
c. I strengthened my critical thinking skills	□	□	□	□	□
d. I strengthened my understanding of the relevance of statistics in daily activities.	□	□	□	□	□

28. As a result of doing the homework online, on the XYZ-Homework platform instead of doing it on paper like any regular class:

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. I strengthened my math skills	□	□	□	□	□

b. I strengthened my understanding of new concepts. □ □ □ □ □

c. I strengthened my understanding of what a college course looked like. □ □ □ □ □

29. As a result of using technology embedded in this Mat 120 course (JASP, XYZ-Homework platform, Microsoft Excel, Daily video lessons, D2L):

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a. After taking the DE course, I would recommend that students take the DE math course during high school.	□	□	□	□	□
b. The DE class kept me academically focused.	□	□	□	□	□
c. DE class challenged me.	□	□	□	□	□

APPENDIX E

SEMI-STRUCTURED INTERVIEW PROTOCOL

About DE and College Courses

1. How would you describe your expectations about college courses before enrolling in DE math course?
2. How did you developed that expectation for college courses? For DE courses?
3. What would motivate you to attend college?
4. What motivate you to enroll in the DE program? Follow-up question: Why not enrolled earlier?
5. What college services do you have access in the DE program?
6. What characteristics do you feel a student needs to be successful in DE courses? Personal? Academic?

About the Mat 120 DE Course

7. What are the differences/similarities between the Mat 120 DE Course and regular high school courses? Follow-up question: describe the teaching styles you have observed in DE class compared to the high school classes. Include comments about technology used in the DE course.
8. What did you know about college before enrolling in the Mat 120 DE Course? How about after completing the Mat 120 DE Course (now)?
9. Did you plan to go to college before participating in the Mat 120 DE Course?

10. Does the technology embedded in the course (JASP, XYZ-Homework platform, Microsoft Excel, Daily video lessons, D2L) encouraged you to want to go to college? Follow up question: If so, how do you think that technology embedded in the Mat 120 DE Course influence your intentions?
11. How did technology embedded in the Mat 120 DE Course meet your expectation of college-level courses?
12. After participating in the Mat 120 DE Course, will the experience encourage you to enroll in college? Please specify why?
13. What technology skills do you think that you gained/refined by taking the Mat 120 DE Course? How will those technology skills help you in college?
14. What factors contributed to your decision to participate in the Mat 120 DE Course?
15. How helpful was JASP/Excel/TI84+ for you to do meta-analysis?
16. How helpful were the XYZ videos? How helpful were teacher-made videos?
17. How helpful was Microsoft Excel for you to work with large databases?

About the DE General Courses

18. Describe your feelings about each of the following aspects of DE course:
    a. the location of the class
    b. characteristics of students in the classes, such as age, maturity level, etc.
    c. technology embedded in the course
19. Was there anything you wish would have been different about the DE courses taken? If so, describe.
20. Why, in your opinion, would a high school student refuse to enroll in a DE course?

APPENDIX F

SURVEYS' ADAPTATIONS

Table F.1 (ACE/BOCES) Student Follow-up Survey Adaptation Anderson, (2010)

Original item	Modification	Justification
Respond to the following 8 questions using the 5 points Likert scale As a result of taking college courses through the ACE Program:	As a result of taking college courses through the DE Program:	The name of the MHS program was DE Program:
1. I was better prepared academically for the challenges of college.		
2. strengthened my study habits *(test-taking, time management, note-taking skills, etc.)*		
3. I strengthened my math skills.		
4. strengthened my technical skills.		
5. strengthened my computer skills.		
6. I strengthened my critical thinking skills.		
7. I was better prepared socially/ personally for the challenges of college		

8. I discussed my college goals with an advisor or counselor.

9. What/who influenced your decision to enroll in college classes while in high school? *(check all that apply)*:

□ Parents and/or family members

□ Opportunity to earn college credit while in high school

□ Friends

□ Free college classes

□ Teachers/Guidance Counselors

□ Opportunity to take classes not offered at high school

□ Opportunity to gain career skills

10. Did the ACE Program help you decide on a college major or career path?

□ Yes, my college classes helped me determine a college major or career path.

□ No, my college classes did not help me choose a career path or college major.

10. Did the DE Program help you decide on a college major or career path?

10. The name of the MHS program was DE Program

11. Looking back, rate your overall experience satisfaction with the Accelerated College Education (ACE)

11. Looking back, rate your overall experience

11. The name of the MHS program was DE Program

Program.

□Excellent □Good □Poor □Very Poor

12. Would you recommend the Accelerated College Education (ACE) Program to current high school students?

□Yes □No

13. Are you: *(Check only one.)*

□African-American/Black

□American Indian/Alaska Native

□Asian-American/Asian

□Caucasian

□Hispanic of any race

□Native Hawaiian/Pacific Islander

□Other: _____

14. Are you a:

□Male

satisfaction with the DE Program.

