PERCEPTIONS OF COMMUNITY AMONG DUAL CREDIT STUDENTS TAKING STEM COURSES OFFERED THROUGH A COMMUNITY COLLEGE

by

Teresa M Johnson

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Philosophy

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ABSTRACT

The United States is currently experiencing a shortage of qualified individuals to fill jobs in the fields of science, engineering, mathematics, and technology. Therefore, educational institutions are concerned with recruiting and retaining students in these fields of study. One means of introducing students to these fields of study is enrollment in dual credit coursework. The purpose of this quantitative, correlational study was to determine whether a relationship exists between student perceptions of community for dual credit students enrolled in these courses through a local community college and end of term averages in these courses. This relationship was examined by collecting survey data on three predictor variables (connectedness, learning, and overall sense of community) and a criterion variable (end of term average). The data were analyzed using a multiple regression analysis. Due to problems with assumption testing, only two of the three criterion variables, connectedness and learning, were included in the statistical analysis. Results of the analysis revealed a significant predictive relationship between student perceptions of connectedness and learning and the end of term average of the participants. These results suggest that student perceptions of community may be a key factor influencing success in the dual credit, STEM and CTE-STEM educational environment.

Keywords: dual credit, community, STEM, technology, community college

Dedication

No one reaches the dissertation phase of a doctoral journey without the help and support of numerous individuals who have contributed to their journey along the way. It is appropriate to say a word of thanks to at least a few of these extraordinary people.

First, thanks be to God, who is an always present source of hope and faith in times of need. For the gift of His son, the presence of His Holy Spirit, and the gift of this opportunity in my life, I give thanks.

Thank you to my husband, Steve, who has always seen the best in me. This dissertation reflects his investment and faith in me as his life partner. And to my children, Sam, Christie, and “Little Ben,” thank you for your encouragement and for telling me that you knew I could do this all along.

Thank you as well to my administrators and colleagues at my school. For permission to conduct my study, advice on my literature review, and any other support that I requested during my coursework and dissertation phase, I thank you.

Thank you to my wonderful committee. For putting together a quick video conference (or hopping on a phone call) to help assure me that it was going to be ok, for invaluable advice, and for thoughtful commentary on all of the drafts and processes that go into such a work, thank you.

And finally, thank you to my parents. To my mom, Imogene, for going back to school after raising me and my brothers and inspiring in me a love of learning, thank you. To my dad, George, who passed away before I could complete this work, thank you. I know you are smiling now and telling your heavenly comrades that I did it.

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List of Abbreviations

Career and College Readiness (CCR)

Early College High School (ECHS)

End of Term Average (EOT)

Every Student Succeeds Act (ESSA)

President’s Council of Advisors on Science and Technology (PCAST)

Science, Technology, Engineering, and Mathematics (STEM)

United States Department of Education (USDE)

CHAPTER ONE: INTRODUCTION

Overview

STEM education is an important and ongoing effort aimed at increasing the number of qualified applicants to fill an increasingly technology-based workforce. STEM students are often recruited and introduced to college-level requirements through dual credit coursework associated with local community colleges. This study investigates the relationship between such dual credit STEM students' perceptions of community and course success, as measured by end of term averages, within the dual credit STEM courses. Chapter One introduces the study by providing background information, the problem and purpose statements for the study, the significance of the study, the research question, and definitions of significant terms.

Background

In November of 2019, the United States Department of Education (USDE) responded to a call from President Trump to increase and expand opportunities in the high demand job market for science, engineering, technology, and mathematics (STEM). The USDE supported this initiative by investing approximately $540 million to support STEM education. Recent complications facing educators in light of the outbreak of the novel COVID-19 coronavirus have resulted in a further investment of over $300 million in discretionary funds, authorized by the CARES Act, to be used to seek out innovative ways to continue to promote STEM education in an uncertain K-12 educational environment (USDE, n.d.). This vast expenditure highlights the importance placed on STEM education by the United States government.

One example of the reasoning behind the United States emphasis on STEM education can be seen from a recent report put out by the President's Council of Advisors on Science and Technology (PCAST). This report emphasizes the technological needs that are required to transform modern cities in the United States. These technological needs are related to improving energy efficiency, wastewater management techniques, connectivity and communication technologies, and modern farming and manufacturing processes (PCAST, 2016). Another report from PCAST predicts that the United States workforce could soon experience a significant shortage of qualified individuals to fill available jobs in STEM related fields (Baher et al., 2017; Morganson et al., 2015; Smith & Wingate, 2016).

The investment of the USDE and the reports from PCAST provide insight into the continuing importance of STEM education in the United States. In light of the importance of this field, educators continue to look for ways to improve recruitment, retention, and success for STEM students. One popular method of recruiting STEM students is the introduction of students to STEM courses through the use of dual credit coursework, often in conjunction with a local community college (Young et al., 2014; Zinth, 2018).

Historical Overview

During the middle part of the twentieth century, the technological landscape of the United States began to change dramatically in order to support the efforts of the troops involved in the Second World War (Erickson, 2018). These efforts led to the creation of the United States Office of Science in support of the Manhattan Project's goal of developing the world's first nuclear weapon (US Department of Energy, n.d.). And not long after the end of the war, President Kennedy declared that the United States was in a worldwide "space race," a sprint to be the first country to put a man on the moon (Erickson, 2018, p. 378).

The need for the technological advances of the space race, among other factors, began to cause a shift in the educational environment of twentieth century America (Fiss, 2012). Prior to these events, secondary and post-secondary education was primarily available to the privileged elite. However, a majority of modern high school students are now exposed to mathematics and science courses that are designed to prepare them for continuing post-secondary education (NAPE, 2018). In conjunction with this phenomenon, dual credit coursework began to emerge in the United States around the 1970s and the 1980s (Barnette et al., 2004).

Originally, dual credit courses were offered to motivated students who had exhausted the offerings available in various courses at their local high school (Thomson, 2017; Young et al., 2014). However, these programs have grown increasingly popular among average and underrepresented student populations (Rivera et al., 2019; Taylor, 2015). In such programs, students are provided an opportunity to obtain high school and college credit simultaneously (Dare et al., 2017; Taylor, 2015). Benefits of dual credit programs for high school students include intellectual challenge, an introduction to college-level coursework, and an opportunity to explore areas of interest which might not be available in traditional high school coursework (Dare et al., 2017; Witkowsky & Clayton; Young et al., 2014). Further, many dual credit programs help with the financial burden of a college education by offering the coursework at low or no cost to students and families (Dare et al., 2017; Loveland, 2017; Stein & Klosterman, 2020; Thomson, 2017).

Dual credit coursework is often tied to a local community college (Taylor, 2015). The formation of community colleges grew out of a general mission to offer post-secondary coursework to all students (Cohen & Kelly, 2019). Further, community colleges have often served as an access point to students who are first generation or from underrepresented populations (Smith & Wingate, 2016). This may be one of the reasons that STEM majors at community colleges are less likely to persist in their programs than are students who begin their STEM degree program at a traditional four-year institution (Cohen & Kelly, 2019; Graham et al., 2013; Snyder & Cudney, 2017). Therefore, persistence and success for students in dual credit STEM courses taken through local community colleges is an issue of concern among such institutions.

Society at Large

As previously stated, the United States workforce is currently facing a shortage of qualified applicants to fill available jobs in STEM-related fields (Baher et al., 2017; Morganson et al., 2015; Smith & Wingate, 2016). Jobs that may be related to STEM education include fields requiring a four-year degree such as chemistry, engineering, mathematics, and computer science, among others (Moody, 2019; Smith & Wingate, 2016). STEM-related jobs that require some post-secondary education in the form of a career certificate or associate degree include such fields as precision machine, information technology, and medical technology (Ellis et al., 2020; Pierce,2019; Siegel & Giamellaro, 2020; Waite & McDonald, 2019). Further, students involved in STEM disciplines and participating in STEM educational programs develop problem-solving skills that enhance their abilities to find solutions to problems related to everyday life situations (Gulen, 2019; Scott-Parker & Barone-Nugent, 2019).

An additional consideration to society is the notion that many jobs that are not directly related to STEM often require technological skills such as working with computers, software, and social media platforms (Moody, 2019). This is particularly true in light of the recent outbreak of the novel coronavirus, COVID-19, which caused widespread global lockdowns beginning in the spring of 2020 (Baker et al., 2021; Taylor, 2020). Social distancing, contactless commerce, and the need to protect from exposure by wearing a mask all present opportunities for increased use of technology in society (O'Leary, 2020). Some of these opportunities include the introduction of robotic technology to facilitate commerce, artificial intelligence technologies aimed at increasing the accuracy of facial recognition while wearing a mask, and video-conferencing technologies used to remotely conduct various meetings and offer telemedicine (Matheson et al., 2020; O'Leary, 2020).

Although there is some debate concerning the issue, many business leaders attribute the phenomenon of outsourcing jobs to foreign countries to the shortage of qualified STEM applicants within the United States workforce (Hira, 2019). Whatever the cause of outsourcing, Jensen and Kletzer (2005) suggest some STEM jobs that are less likely to be outsourced, including jobs in education and healthcare related fields. Because of the problem of outsourcing in many sectors of the economy, including STEM, President Trump has initiated legislation and executive decrees aimed at encouraging businesses to hire and keep jobs within the US (Hira, 2019). These initiatives may have the consequence of continuing to contribute to the need for a technologically qualified workforce, in which individuals will need STEM-based education.

Theoretical Overview

Accepted theories that contribute to an understanding of student success and a sense of community include theories of social integration and social constructivism (Maslow, 1970/2012; Tinto, 1975). Social integration involves the idea that students need to develop positive interactions within the college community to be successful (Mertes, 2015; Tinto, 1975). Social constructivism compliments the theory of social integration by suggesting that learning does not occur in an individual context, but within a social context (Doolittle & Camp, 1999; Schunk, 2016; Vygotsky, 1978).

In the late 20th century, Tinto (1975) began to formulate a theory to explain retention and persistence for college students. His theory suggests that retention and persistence can largely be attributed to successful integration into both the social and academic domains of college life.

Successful academic integration involves the ability of the student to meet the academic expectations of the institution without the need for remediation, a concept that many educators attribute to the notion of college readiness (Woods et al., 2018). Successful social integration involves achieving positive interactions with peers and faculty, as well as participation in college organizations, such as social clubs and other extracurricular activities (Mertes, 2015; Tinto, 1975). Although the Tinto (1975) theory has become mainstream for traditional college students, particularly those at four-year institutions, the theory may not be as relevant for non-traditional student populations, such as commuter students at community colleges, online, and dual credit students (Davidson & Wilson, 2013; Mertes, 2015; Simplicio, 2019). In a revised model of social integration published by Tinto (1997), the concept of social interactions and their impact on college students was expanded to include those which take place within the classroom, lab, and studio settings of college courses.

Maslow (1970/2012) contributes to theories of social integration by theorizing that belonging to a community is among the foundational needs that individuals must have met before self-actualization, through such methods as a college education, can occur. Therefore, students in educational environments that promote a positive sense of community, or belonging, have significant relationships with peers and instructors, believe that they matter to other students, and share a commitment to achieving academic goals, all of which contribute to success (Ritter et al., 2010; Rovai, 2002). In a sentiment consistent with this theorized importance of belonging, many dual credit students in early college high school programs report that the social experiences gained from within the classroom setting in these programs are among the most valuable aspects of the program (Duncheon, 2020). Other studies provide evidence suggesting that students who have a low sense of community are at risk of attrition, experiencing problems such as student burnout (McCarthy et al., 1990) and feelings of isolation (Morgan & Tam, 1999).

Constructivist theories of learning involve the concept that knowledge is gained, and that learning occurs due to the experiences of the learner (Davis et al., 2000; Quay, 2003; Schunk, 2016). Social constructivism expands upon this basic notion by suggesting that learning involves social interactions, including those among students and student-instructor interactions, within a community (Schunk, 2016). Among the most prominent proponents of social constructivism, Vygotsky (1978) theorized that the language and symbolism used by the individuals in the group served to facilitate learning in these shared experiences.

Problem Statement

Much of the literature related to dual credit retention and success involves studies that analyze retention of traditional college students who have previously been enrolled in dual credit courses. For example, Bowers and Foley (2018) completed a study on the relationship between previously earned credit from high school advanced placement or dual enrollment courses and the retention of students at a Tennessee university. Another study conducted by Taylor and Yan (2018) investigated the relationship between concurrent high school enrollments (also referred to as dual credit) and advanced placement enrollments, and enrollment and retention in an Arkansas college. The results of each of these studies corroborates previous research that suggests that participation in dual credit and advanced placement courses during high school increases the likelihood of enrollment and retention in post-secondary education (Bowers & Foley, 2018; Taylor & Yan, 2018). Further research indicates that participation in dual credit programs is a significant predictor of college readiness (Young et al., 2018).

Dual credit programs were further addressed in the Every Student Succeeds Act (ESSA) and the Career and College Readiness (CCR) policies of the state of Illinois as reported in an article by Malin et al. (2017). This report suggests that both policies encourage dual credit programs due to evidence which suggests that completion of these courses has a positive impact on college readiness for students. Further, each of these policies heavily emphasizes increasing access to STEM related programs in secondary schools. These policies additionally suggest that education tailored to workforce readiness is beneficial to students.

In addition to contributing to college readiness, a brief review of the literature reveals that dual credit programs are important for increasing student enrollment and retention once the students graduate and enter post-secondary programs (Blankenberger, et al., 2017; Bowers & Foley, 2018; Malin et al., 2017, Taylor & Yan, 2018). One such study indicates that students who participate in dual credit courses offered through local community colleges may be at least 19% more likely to obtain a bachelor’s degree than are their cohorts who did not participate in dual credit offerings (Blankenberger et al., 2017). However, according to D’Anna et al. (2019), more research is needed to determine which student and school characteristics of dual credit programs might impact future college success.

Additionally, much research addressing the need for STEM education to prepare students for the workforce has been conducted (Baher et al., 2017; Morganson et al., 2015; Smith & Wingate, 2016). Some states, such as Hawaii and Georgia, have addressed the growing need for STEM education by creating programs geared specifically towards STEM students (Berger et al., 2010). Other studies suggest that future research on the motivations and factors influencing attrition in STEM related fields and coursework would be valuable contributions to the current literature (Dyrberg & Holmegaard, 2019; Young et al, 2018). Thus, the problem is that more research is needed to investigate the characteristics and motivational factors influencing attrition and persistence in dual credit, community college STEM courses.

Purpose Statement

The purpose of this quantitative, predictive correlational research study was to determine if there is a significant predictive relationship between perceptions of community for dual credit students enrolled in STEM courses through a local community college and end of term averages of these courses. The criterion variable, end of term average, can be used to examine successful course completion during the discussion following the data analysis. The predictor variables - learning, connection, and overall sense of community - are based on the results of the Classroom Community Scale (Rovai, 2002).

The general population of interest for this study was dual credit high school students who enrolled in STEM courses through a local community college. The sample is a convenience sample comprised of students who fit this description and who are enrolled in such programs at one of the largest community college systems in central Mississippi. Students in the sample population attend high schools associated with a satellite, commuter campus within the previously mentioned community college system.

Significance of the Study

The topic of attrition and persistence in both dual credit courses and STEM courses has been addressed in various forms in the literature. In regard to community college STEM courses, statistics reveal that approximately half of all students involved in STEM-related degree programs completed some coursework at a community college (National Science Board, 2018). Some reasons for attrition among community college STEM students include poor preparation for college-level mathematics (Cohen & Kelly, 2020), issues involving autonomy and self-efficacy (Simon et al., 2015), and fear of receiving a poor grade (McKinney et al., 2019). Further, some college-level STEM students struggle with motivational issues, such as difficulties in identifying the relevance of the coursework (Dyrberg & Holmegaard, 2019).

Studies involving motivational factors affecting high school coursework in the STEM field also suggest that these students face issues of relevance in their coursework (Bozick et al, 2017). Other motivational factors that impact retention of students in dual credit coursework include the following: familiarity with college level expectations and coursework, a quicker path to degree attainment, a quicker path to employment for non-college bound students, cost savings, and less need for college-level remediation, among others (Hunter & Wilson, 2019; Smith et al., 2016; Taylor, 2015).

McMillian and Chavis (1986) discuss how community motivates individuals by suggesting that those who have a strong sense of community believe that they matter to one another and that they can rely on each other to meet their needs. For students, this may mean that those who experience a strong sense of community in their classes will have faith that they can achieve success when they work together (Ritter et al., 2010). And some dual credit students report that the ability to work together with students who are on their level intellectually is one motivational factor influencing their decision to enroll in such courses (Dare et al., 2017). Other dual credit students have reported that social interactions within the classroom community are some of the most valuable aspects of their programs of study (Duncheon, 2020), which may suggest that students value these experiences enough to persist in their individual coursework.

The significance of this study is that the study adds to the body of quantitative literature examining motivational factors that impact dual credit students enrolled in community college STEM courses. Specifically, the study investigates the motivational factor of community by examining the relationship between student perceptions of community in the dual credit courses and end of term averages in these courses, which is one measure of successful course completion for the students. This relationship provides further insight into whether perceptions of community impact attrition and persistence within these courses. Such insight is valuable as is evidenced by research suggesting that completion of these courses contributes to college readiness, retention, and persistence in future post-secondary educational programs for students (Bowers & Foley, 2018; Malin et al., 2018; Taylor & Yan, 2018).

Research Question

RQ1: How accurately can end of term average for high school students enrolled in dual credit, community college STEM courses be predicted from a linear combination of predictor variables (student perceptions of connectedness, learning, and an overall sense of community)?

Definitions

1. *Dual credit (aka concurrent enrollment or dual enrollment)* - Dual credit courses are courses for which students receive both high school and college credit for the same course, taken while the student is in high school (DeSalvo et al., 2017).
2. *Retention* – Retention refers to staying in school until a student completes a degree or remaining enrolled in the same course until the student completes the course (Hagedorn, 2005).
3. *STEM* – An acronym commonly referring to the following four fields – science, technology, engineering, and mathematics (Waite & McDonald, 2019).
4. *STEM education* – STEM education relates to instruction in at least one of the four STEM fields (Waite & McDonald, 2019).

5. *Technology* – Technology refers to the physical components, along with the knowledge required to use these components, incorporated into a design or process (Wahab et al., 2012).
6. *Successful completion* -Successful completion of a course may be considered to be non-withdrawal from the course and the award of a letter grade of A, B, or C (Murphy & Stewart, 2017).
7. *Connectedness* – A sense that students have duties and obligations to each other and to their school and that they trust that their cohorts are committed to meeting shared educational goals (Rovai, 2002).
8. *Learning* – Interactions within the community that aid in the construction of understanding (Rovai, 2002).
9. *Overall sense of community* – A strong sense of belonging and a belief that participation in the community helps the individual achieve their educational goals (Rovai, 2002).

CHAPTER TWO: LITERATURE REVIEW

Overview

A review of the literature was conducted to examine the relationship between community and course success, as measured by numerical averages, for high school students who are enrolled in dual credit STEM courses at an associated community college. In the first section of the literature review, a theoretical background provides a basis for understanding course success for these students, as well as information on how a sense of belonging and community may impact these students. This section is followed by a discussion of related literature, examining the topics of dual credit and STEM education, along with the role community colleges play in educating these students. Finally, a gap in the literature concerning how an understanding of perceptions of community among dual credit high school STEM students may potentially impact course success will be identified and discussed, providing a rationale for the current study.

Theoretical Framework

The theoretical framework of this study provides insight into how theories of social integration and social constructivism contribute to the idea that a sense of community can influence overall success in college-level coursework. In the late 20th century, Tinto (1975) theorized that the successful college student would be fully integrated into both the social and academic domains of the college experience. Maslow (1970) developed a theory concerning human motivation that suggests that belonging to a community is a fundamental human need, which must be met before a student can realize self-actualization through obtaining a college degree. And social constructivists, such as Vygotsky (1978), theorized that human development, knowledge acquisition, and learning directly result from an individual's social interactions within the community.

Theories of Social Integration

In the late 20th century, Tinto (1975) began to formulate a theory on retention and persistence of college students. Tinto's (1975) theory was based on Durkheim's (1961) suicide theory, and suggested that students may leave college for reasons similar to an individual leaving society by suicide. Consequently, this theory attributes a successful college experience to full integration into both the social and academic domains of the college institution. Successful integration into the academic domain involves the ability to meet academic expectations without the need for remediation. Successful social integration can be considered in terms of positive interactions with other students, faculty, and organizations within the college, such as social clubs and sporting events (Mertes, 2015; Tinto, 1975).

Although Tinto's (1975) theory is now considered mainstream, some researchers have suggested that the theory is best suited to explain retention and persistence for traditional, residential students at four-year universities. In the case of non-traditional students, such as online, dual credit, and community college student populations, Tinto's model needs to be further adapted to account for the unique characteristics of these students and programs (Davidson & Wilson, 2013; Mertes, 2015; Simplicio, 2019). In 1993, Tinto himself revised the theory, commenting on its application to specific student populations, such as students of color and commuter students, noting that the social experiences of these students are often more closely tied to experiences within the classroom environment (Braxton, 2019; Tinto, 1993). Mertes (2015) suggests that the social interactions among students at community colleges are also mainly associated with interactions within the classroom setting, rather than the extracurricular experiences of the students in the earlier Tinto model. However, Tinto's overall proposition that social integration contributes highly to student success finds support in the ideas proposed by Maslow (1970/2012) as well as those of other researchers, such as McMillian and Chavis (1986), who contribute ideas concerning the value of belonging in the educational community.

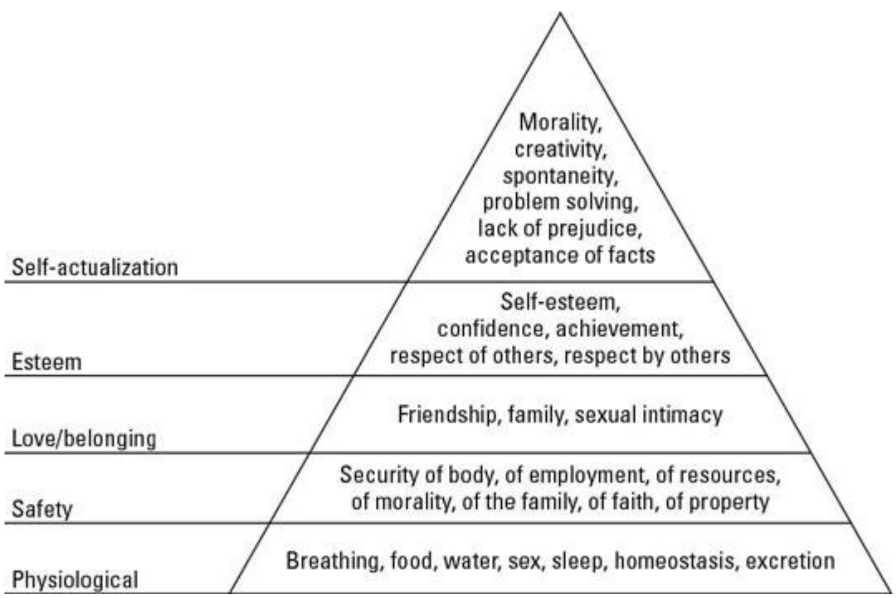
Abraham Maslow (1970/2012) developed his theory of human motivation based largely on his clinical experiences treating psychiatric patients. The overarching theme of Maslow's theory of human motivation revolves around the idea that individuals achieve their highest level of goal attainment and self-actualization only when other more foundational needs are met (Schunk, 2016; Maslow 1970/2012). Further, the driving force behind most human behavior, according to Maslow (1970) is a striving to satisfy foundational needs. This theme in the theory of human motivation is based on humanistic ideologies, integrating theories of such well known individuals as Dewey, Goldstein, Freud, and Jung, that assert that human motivations are important considerations when studying the methods by which individuals have these basic, foundational needs met (Maslow, 1970/2012; Weiner, 1992).

Often referred to as a hierarchy of needs, Maslow's (1970/2012) theory begins with a description of the most basic of the foundational needs and then progresses by describing the needs that emerge on a higher level as each of the foundational needs of an individual is met (Kelleher, 2013; Maslow 1970/2012; Schunk, 2016). See Figure 1. At the bottom of the hierarchy are the physiological needs. Although it would be difficult to list all such needs, examples include sleep, hunger, and physical exercise. When an individual's needs for food, shelter, and other physiological conditions are met, that individual will then discover a need of safety and security in their physical environment. Following the meeting of this need, humans begin to desire belonging to a group or family, and following that, earning the respect of the family members and self-esteem. Only when all of these foundational needs are met can an individual begin to think about personal fulfillment, or self-actualization, through such avenues as finding meaningful work, contributing to a family unit or community, or obtaining a college degree (Maslow, 1970/2012; Schunk, 2016).

The need for belonging, as shown in Figure 1, is foundational to the self-actualization of individuals. According to Schunk (2016), self-actualization, or self-fulfillment, can take on various different forms and can be manifested in a variety of ways, including studies at school. Therefore, it is reasonable to suggest that students who feel a sense of belonging in an educational community may be more likely to succeed in both high school and college-level coursework, and possibly attain higher end of term course averages, than do those students who do not feel connected to their course cohorts (Rovai, 2012).

Figure 1

Maslow's Hierarchy of Needs



Note. Figure 1 attributed to Kelleher (2013).

McMillan and Chavis (1986) further expand the importance of the concept of belonging with a community. These authors maintain that community involves the concept of feeling like individuals belong, that they matter to one another, and that they feel that members of the community may be relied upon to help meet each other's needs. Adapting these ideas to an educational environment reveals that students in classrooms with a positive sense of community have significant relationships with their peers, know that they belong in that class, and believe that all students in the class are committed to shared educational goals (Ritter et al., 2010; Rovai, 2002).

This sense of shared commitment to educational goals suggests that connectedness to the other students in the classroom is another important aspect of community among college students (McAdam, 1982; Ritter et al., 2010; Rovai, 2002). Among the most important aspects of community related to the idea of connectedness are "mutual interdependence, interactivity, shared values and beliefs, and common expectations" among the members of the group (Rovai, 2002, p. 198). All instructors should make an effort to develop a sense of community among the students in their courses, but this may be particularly important for students in distance learning environments, which are becoming increasingly more common in the modern educational environment (Berry, 2018; Ritter et al. 2010; Rovai, 2002).