□Excellent

□Good

□Satisfactory

□Poor □Very Poor

12. Would you recommend the DE Program to current high school students?

□Yes □No

14. Please indicate your gender:

a. Male

b. Female

12. The name of the MHS program was DE Program

14. Include more options.

□Female	c. Other (please specify)_____
	d. Do not respond

Table F.2 Detailed Student Assessment Adaptation, Diggs (2013)

Original item	Modification	Justification
Respond to the following statements by placing an (X) to indicate your response as *Never, Once, Twice*, or *Three or more times* In the past 12 months, how many times did you talk to a school official (teacher, principal, or guidance counselor) about:	In the past 5 months, how many times did you talk to a school official (teacher, principal, or guidance counselor) about:	The DE course was taught over a period of 4.5 months.
1. Your long-term educational plans		
2. Choosing a college		
3. College applications.		
4. Career counseling.		
5. Getting letters of recommendation		
6. Applying for financial aid.		
7. Arranging job interviews		
Respond to the following questions using the 5 points Likert scale		
8.My family has always expected me to go to college.		

9.My school provides a caring, encouraging environment.	9. The DE course provides a caring, encouraging environment.	9. I research the DE influence
10.My high school was helping me be prepared for college.	10. The DE was helping me be prepared for college.	10. I research the DE influence
11. I feel supported by my family to go to college.		
12. I feel supported by my friends to go to college.		
13. I feel supported by my teachers and school to go to college.		
14. I am motivated and have a positive attitude regarding college.		
15. I know what to expect when it comes to the college experience.		
16. I'm familiar with Free Application For Federal Student Aid form and applying for financial assistance.	17. What was your level of interest to attend college	17. I make it similar with a 5 point Likert scale
17. What was your level of interest to attend college within the 1rst year after graduating		

from high school?	within the 1rst
a. Very interested	year after
b. Somewhat interested	graduating
c. Undecided	from high school?
d. Not interested	1 Very interested
	2 Somewhat
	interested
	3 Neutral
	4 Not very
	interested
	5 Not interested.

18. How far you like to go in school?

a. Less than high school graduation

b. High school graduation only

c. Less than 2 years of college, vocational, or business school

d. Two or more years of college, including a 2-year degree

e. Finish college (4- or 5-year degree)

f. Master's degree or equivalent

g. PhD., MD, or other professional degree

Table F.3. DE and Dual Credit Perspectives Survey Adaptation (Smith, 2015)

Original item	Modification	Justification
Respond to the following 3 questions using the 5 points Likert scale By taking college classes while still in high school, I: 1. Developed more realistic expectations about college 2. Was more confident about my ability to succeed in college 3. Considered, for the first time, enrolling in college 4. While in high school how many college courses did you take?	As a result of taking college courses through the DE Program:	The name of the MHS program was DE Program

Table F.4. Student Perceptions Survey Adaptation (Gatlin, 2009)

Original item	Modification	Justification
1. The dual enrollment classes challenge me more than my standard high school courses. 2. DE classes kept me motivated to strive for better grades in high school. 3. DE classes kept me motivated to stay in		

school. 4. DE classes kept me motivated to stay focused during my senior year. 5. I would recommend that all students take DE classes while in high school.		

Table F.5 DE Experience Questionnaire Adaptation (Midcap, 2003)

Original item	Modification	Justification
Respond to the following 12 questions using the 4 points Likert scale. Please indicate how much you agree with the following statements	Respond to the following 12 questions using the 5 points Likert scale. Please indicate how much you agree with the following statements	The 5 points Likert scale was balanced.
1. When I began Dual Enrollment, I was well prepared academically for the class(es) I took. 2. Dual Enrollment was a more positive social experience for me than high		

school.

3. Dual Enrollment was a positive academic experience for me.

4. While in DE, I felt more like a community college student than a high school student.

5. As a DE student, I participate in high school extracurricular activities just as much as I did before DE.

6. I make friends with other DE students.

7. I receive good academic advice from my high school counselor.

8. Overall, I am glad that I made the decision to join DE.

Please rate your satisfaction with the following aspects of your DE experience:

9. Course content

10. Quality of instruction

11. Social environment

12. Overall DE satisfaction

13. What was the factor that most motivated you to become a DE student?

O. I wanted to see what college was like.

O I wanted to start building up college credit

O I was bored in high school.

O. My parents encouraged me to start DE

O My high school guidance counselor encouraged me to start DE

O. Other

14. How frequently do you seek help from Chesapeake College instructors outside of class time (office hours, appointments, etc.)?