Concerning the non-traditional population of dual credit students, some of these students who are part of early college high school (ECHS) programs report that the social integration experiences within the ECHS classes are one of the most valuable aspects of their program (Duncheon, 2020). Duncheon (2020) suggests that these students often acquire this social integration in the form of such activities as group assignments. Further, these group assignments frequently occur within a dual credit classroom situation in which the ECHS student is the only high school student participating in a group with more traditional college-level students

(Duncheon, 2020). And it is possible that these social interactions contribute to the development of a feeling of belonging and connection to the community developed in the classroom.

Theories of Social Constructivism

Constructivist learning theories involve the notion that knowledge is not passively accumulated. Rather, knowledge is accumulated, and learning occurs due to active cognitive processes based the experiences of the learner. These cognitive processes are adaptive in nature, and serve the purpose of making an individual's behavior suitable to their particular environment. Constructivist learning theories often emphasize a curriculum that approaches a topic from multiple perspectives (Schunk, 2016). Through these multiple perspectives, and interactions with the world and the learning environment, individuals experience a transformation in their thinking. Having historical roots in the philosophies of Piaget, Dewey, and other well-known educational theorists, constructivist theories exist on a continuum that includes the subcategories of cognitive constructivism, radical constructivism, and social constructivism (Doolittle & Camp, 1999; Quay, 2003). The guiding theory behind this research centers around the tenants of social constructivism.

Social constructivism expands upon constructivism by relating the learning process not only to individual experiences, but to experiences within the social world such as "pairs of students, teacher-learner interactions, and classroom groupings" (Davis et al., 2000, p. 67; Quay, 2003). Thus, social constructivism narrows the focus of constructivism to how social interactions within a community contribute to learning (Schunk, 2016). According to Doolittle & Camp (1999), these social interactions, accompanied by the use of language in social groups, results in a shared learning experience rather than an individual one. Although many individuals have contributed to theories of social constructivism, Vygotsky is considered among the leaders in this field of learning theories (Schunk, 2016).

Vygotsky (1978) based his theories on those of well-respected philosophers such as James, who associated learning with habit forming, and Piaget, who associated learning with developmental stages, often called zones of proximal development. Vygotsky associated these zones of proximal development, or stages of learning for which an individual is developmentally prepared, with the ability to form interactions and connections to peer groups or instructors. In other words, Vygotsky viewed these zones as the bridging the “gap” between what an individual can learn without assistance and what that individual can learn through teacher-student interactions or peer collaborations within a learning community (Quay, 2003; Schunk, 2016). These peer group and instructor connections were considered by Vygotsky(1978) to be instrumental in assisting individuals with the mental construction of knowledge.

Thus, one of the most important aspects of the theory of social constructivism involves the concept that individual learning only occurs within a social context (Doolittle & Camp, 1999; Schunk, 2016; Vygotsky, 1978). Further, social constructivists assert that social interactions within a community, facilitated by tools such as language and symbolism, are critical aspects of individual learning and knowledge construction. Implications of this philosophy for educators are that the teacher is a guide, facilitating the learning process, often by providing inquiry-based experiences that challenge students to discuss and build knowledge within the educational community (Doolittle & Camp, 1999).

Social Integration and Social Constructivism

Theories of social integration in educational environments and social constructivism provide complimentary theoretical backgrounds that help explain how a sense of community can impact success for college students. Successful integration into the classroom community for students, including dual credit, career & technical, and STEM student populations, helps fulfill the need for social belonging, a foundational need that must be met according to Maslow (1970). And a sense of belonging to the educational community within the classroom can have a positive impact on overall success within a given college course (Rovai, 2002). Additionally, the classroom community provides needed social interactions required for learning and knowledge construction, as theorized by Vygotsky (1978) and other theorists espousing a social constructivist philosophy of education. Finally, successful integration into the classroom community increases the chance for individual success in college-level coursework (Mertes, 2015; Tinto, 1975).

Related Literature

Dual Credit College Students

Historical Overview

Dual credit programs, such as concurrent enrollment or dual enrollment programs, are those in which students are enrolled simultaneously in high school and college, receiving college credits, and completing college-level coursework (Dare et al., 2017). These programs differ from other avenues whereby students may earn college credit, such as Advanced Placement (AP) or International Baccalaureate (IB) courses, in that students enrolled in dual credit programs are not required to take rigorous, standardized exams at the end of their coursework in order to receive college credit (Stein & Klosterman, 2020). Instead, dual credit students complete college-level classes in the same manner in which traditional college students complete the courses. Students in these programs may be enrolled in programs that are self-contained at their local high school, they may travel to a nearby two- or four-year college, or they may take the dual credit courses in an online environment (Arnold, et al., 2017; Taylor & Yan, 2018; Thomson, 2017).

Dual credit programs began to be offered in the United States in the 1970s and 1980s, with the first statewide dual enrollment initiative being launched in Minnesota in the 1980s (Loveland, 2017; Rivera et al., 2019). When these programs first emerged, the programs were generally geared toward the needs of students who were academically gifted, and students who had exhausted the boundaries of the typical high school program of study (Kim et al., 2004; Thomson, 2017). These accelerated programs offered students an opportunity to plan ahead and gain insight into the college experience, and afforded the students an opportunity to work with other academically gifted peers (Dare et al., 2017). Dual credit programs later began to replace honors programs at some institutions and also served to facilitate better communication between high schools and local post-secondary institutions (Hunt & Carroll, 2006).

Modern Dual Credit Programs

In modern times, dual credit programs are becoming an increasingly popular way for not only academically gifted, but also for average students to prepare for college (Young et al., 2014). And although students may earn college credit through other avenues such as AP and IB courses, dual credit courses are now the most common method whereby high school students earn college credit for their coursework (Sadler et al., 2014). Further, some estimates suggest that as many as one third of high school students currently complete at least some college-level coursework before graduation (Rivera et al., 2019).

As previously mentioned, these courses may be taught in a variety of learning environments. Although the most common learning environment involves students taking the dual credit courses at their local high school, online delivery of dual credit coursework is becoming more prevalent. Additionally, having students travel to a nearby two- or four- year college is becoming a more popular method of delivery of these courses. This is because taking courses within the college environment serves to acclimate students to a true college experience, as students become familiar with the physical environment and culture of the institution of higher education (Arnold et al., 2017). Regardless of the learning environment in which a dual credit student is enrolled, the expectation is that dual credit coursework carries the same academic requirements as a regular college-level course (Stein & Klosterman, 2020).

From the perspective of educators, students and other stakeholders, dual credit programs offer many advantages. Postsecondary institutions that offer dual credit opportunities to high school students gain visibility, possibly improving the community perception of their school, and increase collaborations between their institutions and the high schools where dual credit students are enrolled. Further, some studies suggest that students enrolled in dual credit are more likely to enroll and to persist in postsecondary education after high school graduation (Allen et al., 2020; Garcia et al., 2020; Lawrence & King, 2019). Therefore, secondary schools enjoy the benefits of offering courses that introduce students to the rigors of college-level coursework, increasing their students' chances of enrolling in postsecondary educational programs and obtaining degrees and certificates, improving their own standing in the community. And by offering these courses in partnerships with local community colleges, secondary schools often eliminate the need to hire additional instructional staff (Witkowsky & Clayton, 2020).

Parents often cite the cost savings of dual credit coursework as one of the most beneficial aspects of the programs (Loveland, 2017). This is because dual credit programs are often offered to students free of charge, or at a substantially reduced cost compared to normal college tuition rates (Loveland, 2017; Stein & Klosterman, 2020; Thomson, 2017). This cost savings helps to alleviate the financial strain of the students' future college education, which is an often-cited barrier to college for many students (Smith & Wingate, 2016; Young et al., 2014).

Another advantage of dual credit programs involves offering students an opportunity to explore potential college majors and career choices, and to learn new skills that could lead to employment upon high school graduation (Witkowsky & Clayton, 2020). This is because modern dual credit programs offer not only academic courses necessary for associates and bachelors level degrees, but they also have options in the career and technical fields (Hatch et al., 2019; Loveland, 2017; Rosenfield, 2018). STEM options for dual credit students enrolled in career and technical programs include courses in graphic arts, web design, health-related occupations, and robotics, to name a few (Rosenfield, 2018).

Student motivations for enrollment in dual credit programs often include a love of learning, intellectual challenge, interactions with intellectual peers and planning ahead for post-secondary degree programs (Dare et al., 2017; Witkowsky & Clayton, 2020). Some special student populations, such as homeschooled and early college high school students, are motivated by the opportunity to earn an associate's degree while simultaneously completing their high school education (Duncheon, 2020; Loveland, 2017). And for students of high ability, dual credit programs can provide students with an opportunity to choose from a broad selection of courses tailored to their specific interests and abilities (Dare & Nowicki, 2015). Dual credit programs offer students additional benefits, such as the opportunity to reduce time for graduation at college and a decreased likelihood of needing remedial coursework in college (Hemelt et al., 2020; Taylor, 2015). Further, dual credit programs help to foster a sense of academic confidence and independence in students (Allen et al., 2020).

Although research indicates that a rigorous secondary program, including enrollment in dual credit classes, is a significant predictor of college readiness, underrepresented student populations often have less access to dual credit coursework in high school (Taylor, 2015; Villareal et al., 2018; Woods et al., 2018). This is unfortunate because dual credit experiences may have a positive impact on familiarity and attitudes towards higher education for underrepresented student populations, such as those in typical ECHS programs (Taylor, 2015).

Underrepresented students that do have access to quality, dual credit programs of study in high school tend to benefit from those programs in many ways. Perhaps of most benefit for this student population is that successful completion of dual credit coursework can expose the students to the rigors of postsecondary education and can increase their confidence in their ability to succeed in college (Witkowsky & Clayton, 2020). This increased confidence may help to explain the reports of some studies suggesting that students who participate in dual credit programs during their high school careers are more likely to enroll in college immediately after high school graduation, and to persist in college and earn a degree (Corin et al., 2020; Loveland, 2017; Taylor, 2015). It is worth noting, however, these students do not necessarily earn that degree at the college in which they participated in the dual enrollment program (Lawrence & King, 2018).

Many dual credit programs are geared towards specific student interests. For example, both Georgia and Hawaii have dual credit programs designed with the specific goal of increasing access to STEM education (Berger et al., 2010; Taylor 2015; Young et al., 2014). Many other states, such as Tennessee, Illinois, and Texas, have initiated legislation that encourages collaboration between secondary schools and state colleges aimed at increasing access to dual credit programs in widely diverse areas of study (Hemelt el al., 2020; Malin et al., 2017; Yoon & Strobel, 2017). Forty-seven states and Washington, D.C. have statewide regulations addressing policies concerning statewide dual enrollment programs. And all states in the US now offer some form of dual enrollment opportunities for high school students (Corin et al., 2020; Rivera et al., 2019).

STEM Education

Defining STEM Education

Because promoting STEM education is important not only to prepare students to work in the traditionally associated fields of science, technology, engineering, and mathematics, but also to prepare students with generally needed skills and knowledge for 21st century careers and citizenship, an in-depth review of the definition of STEM education follows (Ellis et al., 2020). In its most basic sense, STEM education involves instruction relating to at least one of the designated STEM fields of study - science, technology, engineering, and mathematics (Davidson, 2020; Hasanah, 2020; Waite & McDonald, 2019). However, what that instruction entails and how it applies to the definition of STEM education is a topic that is often inconsistently applied and understood (Hasanah, 2020).

The concept of defining STEM education has a historical background that involves political initiatives designed to improve education related to the workforce, with the goal of improving the economic or military standing of a country (Siegel & Giamellaro, 2020). Modern educators often think of STEM education in similar terms. This is because today's society has become one in which technological advances have permeated the job market and influence a variety of issues, such as communication and employment, across almost all areas of the workforce (Baker et al., 2021; Hoffman, 2017; Waite & McDonald, 2019). Therefore, according to Baker et al. (2021), "STEM education should not be exclusive to those pursuing a degree in science, technology, engineering or mathematics" (p.3). And according to many practitioners, STEM education involves integrating practices such as problem solving, critical thinking, data collection, communication technologies, and modern technological innovations across all areas of study from pre-school through post-doctoral studies (Davidson, 2021; Ellis et al., 2020).

A basis for defining STEM education as a discipline, or preparation for a career in a STEM discipline, can also be found in the literature (Hasanah, 2020). Thus, many educators would describe STEM education in terms of instruction and integration of the four major areas of the STEM disciplines (Davidson, 2020; Siegel & Giamellaro, 2020; Waite & McDonald, 2019). Universities often employ this definition and consider STEM fields in terms of a students' major area of study, with STEM majors being part of the four major disciplines (Major et al., 2020). For this reason, much research centers on retention and persistence of students pursuing traditional STEM majors at two- and four-year colleges (Davidson, 2020; Major et al., 2020; Plasman; 2020).

Contribution to the Society and the Economy

Science, technology, engineering, and mathematics (STEM) education has been recognized by educators and business professionals as a vital factor in the well-being of the United States economy (Batdi et al., 2019; Bybee, 2010; Waite & McDonald, 2019). The United States Department of Education has recently invested in excess of $300 million in discretionary funds, through the CARES Act, to seek out ways to continue to promote and encourage STEM educational efforts in an uncertain instructional environment, brought about by the recent coronavirus pandemic (USDE, n.d.). Further, the 2012 President's Council of Advisors on Science and Technology (PCAST) report suggests that the number of students graduating with degrees in the STEM fields is significantly inadequate to meet the growing demands of the

United States workforce, with some estimates indicating that as many as one million new STEM jobs will need to be filled in the coming years (Baher et al., 2017; Morganson et al., 2015; Smith & Wingate, 2016).

The quickly advancing technological developments in today's society have further added to the need for a highly skilled, collaborative, and creative workforce (Batdi et al., 2019; Waite et al., 2019). For example, growing modern cities in the United States have an increasing need for such technologies as improvements in energy efficiency, wastewater management, connectivity, and manufacturing and farming processes, issues addressed in a more recent PCAST report (PCAST, 2016). Technological advances in connectivity are becoming increasingly important in rural areas as well, owing to the increasingly global nature of the United States educational and economic landscape (Office of Educational Technology, n.d.)

A recent innovation further highlighting the importance of STEM education in today's society involves the development of vaccines to mitigate the societal impact of the pandemic associated with the novel coronavirus SARS-CoV2 (Baker et al., 2021). The development of the vaccine involved not only overt scientific and technological advancements, but also communication and numerous other innovations needed to disseminate and administer the vaccines (Baker et al., 2021; Pagliusi et al., 2020). Nursing and healthcare-related professions also have a direct relationship to vaccine administration, and these professions represent an important field related to STEM education (Davidson, 2020).

Students completing college degrees in traditional STEM fields have the opportunity to fill many highly skilled job openings in areas such as chemistry, engineering, health sciences, information technology, mathematics, and computer science (Moody, 2019; Smith & Wingate, 2016). Additionally, many fields not inherently STEM related will require technological skills, such as word processing and familiarity with various software and social media platforms (Moody, 2019). Non-STEM-related businesses will also need support in areas such as facial recognition, video-conferencing, and contactless commerce after experiencing a dramatic shift in business-related activities due to the coronavirus pandemic of 2020 (O'Leary, 2020).

In addition to the economic impact of STEM on society, modern technological advances in the form of social media have greatly affected the manner in which society communicates and participates in recreational activities. Social media describes internet-based platforms that allow users to voice opinions, share information, communicate, and create web content (Achampong et al., 2020). Many individuals in today's society report that they feel that they would have a difficult time functioning without access to technology to use social media (Hoffman, 2017), with Facebook, Twitter, and YouTube being among the most commonly used social media platforms in the United States (Hadziahmetovic, 2021).

In the 19th and 20th centuries, newspapers were important social influences, disseminating information and advertisements relating to a wide variety of products, political topics, and current events. However, today's media landscape is vastly different and social media has largely replaced newspapers for these purposes with the current generation (Lopez-Sintas et al., 2017). Many small businesses rely on the easily accessible technology of social media to market their products, and larger businesses also rely on this tool to increase familiarity with new products and innovations (Heiens & Narayanaswamy, 2021). Social media also plays an important role in the modern US political landscape, with Presidents Obama and Trump making use of such tools as Twitter and Facebook to spread influence and advertise their campaigns (Hadziahmetovic et al., 2021). Even healthcare has not escaped the pervasive influence of social media, with one study indicating that the university students who participated in the study often received health-related information via a social media platform (Achampong et al., 2020).

Leisure and professional recreation have also been greatly impacted by the technological innovations of the modern age. Digital technologies, with internet enabled devices, have allowed families and individuals an increasingly large selection of media choices, including movies, interactive gaming with friends, and music services such as Spotify (Lopez-Sintas et al., 2017). Wearable technologies such as Fitbit, Apple, and Garmin watches are commonly used to track physical activity and wellness information, including heartbeat, sleep patterns, and blood oxygen levels (Bent & Dunn, 2020). And both amateur and professional athletes use wearable technology and apps to keep track of performance-related data (Brown & Brison, 2020; Ng & Ryba, 2018).

Career and Technical STEM

Although many STEM students and educators think of this discipline in terms of academic fields of study requiring at least a bachelor's degree, the world of STEM has increased significantly beyond traditional academia. This is because, as previously discussed, society relies on STEM for numerous aspects of daily life, including such areas as communication technologies, social media platforms, health and wellness monitoring, recreational activities, weather warning systems, and the development of the vaccines that were needed to combat the SARS-CoV2 pandemic of 2020 (Baker et al., 2021; Bent & Dunn, 2020; Brown & Brison, 2020; Lopez-Sintas et al., 2017; Ng & Ryba, 2018). This expansion beyond the scope of traditional academia has opened up the STEM pipeline to include many disciplines commonly referred to as career and technical education (CTE) programs (Wu-Rorrer, 2017; Yoon & Strobel, 2017). Examples of STEM-related CTE programs that lead to associate degrees and certificates in community colleges include precision machine, welding, automotive technology, health science, biomedical, graphic design, information technology, and simulation and animation design studies, to name a few (Ellis et al., 2020; Pierce, 2019; Siegel & Giamellaro, 2020; Waite & McDonald, 2019).

Career and technical education first began its existence in 1917, when President Wilson signed the Smith-Hughes Act, providing federal funding designed to train teachers and to provide students with vocational instruction (O'Banion, 2019). Over the years, this federal funding has continued to be authorized, with the legislation often being referred to as various iterations of the Perkins Act (Plasman et al., 2020). Although it is widely accepted that bachelors and graduate-level degrees may lead to higher paying jobs than do high school diplomas, the current US job market is experiencing a labor shortage in jobs that require some postsecondary education in the form of an associate degree or career certification, but not necessarily a four-year degree (Sublett & Tovar, 2021). For this reason, the Perkins Act has extended CTE educational programs to include those not only designed to prepare students to enter the workforce after high school graduation, but also to prepare students who choose to enroll in postsecondary schools (Plasman et al., 2020). And both former Presidents Obama and Trump stressed the importance of aligning postsecondary CTE educational programs with the growing needs of the businesses associated with the local communities in which the CTE students will most likely be employed (Sublett & Tovar, 2021).

Many jobs in the shortage areas of the current labor market are those associated with STEM-related areas, such as health care and information technologies (Sublett & Tovar, 2021). And as part of an emphasis on increased academic rigor in CTE programs, Perkins IV encourages an emphasis on STEM instruction and applied science in many CTE courses

(O'Banion, 2019; Plasman et al., 2020). Further, the federal government has allocated special funds to support STEM education in CTE programs, driven in part by the increasingly technological global economic market. And many educators have cited a need to integrate the areas of STEM, liberal arts, and workforce education (O'Banion, 2019). Therefore, a growing number of CTE programs fall under a definition of STEM education that includes a perspective of instruction in "vocational education, industrial arts, or the product of engineering" (Ellis et al., 2020, p. 472).

Role of Community Colleges

Community colleges, at first called junior colleges, began their existence in the twentieth century, with the first such college being Joliet Junior College, founded in 1901. At this time, these educational structures served various purposes. One purpose was to train homemakers and aspiring teachers (Martinez & Munsch, 2019). Another purpose involved releasing some elite colleges from the responsibilities of instructing 18- and 19-year-olds, who could study at a junior college and then transfer to a four-year institution (Baily, 2018). Toward the middle of the century, the 1948 US President's Commission on Higher Education created an opportunity to broaden the community college mission to expand access to higher education to a growing number of students (Martinez & Munsch, 2019).

After World War II, the industrial nature of the job market prompted the rapid expansion and growth of student enrollment in community colleges. Many of these institutions offered the necessary postsecondary credentials for jobs in fields such as nursing, medical technology, professional offices, skilled labor, police, and fire departments (Bailey, 2019). Modern community colleges have continued to train students in such fields, offering postsecondary career and technical certification, associates degrees, and academic transfer credits to students who wish to transition to a four-year school and obtain a bachelor’s degree (Bailey, 2018; Martinez & Munsch, 2019).

In the twenty-first century, the mission of the community college was expanded even further. In 2009, President Obama announced a 2020 college completion initiative, with the goal of having a higher proportion of United States citizens complete a college degree by the year 2020. This initiative brought with it funding and resources to support the community college mission of access to higher education. As a result, modern community colleges are open-access institutions, meaning that almost anyone who applies to a community college will be granted admission, although many students may require some remediation as a result of being underprepared for college-level coursework (Bailey, 2018). This open-access policy implements the tenants of the Obama initiative by providing support and low-cost educational opportunities for students across widely diverse demographic and academic backgrounds (Martinez & Munsch, 2019).

Community colleges have therefore been historically identified (and maintain the status) of being a significant means of access to higher education for minority, first-generation, and economically disadvantaged student populations (Bailey, 2018; Cohen & Kelly, 2019; Smith & Wingate, 2016). Because community colleges are accessible and affordable, these institutions are particularly well suited to address the previously described labor shortage associated with local businesses. And workforce and vocational education has long been ingrained in the community college level of higher education, and these institutions continue to serve local populations, business, and civic organizations within their respective communities (Bailey, 2018; O’Banion, 2019).

As part of this partnership with local communities and the technologically driven needs of the global economy, community colleges are also challenged with the goal of instructing students in soft skills, a component that business leaders and human resource officers often cite as important in the job market. These needed soft skills include timeliness and professionalism, and are often associated with understanding and adapting to various communication technologies used in many areas of today's business environment, including such things as tablets, spreadsheets, and smart phones (Pierce, 2019).

This phenomenon of affordable and accessible postsecondary education extends to students enrolled in STEM and CTE-STEM education programs, with community colleges having a critical role in increasing the diversity of the student population in this area (Hagedorn & Purnamasari, 2012; Snyder & Cudney, 2019). Further, some studies indicate that just under half of all STEM degrees awarded by four-year colleges were given to students who had attended a community college during their first two years of postsecondary education (Baher et al., 2017). Additionally, just over half of all degrees awarded to community college students involve occupational, CTE studies, many associated with STEM areas of study, such as healthcare and information technologies (O'Banion, 2019).

However, academic community college STEM majors are still less likely to persist in their degree programs than are students who began their studies at a four-year institution (Baher et al., 2017; Wang, 2015). And many students who initially desire to complete a STEM program of study either change their college major or withdraw from college altogether (Cohen & Kelly, 2019; Graham et al., 2013; Snyder et al, 2017). Therefore, it is important that community colleges continue to study their role in this vital program, developing strategies aimed at further retention of students in all aspects of STEM-related academic and career-oriented education.

Studies have identified some of following strategies that could help community colleges increase retention in STEM student populations. Project-based and peer-led instructional strategies, which foster a sense of community and social integration, can help with retention by providing students with insight into how a STEM education can lead to future employment opportunities (Rodriquez et al., 2018: Smith & Wingate, 2016). Such problem-based activities can also help to address needs of the students' future employers, introducing both the previously discussed soft-skills, and many of these STEM-related skills in that employers look for when hiring new recruits: critical problem solving, effective communication strategies, collaboration, data collection and analysis, coding, and computational thinking skills (Ellis et al., 2020; Pierce, 2019; Siegel & Giamellaro, 2020).

Participation in early recruitment, such as dual credit and early college high school, peer mentoring, and partnerships with local industries are other strategies which could positively impact retention, persistence, and success for STEM and CTE-STEM students at community colleges (Smith& Wingate, 2016). Baher et al. (2017) also suggest that a comprehensive database with metrics on success rates of various institutions could help to identify and assist community colleges with deficiencies in retention rates of STEM majors.

A Sense of Community

Learning and the Community

Learning is a concept that is both simple and difficult to put into context. According to Merriam-Webster (n.d.), learning can have multiple definitions, among them "knowledge or skill acquired by instruction or study." And Schunk (2016) defines learning in terms of a change in behavior as a result of practice or experience. When researching a definition of learning, the literature often cites learning theories, including behaviorist, cognitive, and constructivist theories of learning (Agarkar, 2019). Behaviorist theories focus on behavior modification, cognitive theories focus on changing cognition, and constructivist theories focus on providing opportunities for students to construct knowledge based on experiences (Agarkar, 2019; Schunk, 2016). Active learning is another commonly used description of learning in the educational community. Active learning, however, is consistent with constructivist views in that this style of learning focuses on providing students with opportunities to read, discuss, and work with one another to solve problems (Vanhorn et al., 2019).

These various theories of learning illustrate the notion that educators are continuously researching and trying to determine the best ways to facilitate learning for students, particularly in light of the rapidly increasing technological advances that modern students are exposed to (Trespalacios et al., 2021). When students are asked about their perceptions of learning, such ideas as educational environments, interactions with peers and instructors, materials, and cultural contexts and practices may be part of the discussion (Ferreira et al., 2019). Educators and theorists began to have serious discussions on how social interactions, community, and learning were related at least as early as the 1990s (Trespalacios et al., 2021). And all of these ideas contribute to the concept of learning and the learning environment.

As has been previously discussed, the learning environment for dual credit, STEM and CTE-STEM courses may be stand alone, taught exclusively at the students' high school, or the students may participate in an online or college site learning experience (Arnold et al., 2017; Stein & Klosterman, 2019). For students in a variety of learning environments, their perceptions of learning often involve not only skill and knowledge acquisition, but also the personal growth that occurs through the building of relationships with their peers, classmates, and instructors (Ferreira et al., 2019; Rovai, 2002; Stein & Klosterman, 2020; Trespalacios et al., 2021). The idea that learning involves interaction with the learning environment and members of the learning community is consistent with the previously discussed theories of social interaction and social constructivism (Maslow, 1970; Mertes, 2015; Schunk, 2016; Vygotsky, 1978).