O Once a week or more

O Once every two weeks

O Once a month

O Once a semester

O Never

14. How frequently do you seek help from Technical College adjuncts outside of class time (office hours, appointments, etc.)?

O Once a week or more

O Once every two weeks

O Once a month

O Once a semester

O Never

14. College's name was different

APPENDIX G

ITEMS THAT ADDRESS STUDY'S RESEARCH QUESTIONS

RQ1: How does participation in a technology-enhanced DE course influence high school students' perception of college courses?

Table G.1 Items That Address Research Question About College Classes

Items	Source
3. What/who influenced your decision to enroll in college classes while in high school? (check all that apply): □ Parents and/or family members □ Opportunity to earn college credit while in high school □ Friends □ Free college classes □ Teachers/Guidance Counselors □ Opportunity to take classes not offered at high school □ Opportunity to gain career skills	(ACE/BOCES) Student Follow-up Survey (Anderson, 2010)

□ Degree of difficulty/challenges of DE math courses □ Self-confidence in your math skills	
4. Did the DE Program help you decide on a college major or career path? □ Yes, my college classes helped me determine a college major or career path. □ No, my college classes did not help me choose a career path or college major.	(ACE/BOCES) Student Follow-up Survey (Anderson, 2010)
Respond to questions 5, 6 and 7 using the 5 points Likert-type scale	
5. As a result of taking college courses through the DE Program: Strongly Agree Agree Neutral Disagree Strongly Disagree a. I was better prepared academically for the challenges of college. b. DE strengthened my study habits (test-taking, time management, note-taking skills, etc.) c.. I strengthened my math skills d.. I strengthened my technical skills e.. I strengthened my computer skills	(ACE/BOCES) Student Follow-up Survey (Anderson, 2010)

f. I strengthened my critical thinking skills	
6. As a result of taking college courses through the DE Program: Strongly Agree Agree Neutral Disagree Strongly Disagree a. I was better prepared socially/personally for the challenges of college. b. I discussed my college goals with an advisor or counselor.	(ACE/BOCES) Student Follow-up Survey (Anderson, 2010)
7. Looking back, rate your overall experience satisfaction with the DE Program. Excellent Good Satisfied Poor Very Poor	(ACE/BOCES) Student Follow-up Survey (Anderson, 2010)
8. Would you recommend the DE Program to current high school students? □Yes □No	(ACE/BOCES) Student Follow-up Survey (Anderson, 2010)
9. Are you: (Check only one.) □African-American/Black □American Indian/Alaska Native □Asian-American/Asian □Caucasian	

□Hispanic of any race □Native Hawaiian/Pacific Islander

□Other: _____

10. How would you describe your level of preparation for college coursework when you started in the MHS DE Program.

Excellent Good Satisfied Poor Very Poor

11. Answer to this question only after you finish Mat 120 course! How would you describe your level of preparation for college coursework when you started in the MHS DE Program.

Excellent Good Satisfied Poor Very Poor

12. I gained more confidence toward taking college classes after taking DE course.

Strongly Agree Agree Neutral Disagree Strongly Disagree

RQ2: How does participation in a technology-enhanced DE course influence high school students' intention of going to colleges?

Table G.2 Items That Address Research Question About Intention to Go to College

Items	Source
13. Respond to the following statements by placing an (X) to indicate your response as Strongly disagree, Disagree, Neutral, Agree, or Strongly agree.	Detailed Student Assessment (Diggs, 2013)
Please tell me how you feel about the following statements.	
a. After taking DE course I would recommend that students take the DE math course during high school.	
b. During the semester DE class kept me academically focused.	
c. DE class challenged me.	
14. Respond to the following statements by placing an (X) to indicate your response as Never, Once, Twice, or Three or more times.	Detailed Student Assessment (Diggs, 2013)
In the past 6 months, how many times did you talk to a school official (teacher, principal, or guidance counselor) about	
a. Your long-term educational plans	
b. Choosing a college	

c. College applications	
d. Career counseling	
e. Getting letters of recommendation	
f. Applying for financial aid	
g. Arranging job interviews	
15. Respond to the following statements by placing an (X) to indicate your response as Strongly disagree, Disagree, Neutral, Agree, or Strongly agree.	Detailed Student Assessment (Diggs, 2013)
Please tell me how you feel about the following statements.	
a. My family has always expected me to go to college.	
b. My high school was helping me be prepared for college.	
c. My DE provides a caring, encouraging environment.	
16. How far you like to go in school?	Detailed Student Assessment (Diggs, 2013)
a. Less than high school graduation	
b. High school graduation only	
c. Less than 2 years of college, vocational, or business school	
d. Two or more years of college, including a 2-year degree	