Connectedness and the Community

Connectedness and community are concepts that are somewhat interchangeable in much of the literature and discussion within the educational landscape. Many researchers have attempted to explain the concept and a universally agreed upon definition has not yet been accepted. However, Trespalacios et al (2021) conducted a literature review which reveals that there are common threads among many published definitions of connectedness. These commonalities involve the following ideas: a sense of belonging, a development of relationships among classmates and the instructor, and the intellectual growth of a community of students based on common interests and goals.

Because connectedness involves relationship building, some researchers report that students may develop a sense of belonging and connectedness as a function of time in their personal journeys (Jorgenson et al., 2018). This development may involve interactions among both old and new friends, as well as any campus employees and faculty members with whom the student interacts. Therefore, some institutions have begun programs that help orient new faculty and staff to alert them to the needs of students at their college. And more research is needed to investigate how these efforts impact student perceptions of belonging across various student populations (Gopalan & Brady, 2019).

In light of the recent pandemic brought on by the outbreak of a new strain of coronavirus in 2020 (Maguth, 2020), it may be important to mention how times of stress can impact connectedness. Students transitioning to online learning during the pandemic reported being stressed over many concerns, such as course completion, fear of lower grades due to fluid deadlines and quick changes, and the isolation, or lack of community brought about by not being able to get out and return to the traditional classroom environment (Day et al., 2021). According to Peacock et al.(2020), an individual's need for belonging can increase during such times of heightened stress.

This increased need for belonging and connectedness during times of stress may explain a recently emerging mantra among many educators trying to adapt to the challenges of the pandemic. The mantra, "Maslow before Bloom," highlights the concerns that educators have about both connectedness and meeting even more foundational needs of students transitioning to online instruction during the pandemic (Maguth, 2020, p.40). Among those needs are food and shelter, and social interactions provided by meeting with their school community of peers, friends, and instructors (Day et al., 2021; Maguth, 2020).

Overall Sense of Community

Having a positive sense of community allows for individual growth and helps to create a sense of connection and belonging within a social system. Studies of urban youths of color who have a negative sense of community suggest that this characteristic often leads these individuals to feel that their communities cannot fulfill their needs. These youths reporting a negative sense of community tend to also report having a limited sense of hope, a lack of opportunities for social advancement, and thoughts about leaving the community. Students in these areas who have a negative sense of community often report that they impart these feelings to the educational environment as well as the overall social community (Lardier et al., 2020). These consequences of a negative sense of community highlight the importance that educators place on working towards creating a positive sense of community in the educational environment (Greathouse, 2019; Lardier et al., 2020).

Developing a sense of belonging, or an overall sense of community, in an educational environment is a critical factor that contributes to the success of the college student , particularly for students who may be at-risk, such as economically disadvantaged, first-generation students or those who are mentally ill (Lardier et al., 2020; O'Keefe, 2013). And during the recent coronavirus pandemic, the mental health issues associated with isolation of students have driven many educational institutions to devote special funding to psychological counseling for their students (Day et al., 2021). This notion of the critical need to belong in the educational environment is consistent with the previously discussed hierarchy of needs suggested by Maslow's (1970/2012) theory of belonging and social connectedness.

Educators have expressed the importance of a sense of community for many years. In 1957, National Teacher of the Year, Mary Schwarz, spoke about the value of a sense of community as applied to students by stating that learning best occurs when "students develop a sense of belonging" in classrooms that encourage and sustain positive relationships (Greathouse et al., 2019, p.43). This general sentiment has been echoed by more recent awardees of the National Teacher of the Year at almost all levels of education, and many such awardees have suggested that this sense of belonging is particularly important given that students in today's technologically based classrooms often focus more on test preparation than on exploration and inquiry (Greathouse, et al., 2019). For example, David Yeager and colleagues explain that "As students form better relationships is school, these become sources of support and learning that promote the feeling of belonging and academic success" (Cooper, 2018. p. 19-20).

Some suggested tools for building community with students include the use of icebreaker activities at the beginning of a school term, introducing students to each other and the instructor on the first day of the term, and having students complete questionnaires containing information that helps classmates and the instructor to get to know one another as individuals (Cooper, 2018). Another technique recently used at a large, urban community college involved creating communities of practice in which students provided peer feedback on creative writing assignments. Results of the study verify that the use of interactive activities between students may enhance the students' sense of community and belonging in postsecondary educational environments (Gilken & Johnson, 2019).

Some suggested tools for building community in online learning environments, which have become prevalent during the coronavirus pandemic of 2020, include the following. Instructors may wish to hold contests and invite guest speakers to encourage student engagement within the virtual classroom. Instructors should also be honest about their personal challenges and experiences so that students view them as individuals, rather than just a voice (or picture) behind a screen. And finally, instructors may wish to solicit student feedback concerning assignments and other issues related to online instruction (Freedman & Voelker-Morris, 2020).

Summary

According to the President's Council of Advisors on Science and Technology, the increasingly technological demands of a growing economy indicate that there will be a shortage of qualified individuals to fulfill workforce requirements for jobs in STEM-related fields in the coming years (Baher et al., 2017; Morganson et al, 2015; Smith & Wingate, 2016). Further studies indicate that the US is experiencing an overall shortage of labor in jobs that require some postsecondary education, but not necessarily a four-year degree (Sublett & Tovar, 2021). These predictions highlight the need for continuing research into the best practices and methodologies for recruiting and increasing the retention, persistence, and success rates of various student populations enrolled in both STEM and CTE-STEM areas of higher education. And one major factor that is critically important to student success involves the development of a sense of community, or an overall sense of belonging in both the educational institution as a whole, as well as in the students' course specific learning environment (Cooper, 2018; Gilken & Johnson, 2019; Greathouse et al., 2019; Lardier et al., 2020; O'Keefe, 2013). An understanding of the theories of social integration and social constructivism can begin to provide further insight into this topic.

Adapted from Durkheim's (1961) theories on suicide and dropout from society, Tinto's (1975) theory on dropout from higher education suggests that a student's success, in terms of college retention and persistence, involves the successful integration of individuals into both the academic and the social domains of overall college life. Tinto's (1975) social integration involves collegiate organizations, such as social clubs and extracurricular activities, such as sporting events. Although Tinto's (1975) theories are well established for traditional students at four-year institutions of learning, a modified theory of social integration may be needed for non-traditional students, such as those dual credit programs of study. For these students, social integration often involves interactions within the classroom environment (Mertes, 2015). And many students in dual credit programs report that social interactions with their peers are among the most valuable characteristics of their program (Duncheon, 2020).

Social interactions strongly relate to the basic, foundational need that all human beings have for belonging and connectedness to a group or family (Maslow, 1970/2012). Located among the middle tiers of Maslow's (1970) hierarchy of needs, the need to belong is a necessary requirement that must be met before individuals, or students, can realize and meet the need for self-fulfillment through an educational program of study. For this reason, many educators, including several awardees of the National Teacher of the Year, have observed that students learn best in classroom environments that foster and encourage positive peer and faculty relationships (Greathouse et al., 2019). Conversely, at least one study reveals that a negative sense of community can decrease a student's sense of belonging and connectedness (Lardier et al., 2019). Therefore, studies designed to investigate factors involving a student's sense of belonging provide needed insight and may have practical implications involving how a student's sense of community relates to their success in higher education (Rovai, 2002).

Some studies have suggested that one tool that helps to build a student's sense of community and connectedness relates to providing experiences, such as peer feedback and interactive problem-solving exercises, that encourage students to work with one another and the course instructor (Cooper, 2018; Freedman & Voelker-Morris, 2020; Gilken & Johnson, 2019). These studies support the social constructivist theories of learning, which involve the notion that knowledge occurs due to active processes, based on the experiences of the learner (Davis et al., 2000; Doolittle & Camp, 1999; Quay, 2003; Schunk, 2016). And according to one of the primary theorists of social constructivism, one of the most important aspects of this theory suggests that individual learning occurs only within a social context, facilitated by such tools as language and symbolism (Doolittle & Camp, 1999; Schunk, 2016; Vygotsky, 1978).

Dual credit programs emerged in the United States during the latter part of the twentieth century as a means to challenge academically gifted students who had exhausted the boundaries of the traditional high school experience (Kim et al., 2004; Thomson, 2017). As these programs expanded, they became an increasingly popular way for more average students to prepare for and familiarize themselves with the college experience (Sadler et al., 2014; Thomson, 2017; Young et al., 2014). Dual credit courses offer students a chance to receive both high school and college credit simultaneously, and can be offered in a variety of learning environments, including virtual and face-to-face at the student's high school or on a nearby college campus (Arnold et al., 2017). These courses offer many advantages to students including a cost savings for college coursework, the opportunity to explore potential college majors and career opportunities, and an introduction to the experience of postsecondary education (Dare et al., 2017; Loveland, 2017; Stein & Klosterman, 2020; Thomson, 2017; Witkowsky & Clayton, 2020).

STEM education at all levels, including high school , postsecondary, CTE, and dual credit, has become an important topic of interest due to the increasingly technological demands of society (Baker et al., 2021; Batdi et al., 2019; Hoffman, 2017; Waite & McDonald, 2019). The United States Department of Education has responded to this issue by promoting and encouraging programs aimed at STEM and CTE-STEM educational endeavors (O'Banion, 2019; PCAST, 2016; Plasman, 2020; USDE, n.d.). Not only is there a demand for STEM specific jobs, such as chemistry, engineering, health sciences, an information technologies, but many jobs not directly related to STEM fields require technological skills (Moody, 2019; O'Banion; 2019; O'Leary, 2020; Pierce, 2019; Smith & Wingate, 2016). Examples of these skills include word processing, video-conferencing, and contactless commercial transactions, skills increasingly important during the aftermath of the coronavirus pandemic of 2020 (O'Leary, 2020; Pierce, 2019).

Community colleges play a critical role in increasing diversity and participation of students involved in postsecondary STEM education (Hagedorn & Purnamasari, 2012; Snyder & Cudney, 2019). Some studies indicate that almost half of all four-year STEM degrees were awarded to students who had previously completed coursework at a community college (Baher et al., 2017). Further, over half of the degrees awarded at community colleges involve vocational areas of study, many in STEM-related areas (O'Banion, 2019).

Although community college programs, dual credit programs, and STEM programs have each been addressed in the literature, research on students simultaneously involved in all three programs is scant. Therefore, research specifically addressing the success of dual credit students, such as those enrolled in STEM and CTE-STEM courses, can potentially provide important information concerning this student population (Arnold et al., 2017; Baher et al., 2017; Witkowsky & Clayton, 2020)).And most studies of student belonging and its impact on success in college have focused on convenience samples from four-year colleges. Although one recent national study included a measure of belonging for college students, more research concerning various student populations, particularly those at two-year colleges could provide further insight into the importance of belonging for these students (Gopalan & Brady, 2019). This information could possibly identify and improve strategies for the retention of these students and increase their chances of completing a STEM or CTE-STEM program of study.

CHAPTER THREE: METHODS

Overview

This study investigated the relationship between student perceptions of community and end of term averages for students enrolled in dual credit STEM courses through a local community college. This data provides insight into how the motivational factor of community impacts attrition and retention for dual credit, community college STEM students. Data for the study were collected from two sources: responses to the Classroom Community Scale (CCS) survey instrument (Rovai, 2002) and institutional data reflecting numerical, end of term course averages. Chapter Three provides the reader with a summary of the research design, research questions and null hypotheses, the participants and setting of the study, instrumentation, procedures used, and the data analysis.

Design

A nonexperimental, quantitative, predictive correlational research design was employed for this study. The study was nonexperimental because data collected were in the form of responses to a survey instrument and end of term averages, which are observations rather than treatments or interventions (Creswell & Poth, 2019; Gall et al., 2007). According to Gall et al. (2007), correlational research studies are appropriate for the purpose of determining whether there is a statistical relationship between two or more variables. Therefore, because this study was designed to investigate the relationship among perceptions of community and end of term averages, the correlational research design is an appropriate choice.

The criterion variable for the study is the end of term average, or final numerical grade, for the participants enrolled in the dual credit STEM courses. There are three predictor variables for the study: student perceptions of connectedness, student perceptions of learning, and student perceptions of overall community in the dual credit STEM course. Connectedness is defined as a belief that individuals in a community have duties and responsibilities to one another, learning is defined as meeting the academic goals of the course, and overall community is defined as the sense of belonging and connectedness to other members of the community (Rovai, 2002).

Research Question

RQ1: How accurately can end of term average for high school students enrolled in dual credit, community college STEM courses be predicted from a linear combination of predictor variables (student perceptions of connectedness, learning, and an overall sense of community)?

Hypotheses

$H_0$1: There will be no statistically significant predictive relationship between the criterion variable end of term averages for high school students enrolled in dual credit, community college STEM courses, and the linear combination of predictor variables (student perceptions of connectedness, learning, and an overall sense of community) as measured by the Classroom Community Scale.

Participants and Setting

For the study, a convenience sampling procedure was used to recruit participants who are high school students dual enrolled in STEM and CTE-STEM courses associated with Mississippi Central Community College. Mississippi Central Community college is a pseudonym describing one of the largest systems of community colleges in the state, having a main campus as well as satellite locations. The main campus serves residential students and five satellite campuses, each within 50 miles of the main campus, serve commuter students in the local communities. The student population for the colleges and secondary schools in these communities consists of approximately 55 % African American students, 40 % Caucasian students, and 5 % of students from various other ethnic populations including Hispanic and Asian students. Approximately 55 % of the students are male and 45 % are female students.

Participants

A convenience sampling procedure was used to identify participants who met the criteria of the study. The criteria are that the participants are students enrolled in dual credit STEM or CTE-STEM courses offered through a community college. Target courses that students were enrolled in, and the number of participants from each, include the following: 14 college algebra students; 16 engineering graphics students; 40 nursing students; 6 precision machine students; 4 construction math students; 5 culinary arts students; 9 marketing students; 2 energy studies students.

Setting

The educational environment of the high schools from which participants were recruited is a blend of face-to-face courses and distance learning. This is because of the covid-19 pandemic. Due to the Covid-19 pandemic, students in the school district were offered the opportunity to take courses in a distance learning environment, and a minority of students chose to take advantage of this offer. However, most students attended their courses in a face-to-face environment. Students in CTE-STEM courses took courses on the campus of the offering community college. And students in traditional dual credit courses, such as college algebra and engineering, took courses at their local high school.

Sampling and Statistical Analysis

Participants were drawn from a convenience sample. After the appropriate institutional permissions were obtained, the researcher selected courses which met the study criteria as described above. Students in these courses were invited to participate via a site visit from the researcher. During the site visit, the researcher explained the nature of the research and provided copies of consent forms and the recruitment letter (See Appendices B, C, and D for the consent letters and recruitment letter) to the instructors of students in the target population. When possible, the researcher spoke to the students' classes and read the recruitment letter to potential participants. When not possible, the instructor of the students' courses read the letter and helped recruit participants.

Assuming a medium effect size, a statistical power of 0.7, and an alpha level of 0.05, Warner (2013) recommends a minimum sample size of $N \geq 50 + 8k$ for multiple R. This recommendation implies that a minimum sample size of 75 participants was needed for the study. Therefore, the researcher invited approximately 450 students from the target population to participate in the study. Of the potential participants who were invited to participate, approximately 120 returned the required consent forms and received the email link to the survey. 116 students who received the email link completed the survey instrument. Twenty of the survey responses were omitted due to incomplete or inconsistent responses, leaving a total of 96 participants. This number well exceeded the minimum sample size recommended by Warner (2013).

Instrumentation

The survey instrument used for this study was the Classroom Community Scale (CCS) developed by Rovai (2002). (See Appendix A for the survey instrument). The purpose of the CCS was the development of a tool that can be used by educational researchers to study perceptions of community in virtual classrooms. When creating this survey instrument, Rovai (2002) determined that there was a need to address the issue of community and its contribution to the dropout rate of students in distance learning environments. When creating the CCS, Rovai

(2002) first generated a set of 20 questions that addressed student perceptions of connectedness, among other literature-based aspects of community. An additional set of 20 questions was generated to address the classroom environment, traditional or virtual.

Although the original intention of the survey was to address this issue with online students, the issue of community is one that also impacts other course formats, including traditional face-to-face courses and blended (also referred to as hybrid) courses. And Rovai (2002) indicates in his article describing the development of the scale that it can be used for students in these alternate classroom settings, noting that the scale was not developed with the intention of limiting its use solely to online educational environments. The use of the CCS in various peer-reviewed research studies lends additional support for the use of this instrument to measure a sense of community in blended and traditional classroom environments (Dawson, 2008; Gilken & Johnson, 2019; Polnick, et al., 2011; Ritter et al., 2010; Rovai & Jordan, 2004; Vora & Kinney, 2014).

To establish content validity for the instrument, a panel of three educational psychology professors was enlisted to review the questions for relevance, resulting in a final instrument containing a total of 20 questions designed to measure overall sense of community, and two subscales: connectedness and learning. The connectedness construct is defined to represent feelings related to “connectedness, cohesion, spirit, trust, and interdependence” (Rovai, 2002, p. 206). Learning represents feelings related to interactions with other students and their relationship to student “construction of understanding” (Rovai, 2002, p. 206). Reliability estimates for the instrument were calculated using Cronbach’s alpha and a split-half coefficient corrected by the Spearman-Brown formula. Cronbach’s α for the overall CCS was 0.93 and the split-half coefficient was 0.91, indicating an excellent level of internal validity. The two subscales, connectedness and learning, had Cronbach's α and split half values of 0.92 & 0.92 and 0.87 & 0.80 respectively, indicating that each subscale has good internal validity.

Use of the CCS instrument for populations involving blended and traditional classroom environments have generated updated values supporting its validity in studies not related to virtual classrooms. For example, a comparison study of three different instructional delivery methods – traditional, blended, and online – employed a confirmatory factor analysis technique to estimate Cronbach's α values for the study (Ritter et al., 2010). The Ritter study reported these Cronbach α values as 0.91, 0.91, and 0.86 for the overall instrument, connectedness subscale, and learning subscales, respectively. A similar comparative study of these three instructional delivery methods conducted by Rovai and Jordan (2004) reported Cronbach's α values of 0.92, 0.90, and 0.82 for the overall instrument, connectedness subscale, and learning subscale, respectively. Therefore, the instrument has been shown to have an acceptable level of reliability for use in studies involving distance learning, traditional, and blended classroom environments.

As previously discussed, the survey instrument contains a total of 20 questions, half addressing the subscale of connectedness and half addressing the subscale of learning. Participants needed approximately ten to fifteen minutes to complete the questionnaire, which was administered online, using an e-link to the survey in Google Forms. The survey uses a 5-point Likert scale, with the following possible responses: Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D), or Strongly Disagree (SD). Scoring the responses yields a maximum possible score of 40 for each of the subscales and a score of 80 for the overall sense of community. Responses to the Likert type survey questions were scored by the researcher. Half of the questions in the survey are worded in a positive manner (See Appendix A). An example of a positively worded question is *I feel that students in this class care about each other*. For these questions, scoring will be recorded as follows: SA- 4 points; A- 3 points; N- 2 points, D – 1 point; SD- 0 points. An example of a negatively worded question is *I do not feel a spirit of community.* For questions worded in a negative manner, scoring will be recorded as follows: SA- 0 points; A- 1 point; N- 2 points; D- 3 points; SD- 4 points. Using this scoring rubric, a score of 40 points would indicate that the student perceives the highest level of a sense of community possible for each subscale. A score of 0 would indicate that the student does not feel any sense of community associated with the respective subscale.

In his article detailing the development of the CCS, Rovai (2002) expressly states that permission to use the survey is given to educational researchers, provided that the researcher appropriately cites the development article (p. 202). Noting that the instrument was used for educational research in this study, the researcher accepted this expressly stated permission as a justification to move forward with the administration of the survey. The survey instrument was administered electronically using Google Forms. Student participants were given a four-week window of opportunity during the midterm of the course to complete the survey instrument.

Procedures

Before the data collection process could occur, IRB approval was needed to ensure that the study could be conducted according to established ethical guidelines. This process involved first obtaining permission from the high schools in which the dual credit STEM courses were taught. And additional IRB approval from Mississippi Central Community College (MCCC) was needed, along with permission to access end of term averages for the students. Once permissions from the high schools and IRB approval from MCCC were granted, the researcher sought IRB approval from Liberty University. After being granted full permission and IRB approval, the researcher moved forward with the data collection process. See Appendix E for IRB approval.

The first step in the data collection process involved site visits to local high schools offering dual credit STEM courses through MCCC, as well as a site visit to the dean of the CTE program at MCCC. The researcher explained the nature of the study to the local, high school administrators and guidance counselors and sought guidance in identifying courses and instructors of students in the target population of dual credit STEM and CTE-STEM courses. Teachers who agreed to offer their students an opportunity to participate in the study were given the details of the data collection process, and copies of consent letters for students at least 18 years of age, and parental consent letters for minor students. Teachers of the target courses collected consent letters and email addresses from students who agreed to participate in the study and forwarded these consent letters to the researcher. The researcher then sent an email link to the CCS for students who provided consent forms. End of term numerical averages were provided by the instructors of the courses and were associated with the students' school ID numbers. (See Appendix G for reporting form.) After entering study data into the analytical program, student ID numbers were deleted to maintain student confidentiality.

Administration of the survey took place during the middle of the course term, from approximately weeks 8-11 of the 16-week courses. The survey was administered electronically, with the researcher sending participants an email containing a link to the survey in Google Forms. After completing the electronic survey, each participant was compensated with a $10 Chick-fil-A gift card. Gift cards were distributed by writing the ID number of the participant on the gift card envelope, and these labeled gift cards were sent to instructors to give to their students. At all stages of the data collection process, the participants' privacy was respected by requesting only consent forms, email addresses, course information, and student ID numbers. Student ID numbers and email addresses were separated from the consent forms so that names of participants were not associated with the actual data collection process. Further, data were stored on a password protected external flash drive and stored in a lock box, accessible only to the researcher. The data will be stored for a period of five years after the completion of this research study. After the expiration of this five-year period, the flash drive will be wiped clean and reformatted by the researcher.

Data Analysis

The data in this study were analyzed using a multiple linear regression technique. Green and Salkind (2017) suggest that this type of data analysis is appropriate when examining whether a predictive relationship exists between a dependent, criterion variable and a linear combination of multiple independent, predictor variables. Further, Green and Salkind (2017) state that the criterion variable for a multiple linear regression must be continuous in nature, which is the case with end of term numerical averages. Therefore, this technique is an appropriate choice for statistical analysis for examining the predictive relationship between the variables *learning*, *connectedness*, and *overall community* and the criterion variable, *end of term average.*

Preliminary data analysis is necessary when conducting a multiple regression to verify the underlying assumptions necessary for the statistical analysis. Screening for bivariate outliers was conducted by generating a scatterplot matrix showing each set of two-by-two comparisons for the predictor variables. The scatterplot matrix was further analyzed to test the assumption of multivariate normal distribution. This was accomplished by looking for a linear relationship, noted by the classic cigar shape of the data in the scatterplot matrix (Green and Salkind, 2017). The variance inflation factor (VIF) was examined to verify the assumption of non-multicollinearity. Accepted values for the VIF are between 1 and 5 (Warner, 2013). In addition to preliminary data screening to verify the assumptions of no extreme bivariate outliers, multivariate normal distribution, and non-multicollinearity between the variables, general descriptive statistics were obtained to determine the mean and standard distribution of the overall data set, along with each of the subscales and the final numerical average of the student participants.

When assuming a medium effect size, and a statistical power of 0.7, at the alpha level of 0.05, a minimum of 75 participants were required (Warner, 2013, p. 570). Therefore, the researcher invited in excess of 400 potential participants from the dual credit STEM courses offered in high schools associated with MCCC. Of those invited, 116 ultimately completed the survey instrument. Of the 116 responses, 20 were discarded for various reasons including incomplete responses, repeat responses, and atypical answer selections. This left 96 remaining survey responses, exceeding the recommended 75 participant minimum (Warner, 2013, p.570).

When interpreting the results of the multiple regression analysis, Green and Salkind (2017) state that the null hypothesis will be rejected at the 95% confidence level. The multiple correlation value (R) can have values between 0 and 1, with 1 indicating a perfect predictive relationship and 0 indicating no predictive relationship. Finally, squaring the multiple correlation value (R^2) and multiplying by 100, provides a percentage value for the strength of the predictive relationship between the criterion variable and the predictive variables.

CHAPTER FOUR: FINDINGS

Overview

The data for this study were analyzed using multiple linear regression. Because assumption testing was not tenable for all three predictor variables, *connectedness*, *learning*, and *overall sense of community*, the analysis was conducted using only two of the predictors, *connectedness*, and *learning.* This chapter presents the reasons for omitting the third predictor variable from the analysis, a revised research question and null hypothesis, the results of the analysis, and general descriptive statistics for the data collected.

Research Question

RQ1: How accurately can end of term average for high school students enrolled in dual credit, community college STEM courses be predicted from a linear combination of predictor variables (student perceptions of connectedness, learning, and an overall sense of community)?

Null Hypothesis

$H_0$1: There will be no statistically significant predictive relationship between the criterion variable end of term averages for high school students enrolled in dual credit, community college STEM courses, and the linear combination of predictor variables (student perceptions of connectedness, learning, and an overall sense of community) as measured by the Classroom Community Scale.

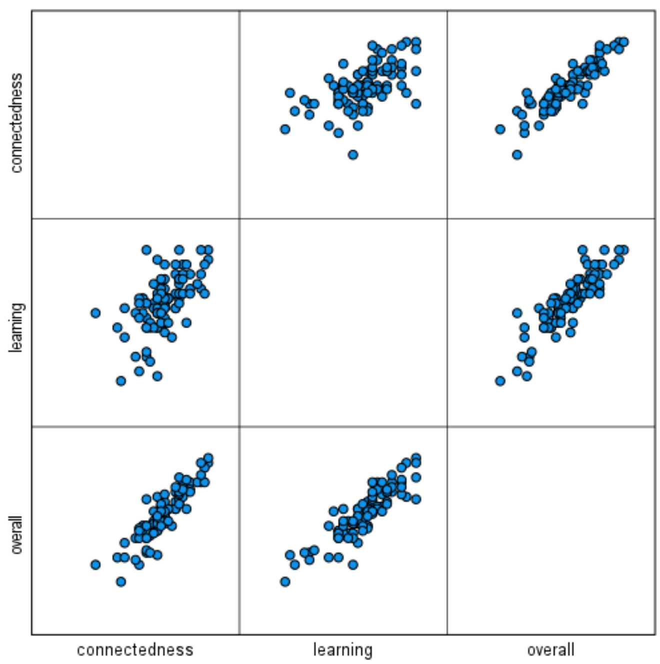
Data Screening

Data relating participant perceptions of connectedness, learning, and an overall sense of community were collected from 116 dual credit high school students enrolled in STEM and CTE-STEM courses at a community college. A general inspection of the data revealed 7 incomplete responses. And instructors failed to provide end of term averages for 11 participants.