e. Finish college (4- or 5-year degree)	
f. Master's degree or equivalent	
g. PhD., MD, or other professional degree	
17. Respond to the following statements by placing an (X) to indicate your response as Strongly disagree, Disagree, Neutral, Agree, or Strongly agree.	Detailed Student Assessment (Diggs, 2013)
a.I feel supported by my family to go to college.	
b. I feel supported by my friends to go to college.	
c. I feel supported by my teachers and school to go to college.	
d. I am motivated and have a positive attitude regarding college.	
e. I know what to expect when it comes to the college experience.	
f. I'm familiar with Free Application For Fedral Student Aid form and applying for financial assistance.	
18. What was your level of interest to attend college within the 1rst year after graduating from high school?	Developed by myself
a. Very interested	
b. Somewhat interested	
c. Neutral	
c. Not very interested	

d. Not interested	
19. Please rate how well you perceive yourself to be prepared for college courses in each of the following areas, with 1 being extremely well, 2 very well, 3 well, 4 somewhat well, and 5 not well	Dual Enrollment and Dual Credit Perspectives Survey (Smith, 2015)
a. Statistics	
b. Academic Rigor	
c.. Motivation to succeed in college	
d. Overall readiness for college	
20. Respond to the following statements by placing an (X) to indicate your response as Strongly disagree, Disagree, Agree, Strongly agree, or Does not apply (i.e., I don't plan to go to college)	Dual Enrollment and Dual Credit Perspectives Survey (Smith, 2015)
As a result of taking college courses through the DE Program, I:	
a. Developed more realistic expectations about college.	
b. Was more confident about my ability to succeed in college	
c Considered, for the first time, enrolling in college	
d. After taking the DE class, I am confident that I have more chances to succeed in college	
e. After taking the DE course, I plan to enroll in a 2-year or 4-year college/university.	

21. While in high school, how many college courses did you take? 1 2 □ 3 □ 4 □ 5 or more □	Developed by myself

RQ3: What was the student's perception of the DE math course that they participate in?

Table G.3 Items That Address Research Question About DE Courses

Items	**Source**
22. Respond to the following statements by placing an (X) to indicate your response as Strongly disagree, Disagree, Neutral, Agree, or Strongly agree As a result of taking the DE Mat course I had a great experience.	Developed by myself
23. Respond to the following statements by placing an (X) to indicate your response as Strongly disagree, Disagree, Neutral, Agree, or Strongly agree. Please tell me how you feel about the following statements. a. After taking the DE course, I would recommend that students take the DE math course during high school. b. During the semester, DE class kept me academically focused. c. DE class challenged me.	Developed by myself

24. Respond to the following statements by placing an (X) to indicate your response as Strongly disagree, Disagree, Neutral, Agree, or Strongly agree a. The dual enrollment classes challenge me more than my standard high school courses. b. DE classes kept me motivated to strive for better grades in high school. c. DE classes kept me motivated to stay in school d. DE classes kept me motivated to stay focused during my senior year. e. I would recommend that all students take DE classes while in high school. f. I gained more confidence toward taking college classes after taking DE course	Student Perceptions Toward Dual Enrollment Courses And College Preparedness (Gatlin, 2009)
25. Respond to the following statements by placing an (X) to indicate your response as Strongly disagree, Disagree, Neutral, Agree, Strongly agree, Please indicate how much you agree with the following statements:	DE Experience Questionnaire (Midcap, 2003)

a. When I began Dual Enrollment, I was well prepared academically for the class(es) I took

b. Dual Enrollment was a more positive social experience for me than high school.

c. Dual Enrollment was a positive academic experience for me.

d. While in DE, I felt more like a community college student than a high school student.

e. As a DE student, I participate in high school extracurricular activities just as much as I did before DE.

f. I make friends with other DE students

g I receive good academic advice from my high school counselor.

h. Overall, I am glad that I made the decision to join DE.

26. Respond to the following statements by placing an (X) to indicate your response as Excellent Good Satisfied Poor Very Poor

Please rate your satisfaction with the following aspects of your DE experience:

DE Experience Questionnaire (Midcap, 2003)

a. Course content

b. Quality of instruction

c. Social environment

d. Overall DE satisfaction

27. What was the factor that most motivated you to become a DE student?	DE Experience Questionnaire (Midcap, 2003)
O. I wanted to see what college was like.	
O I wanted to start building up college credit	
O I was bored in high school.	
O. My parents encouraged me to start DE	
O My high school guidance counselor encouraged me to start DE	
O. Other	
28. How frequently do you seek help from Trident Tech College adjuncts outside of class time (office hours, appointments, etc.)?	DE Experience Questionnaire (Midcap, 2003)
O Once a week or more	
O Once every two weeks	
O Once a month	
O Once a semester	
O Never	