Further, two respondents reported identical answers to all 20 survey items. Because half of the items were worded positively and half were worded negatively, it is inconsistent to either strongly agree or strongly disagree with all questions. Therefore, these responses were omitted as outliers. No further irregularities were discovered among the remaining 96 participant data items. A scatterplot matrix was used to screen for bivariate outliers between predictor variables and the criterion variable. No bivariate outliers where identified. See Figure 2 for the scatterplot matrix.

Figure 2

Scatterplot Matrix of Predictor Variable Relationships.



Descriptive Statistics

More than 400 potential participants were invited to take part in this study. Of the invitees, 116 responses were received. Two of the responses were identified as duplicate replies, 5 responses were incomplete, and 2 responses gave identical answers to all questions. Instructors were unable to report end of term averages for an additional 11 respondents. These 20 responses were therefore discarded, leaving a total of 96 survey responses that were included in the data analysis. For the responses included in the study, participants were enrolled in the following dual credit STEM and CTE-STEM courses: 14 college algebra students; 16 engineering graphics students; 40 nursing students; 6 precision machine students; 4 construction math students; 5 culinary arts students; 9 marketing students; 2 energy studies students.

Scoring for the predictor variables *connectedness* and *learning* can range from values of 0-40, with a score of 40 indicating the highest student perception of community for each value and a score of 0 representing the lowest. Scoring for the predictor variable *overall* sense of community can range from values of 0-80, with a score of 80 representing the highest student perception of community for each value and a score of 0 representing the lowest. Scores for the criterion variable *EOT* (end of term average) can range from a low of 0 to a high of 100% for the course. Descriptive statistics for the predictor and criterion variables can be found in Table 1.

Table 1

Descriptive Statistics

Variable	Min	Max	*M*	*SD*	*N*
Connectedness	9	40	27.7	5.7	96
Learning	13	40	29.2	5.6	96
Overall	29	80	56.9	10.1	96
EOT	11	100	82.7	22.1	96
Total					96

Assumption Testing

Assumption of Linearity

The multiple regression analysis requires that the assumption of linearity be met. Linearity was examined using a scatterplot matrix. The assumption of linearity was met. See Figure 2 for the scatterplot matrix.

Assumption of Bivariate Normal Distribution

The multiple regression requires that the assumption of bivariate normal distribution be met. The assumption of bivariate normal distribution was examined using the matrix scatter plot. The assumption of bivariate normal distribution was met. See Figure 2 for the matrix scatter plot.

Assumption of Multicollinearity

A Variance Inflation Factor (VIF) test was conducted to ensure the absence of multicollinearity. This test was run because if a predictor variable (x) is highly correlated with another predictor variable (x), they essentially provide the same information about the criterion variable. If the Variance Inflation Factor (VIF) is too high (greater than 10), then multicollinearity is present. Acceptable values are between 1 and 5. Warner (2013) defines multicollinearity as the degree to which one variable can be predicted by one or more other variables in the study. Because the overall sense of community was determined by adding the connectedness and learning sub scores from the CCS survey instrument, there is a high predictive relationship between this variable and the other two. For this reason, the researcher conducted collinearity diagnostics removing the overall sense of community variable, resulting in VIF values that fall within the limits recommended by Warner (2013). See Tables 2 and 3 for collinearity diagnostic tests.

Table 2

Collinearity Diagnostic VIF for Three Predictor Variables

Variable	VIF
Connectedness	62.66
Learning	57.16
Overall	186.37

Table 3

Collinearity Diagnostic VIF for Connectedness and Learning

Variable	VIF
Connectedness	1.53
Learning	1.53

Removing the predictor variable *overall sense of community* from the regression analysis requires a revision of the research question and null hypothesis. The revised research question and null hypothesis are written below.

Revised Research Question

RQ1: How accurately can end of term average for high school students enrolled in dual credit, community college STEM courses be predicted from a linear combination of predictor variables (student perceptions of connectedness and learning)?

Revised Null Hypothesis

$H_0$1: There will be no statistically significant predictive relationship between the criterion variable end of term averages for high school students enrolled in dual credit, community college STEM courses, and the linear combination of predictor variables (student perceptions of connectedness and learning) as measured by the Classroom Community Scale.

Results

Based on results of the assumption testing, the revised null hypothesis was tested using multiple regression analysis to examine the strength of the predictive relationship between the linear combination of predictor variables *connectedness* and *learning* and the criterion variable *end of term average*. The researcher rejected the null hypothesis at the 95% confidence level where $F(2,93)=6.003$; $p=0.003$. See Table 4 for the regression model results.

Table 4

ANOVA[a] Table

Model		Sum of Squares	df	Mean Square	F	Sig
1	Regression	5331.903	2	2665.951	6.033	0.003
	Residual	41094.056	93	441.872		
	Total	46425.958	95			

a. Dependent variable: EOT
b. Predictors: (Constant), learning, connectedness

Thus, the analysis indicates that there is a significant predictive relationship between the combination of predictor variables, *connectedness* and *learning*, and the criterion variable *end of term average* for this study. The regression equation was determined to be Y = 40.566 +

$0.500X_{connectedness} + 0.968X_{learning}$. The predictor variable, *learning,* contributed in a statistically significant manner to the prediction of the EOT, $p < 0.05$. See Table 5 for model coefficients.

Table 5

Regression Model Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	*t*-stat	Sig	95% Confidence Interval for B	
	B	Std. Error	β			Lower Bound	Upper Bound
1 (constant)	40.566	12.358		3.282	0.001	16.025	65.108
Connectedness	0.500	0.468	0.129	1.069	0.288	-0.429	1.430
Learning	0.968	0.464	0.247	2.044	0.044	0.028	1.909

The adjusted R^2 value for the analysis, 0.096, indicates that 9.6 % of the *end of term average* is related to the linear combination of the predictor variables *connectedness* and *learning.* See Table 6 Regression Analysis Model Summary.

Table 6

Regression Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of Estimate
1	0.339	0.115	0.096	21.021

CHAPTER FIVE: CONCLUSIONS

Overview

This research study involved the distribution of a survey instrument to measure student perceptions of community for dual credit students enrolled in STEM and CTE-STEM courses at a local community college. Chapter 5 includes a discussion of the results of the survey instrument and its statistical analysis, as well as the implications, limitations of the study, and recommendations for future research related to this topic.

Discussion

The purpose of this nonexperimental, predictive quantitative, correlational research study was to determine whether there was a significant predictive relationship between a linear combination of predictor variables (*connectedness, learning, and overall sense of community*) and the criterion variable *end of term average* (EOT) for dual credit students enrolled in STEM courses at a local community college. Assumption testing for the multiple regression analysis of the survey results and EOT data revealed a problem with the assumption of noncollinearity of the predictor variables. The VIF factor used to test this assumption indicated a high level of collinearity associated with the predictor variable *overall sense of community* and the other two variables. For this reason, the researcher moved forward with a statistical analysis involving a linear combination of only the remaining two predictor variables *connectedness* and *learning.* Removing the predictor variable *overall sense of community* from the statistical analysis required a revision to the research question and the null hypothesis. The revised null hypothesis was rejected because the statistical analysis indicated a significant predictive relationship between the predictor variables *connectedness* and *learning* and the criterion variable *end of term* average.

The literature describes connectedness in terms of building relationships and a sense of belonging among students within an educational environment (Tespalacios et al., 2021). A literature-based definition of learning is more difficult to pinpoint, but the constructivist concept of learning is often described as an ability to read, discuss, and work with cohorts to solve problems (Vanhorn et al., 2019). The overall sense of community for students in the survey was obtained by summing the scores from the sub-scores for connectedness and learning. Study participants reported a mean score for perceptions of connectedness and learning as 27.7 and 29.2 respectively, which is approximately 69% and 73% of the highest possible score for these variables in the survey. The combined scores reveal an overall sense of community score of 56.9, which is approximately 71% of the highest possible score of 80. Interestingly, only 12 (or 13 %) of the 96 students in this course were unsuccessful overall, having a failing end of term average (below 60%).

In addition to the statistical analysis, the study participants' mean score of 71% of the highest possible value for an overall sense of community, together with an 87 % success rate, further illustrates a correlation between a positive sense of community and success in dual credit STEM and CTE-STEM courses. These results are consistent with educational theories of social integration and social constructivism, the theoretical frameworks guiding this study. Social integration theories suggest that positive social interactions, or connectedness, correlate highly with student success in college (Tinto, 1993; Braxton, 2019). These theories further suggest that fulfillment of the need for belonging is a requirement that must be met before an individual can progress towards self-actualization, such as successful completion of college coursework (Maslow, 1970/2012; Schunk, 2016). And social constructivist theories affirm that individual learning largely occurs within a community (Doolittle & Camp, 1999).

The study results indicating a generally positive sense of community are also consistent with studies suggesting that interactions with intellectual peers and the corresponding potential for positive social interactions are among the various motivating factors that students report for choosing to participate in such programs (Dare et al., 2017). Duncheon (2020) further states that for some dual credit populations, students report that their social experiences within the classroom were among the most valuable parts of their dual credit experience.

One predictor variable in this study, *learning*, contributed in a statistically significant manner to the prediction of end of term average, meaning that student perceptions of learning may be a key factor in course success. This finding supports research indicating that student perceptions of learning are related to the growth experienced through the building of relationships with the students' classmates and instructors (Ferreira et al., 2019; Rovai, 2002; Stein & Klosterman, 2020; Trespalacious et al., 2021).

Although the results of the study highlight the importance of connectedness in the classroom setting, one study reported that students enrolled in dual credit courses taking place at a community college relied not only on peer interactions, but also on previously established relationships with high school counselors to help adjust to their college environment (Lile et al., 2018). The same study emphasizes the importance of personal responsibility and individual autonomy, although aided by relationships with counselors and administrators, as factors that impact student success in the dual enrollment educational journey.

Implications

This study adds to the existing body of literature by examining dual credit high school students using a survey instrument to collect data relating to their success while the students are actively enrolled in their coursework. Many studies have shown that exposure to dual credit coursework positively contributes to future success in higher education (Allen et al., 2020;

Garcia et al., 2020; Lawrence & King, 2019). And much of the current literature involving dual credit studies centers around implications of these studies after students graduate (Bowers & Foley, 2018; Taylor & Yan, 2018; Young et al., 2018). Further, Gopalan and Brady (2019) indicate a need for more studies, such as this one, that measure belonging for two-year college students.

The participants of this particular study combine the following student populations: dual credit students, community college students, and STEM and CTE-STEM students. The population of the study is important because of research that indicates that community colleges serve as an important pipeline into the world of STEM and CTE-STEM education, particularly for underrepresented student populations (Baher, et al., 2017; O'Banion, 2019; Snyder & Cudney, 2017).

This study was conducted during a time of heightened stress in the educational environment brought about by the coronavirus pandemic. As a result, some of the student participants chose to take advantage of remote instructional opportunities designed to minimize exposure risk while the remainder of their peers reported to the classroom to receive traditional instruction. Some researchers believe that conditions creating this type of additional stress can increase the need for belonging (Peacock et al., 2020).

Instructors of the participants in this study reported the need for some novel solutions in light of the previously mentioned pandemic conditions, with most participants reporting for traditional face to face instruction and a few choosing remote instructional options. Remote instructional options reported by course instructors included the use of videoconferencing tools, such as Zoom, and various types of online learning platforms, such as Google Classroom and the college's Canvas learning management system. One study reported the use of similar strategies to mitigate the sudden shift in the instructional environment due to the shutdown in the Spring of 2020, caused by the pandemic (Ison, et al., 2021). In the Ison study, other strategies that were implemented included training dual credit instructors on how to effectively use the college learning management system and online instructional resources. As educators continue to deal with the fallout from the pandemic, training on these techniques and how to use them to increase community in an online environment could have a positive impact on student success in dual credit coursework.

Although the initially planned statistical analysis was not doable due to assumption testing limitations, the revised analysis and its findings do indicate a generally positive sense of connectedness, learning, and community for participants in the dual credit STEM and CTE-STEM courses associated with the study. As society continues to examine the impact of the effects of the pandemic caused by the novel coronavirus and its variations on the educational environment, this study indicates that it is possible for educators to continue to foster a generally positive sense of community and belonging among students in their courses, whether students participate in remote or in person instruction.

Some suggested tools for building community in online learning environments, such as those brought about by the pandemic, include the use of guest speakers in the classroom, transparency with personal experiences of instructors, and inviting student feedback pertaining to online assignments (Freedman & Voelker-Morris, 2020). Some suggestions for building community in traditional classroom environments include icebreaker activities and discussing student questionnaires that are designed to help students within a classroom get to know each other (Cooper, 2018).

Limitations

One limitation of this study was the need to seek parental consent for minors (dual credit high school students) to participate. Instructors of courses in which student participants were recruited reported general difficulties obtaining parental consent forms for various purposes. One instructor reported that a particular student requested parental consent to participate in this study, but consent was denied by the parents because the parents were not given compensation. Therefore, it is possible that the overall positive sense of community reported by participants reflected environments in the home in which parents were more generally supportive of educational endeavors.

Further, students in the study sample were enrolled in their coursework in an uncertain educational environment due to the COVID-19 pandemic. Student participants were given the option to complete coursework remotely or to come to traditional face-to-face classes. And students were afforded the opportunity to change their decision at will. Therefore, participants' sense of belonging, and their perceptions of the extent to which they could depend on classmates to help them meet their educational needs, could have been impacted by the learning mode chosen by their classmates.

Another limitation of the study was the use of a convenience sampling procedure. This sampling technique may not have provided for a sample of dual credit STEM and CTE-STEM students that was generalizable to the larger population of such students (Gall et al., 2007). However, the researcher provided some information that could help the reader determine how to best relate the results to other populations of students by providing the types of courses in which students were enrolled, the number of participants in each, and a general description of the student population at the community college in which the study took place.

An additional limitation of the study was the inability to include all of the predictor variables in the statistical analysis. This situation caused the researcher to be unable to reject the original null hypothesis. However, the analysis of the revised null hypothesis using the remaining predictor variables provided similar information and insight into the nature of the question concerning a possible predictive relationship among the predictor variables and the criterion variable because the third variable was obtained by summation of the two included in the eventual analysis.

Recommendations for Future Research

As has been previously mentioned, more research measuring a sense of belonging for two-year college students is needed. Gopalan & Brady (2019) recommend continued research concerning how belonging differs among various student populations. One recommendation for such a study would be one measuring a sense of community among dual credit students enrolled in community colleges in areas of study other that STEM and CTE-STEM courses. Other student populations might include dual credit students enrolled in courses in public four-year and private higher education settings.

With respect to STEM and CTE-STEM specific student populations, including those enrolled in dual credit courses, Cohen and Kelly (2020) recommend more research into how student outcomes in science and math courses impact affective domains in students and how this influences STEM persistence for community college students. Although this study focused on students' sense of community, Cohen and Kelly suggest that other areas of study could include qualitative studies designed to develop further understanding of student resilience and self-efficacy in both dual credit and traditional STEM courses.

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APPENDIX A: Classroom Community Scale (Rovai, 2002)

APPENDIX B: Study Consent Form Ages 18 & Up

Study Consent Form (Ages 18 & Up)

Title of the Project: Perceptions of Community Among Dual Credit Students Taking STEM Courses Offered Through a Community College

Principal Investigator: Teresa M Johnson, BS, MS, Liberty University Graduate School

Invitation to be Part of a Research Study

You are invited to participate in a research study. To participate, you must be enrolled in a dual credit STEM course associated with a community college. Taking part in this research project is voluntary.

Please take time to read this entire form and ask questions before deciding whether to take part in this research project.

What is the study about and why is it being done?

The purpose of the study is to determine if there is a relationship between perceptions of community for students enrolled in dual credit STEM courses and success in these courses.

What will happen if you take part in this study?

If you agree to be in this study, I will ask you to do the following things:

1. Complete the Classroom Community Scale survey instrument as directed by your instructor. The instrument will be administered once at your course midterm. (15 minutes)
2. Grant permission for the researcher to obtain end-of-term averages for your course.

How could you or others benefit from this study?

Participants should not expect to receive a direct benefit from taking part in this study.

Benefits to society include gathering of data and information that can help teachers improve instructional techniques for dual credit students in STEM classes associated with local community colleges.

What risks might you experience from being in this study?

The risks involved in this study are minimal, which means they are equal to the risks you would encounter in everyday life.

How will personal information be protected?

The records of this study will be kept private. Research records will be stored securely, and only the researcher will have access to the records.

- Participant responses to the Classroom Community Scale will be kept confidential.
- End of course scores will be reported and stored on a secure flash drive, available only to the researcher. Student confidentiality will be further protected by erasing

student ID numbers after the study data has been entered into the program for analysis.
- Data collected in the study will be stored on the personal flash drive of the researcher. Data will be kept for five years and then destroyed by the researcher.
- No information that could personally identify any participants will be included in the study report. Only numerical data and survey responses will be included in the final document reporting the details of the study.

How will you be compensated for being part of the study?

Participants will be compensated for participating in this study. Each participant will be provided a $10 gift card to Chick-Fil-A after completing the survey instrument towards the midterm of their course. Gift cards will be distributed to course instructors, along with a list of students who are to receive the cards.

Does the researcher have any conflicts of interest?

The researcher serves as an instructor at your Community College. This disclosure is made so that you can decide if this relationship will affect your willingness to participate in this study. No action will be taken against an individual based on his or her decision to participate in this study.

Is study participation voluntary?

Participation in this study is voluntary. Your decision whether to participate will not affect your current or future relations with Liberty University, your high school, or Mississippi Central Community College. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

What should you do if you decide to withdraw from the study?

If you choose to withdraw from the study, please contact the researcher at the email address provided below to inform her that you wish to discontinue your participation, and do not submit your study materials. Your responses will not be recorded or included in the study.

Whom do you contact if you have questions or concerns about the study?

The researcher conducting this study is Teresa M Johnson. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact Mrs. Johnson at [redacted]. You may also contact the researcher's faculty sponsor, Dr. Katie Thompson, at [redacted]

Whom do you contact if you have questions about your rights as a research participant?

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher **you are encouraged** to contact the Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA 24515 or email at irb@liberty.edu.

Disclaimer: The Institutional Review Board (IRB) is tasked with ensuring that human subjects research will be conducted in an ethical manner as defined and required by federal regulations. The topics covered and viewpoints expressed or alluded to by student and faculty researchers are those of the researchers and do not necessarily reflect the official policies or positions of Liberty University.

Your Consent

By signing this document, you are agreeing to be in this study. Make sure you understand what the study is about before you sign. You will be given a copy of this document for your records. The researcher will keep a copy with the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study.

____

Printed Subject Name

____

Signature & Date

APPENDIX C: Parental Consent Letter

Parental Consent Letter

Title of the Project: Perceptions of Community Among Dual Credit Students Taking STEM Courses Offered Through a Community College

Principal Investigator: Teresa M Johnson, BS, MS, Liberty University Graduate School

Invitation to be Part of a Research Study

Your student is invited to participate in a research study. Participants must be enrolled in a dual credit STEM course associated with a community college. Taking part in this research project is voluntary.

Please take time to read this entire form and ask questions before deciding whether to allow your student to take part in this research project.

What is the study about and why are we doing it?

The purpose of the study is to determine if there is a relationship between perceptions of community for students enrolled in dual credit STEM courses and success in these courses, as measured by end of term numerical averages.

What will participants be asked to do in this study?

If you agree to allow your student to be in this study, I will ask him/her to do the following things:

1. Complete the Classroom Community Scale survey instrument as directed by the course instructor. The instrument will take 10-15 minutes and be administered near the midterm of the semester for your student's course.
2. You will need to grant permission for me to obtain your student's final course scores. The data collected will be associated with the student's college ID number. However, confidentiality will be maintained by erasing these numbers from the data collection analysis program after the data has been entered.

How could participants or others benefit from this study?

Participants should not expect to receive a direct benefit from taking part in this study.

Benefits to society include gathering of data and information that can help teachers improve instructional techniques for dual credit students in STEM classes associated with local community colleges.

What risks might participants experience from being in this study?

The risks involved in this study are minimal, which means they are equal to the risks your student would encounter in everyday life.

How will personal information be protected?

The records of this study will be kept private. Research records will be stored securely, and only the researcher will have access to the records.

- Participant responses to the Classroom Community Scale will be kept confidential.
- End of course scores will be stored on a secure flash drive, available only to the researcher. Student confidentiality will be protected by erasing student ID numbers after data has been entered into the program used for analysis.
- Data collected in the study will be stored on the personal flash drive of the researcher. Data will be kept for five years and then destroyed by the researcher.
- No information that could personally identify any participants will be included in the study report. Only numerical data and survey responses will be included in the final document reporting the details of the study.

How will you be compensated for being part of the study?

Participants will be compensated for participating in this study. Each participant will be provided a $10 gift card to Chick-Fil-A after completing the survey instrument towards the midterm of their course. Gift cards will be distributed to course instructors, along with a list of students who are to receive the cards.

What conflicts of interest exist in this study?

The researcher serves as an instructor at your student's Community College. This disclosure is made so that you can decide if this relationship will affect your willingness to allow your student to participate in this study. No action will be taken against an individual based on her or his decision to allow his or her student participate in this study.

Is study participation voluntary?

Participation in this study is voluntary. Your decision whether or not to allow your student to participate will not affect your or your student's current or future relations with Liberty University, their high school, or any community college. If you decide to allow your student to participate, your student is free to not answer any question or withdraw at any time without affecting those relationships.

What should be done if a participant wishes to withdraw from the study?

If you choose to withdraw your student from the study or if your student chooses to withdraw from the study, please contact the researcher at the email address provided below or have your student contact the researcher to inform her that you/your student wishes to discontinue his/her participation, and your student should not submit the study materials. Your student's responses will not be recorded or included in the study.

Whom do you contact if you have questions or concerns about the study?

The researcher conducting this study is Teresa M Johnson. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact Mrs. Johnson at [redacted]. You may also contact the researcher's faculty sponsor, Dr. Katie Thompson, at [redacted].

Whom do you contact if you have questions about rights as a research participant?

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA 24515 or email at irb@liberty.edu.

Disclaimer: The Institutional Review Board (IRB) is tasked with ensuring that human subjects research will be conducted in an ethical manner as defined and required by federal regulations. The topics covered and viewpoints expressed or alluded to by student and faculty researchers are those of the researchers and do not necessarily reflect the official policies or positions of Liberty University.

Consent

By signing this document, you are agreeing to allow your student to be in this study. Make sure you understand what the study is about before you sign. You will be given a copy of this document for your records. The researcher will keep a copy with the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

I have read and understood the above information. I have asked questions and have received answers. I consent to allow my student to participate in the study.

____

Printed Child's/Student's Name

____

Parent's Signature Date

____

Minor's Signature Date

APPENDIX D: Recruitment Letter

Hello Dual Credit STEM Student,

As a graduate student in the School of Education at Liberty University, Teresa M Johnson is conducting research as part of the requirements for a Ph.D. in Curriculum and Instruction. The purpose of the research is to determine whether a relationship exists between student perceptions of community and end-of-term averages in your course. If you meet her participant criteria and are interested, Teresa would like to invite you to join her study.

Participants must be dual credit high school students enrolled in a STEM related course offered in association with a community college. Participants, if willing, will be asked to complete a brief survey near the course midterm. It should take approximately 10-15 minutes to complete the survey. The names of participants will not be requested as part of this study, but student ID numbers will be collected and used to connect participants' midterm survey responses to their end-of-term averages. However, this information will remain confidential, as the researcher will delete student ID numbers when entering data into the program being used for analysis.

Would you like to participate? [Yes] Great, students who are at least 18 years old may sign the consent form being distributed by your teacher. Students who are younger than 18 years of age should take the consent form to your parent or legal guardian and return the completed consent form to your teacher. After receiving your consent form, your teacher will ask you for your email address. Could you please provide your email address so that you can be sent the link to the survey at the appropriate time? [No] I understand. Your participation is completely voluntary. Thank you for your time.

A consent document will be provided by your instructor. The consent document contains additional information about my research.

- If you choose to participate and are at least 18 years old, you will need to sign the consent document and return it to me.
- If you choose to participate and are younger than 18 years old, both you and your parent/legal guardian will need to sign the consent document and return it to me.

Each participant will be provided a $10 gift card to Chick-Fil-A after completing the survey instrument towards the midterm of their course. Gift cards will be distributed to course instructors, along with a list of students who are to receive the cards.

Thank you for your time. Do you have any questions?

APPENDIX F: Liberty IRB Approval Letter

LIBERTY UNIVERSITY
INSTITUTIONAL REVIEW BOARD

August 11, 2021

Teresa Johnson
Katie Thompson

Re: IRB Approval - IRB-FY20-21-971 Perceptions of Community Among Dual Credit Students Taking STEM Courses Offered Through a Community College

Dear Teresa Johnson, Katie Thompson,

We are pleased to inform you that your study has been approved by the Liberty University Institutional Review Board (IRB). This approval is extended to you for one year from the following date: August 11, 2021. If you need to make changes to the methodology as it pertains to human subjects, you must submit a modification to the IRB. Modifications can be completed through your Cayuse IRB account.

Your study falls under the expedited review category (45 CFR 46.110), which is applicable to specific, minimal risk studies and minor changes to approved studies for the following reason(s):

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

Your stamped consent form(s) and final versions of your study documents can be found under the Attachments tab within the Submission Details section of your study on Cayuse IRB. Your stamped consent form(s) should be copied and used to gain the consent of your research participants. If you plan to provide your consent information electronically, the contents of the attached consent document(s) should be made available without alteration.

Thank you for your cooperation with the IRB, and we wish you well with your research project.

Sincerely,

G. Michele Baker, MA, CIP
Administrative Chair of Institutional Research
Research Ethics Office

APPENDIX G: End-of-Term Average Form for Instructors

Please complete the following form, providing numerical final averages, for students in your class. Do NOT use student names on this form, only student ID numbers. It is not necessary to place a letter grade on the form, only a *numerical* grade for each student.
Course Section Number __________

Student ID	Final Grade		Student ID	Final Grade