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EVALUATION AND IMPROVEMENT OF PROCESSES AND METRICS IN A
DUAL CREDIT PROGRAM

by

KRISTIAN E. FISCHER

A dissertation submitted in partial fulfillment of
the requirements for the degree of Doctor of Education in School Improvement
Department of Education

Teresa Kennedy, Ph.D., Committee Chair

College of Education and Psychology

The University of Texas at Tyler
November 2023

The University of Texas at Tyler
Tyler, Texas

This is to certify that the Doctoral Dissertation of

KRISTIAN E. FISCHER

Has been approved for the dissertation requirement on
November 13, 2023 for
the Doctor of Education in School Improvement degree

Approvals:

DocuSigned by:

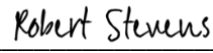
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Dissertation Chair: Teresa Kennedy, Ph.D.


DocuSigned by:

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Member: Kelly Dyer, Ph.D.

DocuSigned by:

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Member: Robert Stevens, Ed.D.


DocuSigned by:

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Member: Woonhee Sung, Ed.D.

DocuSigned by:

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Chair, School of Education

DocuSigned by:

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Dean, College of Education & Psychology

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Abstract

EVALUATION AND IMPROVEMENT OF PROCESSES AND METRICS IN A DUAL CREDIT PROGRAM

Kristian E. Fischer

Chair: Teresa Kennedy, Ph.D.

The University of Texas at Tyler

November, 2023

This dissertation used convergent mixed methods design in a program implementation evaluation of a dual credit program. A binary logistic regression was performed on dual credit enrollment persistence. A stakeholder survey was deployed to parents, administrators, instructors and counselors associated with the dual credit program. A full review of district documents related to dual credit was included as part of the qualitative component. The results of the regression indicated non-significance in the predictor variables for the dependent variable of dual credit persistence. The emergent themes from the survey included concerns about student readiness for dual credit coursework and a need for more course options. This dissertation also revealed a notable gap in the literature related to guidelines for dual credit program implementation for public schools as well as a lack of research examining cognitive and non-cognitive factors in the secondary environment which may impact student participation in dual

credit programs. These results and findings highlight the lack of research-based guidance for secondary institutions in the data strategies, program implementation and monitoring for their dual credit programs. Research to investigate secondary-specific effects of dual credit participation is recommended. Further recommendations include development of data strategies and program implementation for dual credit programs for secondary schools.

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PROBLEM OF PRACTICE

The purpose of this convergent mixed methods study and implementation evaluation was to identify possible factors impacting optimal outcomes and implementation of the dual credit program at a public STEM charter school. As illustrated in the literature review, research has been published on dual credit programming benefits for students and institutions of higher education, however, there is a paucity of related research for K–12 partners collaborating with these programs. Informative data collection and analyses for K–12 dual credit partners, as well as systems for monitoring and evaluation of these systems, remained unaddressed prior to this study.

Background

The lack of STEM qualified students and workers in the United States was identified as a burgeoning problem in *Rising Above the Gathering Storm* (National Academies of Sciences, Engineering, and Medicine, 2007). Despite numerous statewide and nationwide efforts to expand the pipeline of STEM proficient secondary students progressing to postsecondary STEM studies or STEM careers, there has continued to be inadequate growth of the STEM proficient tertiary student and professionals (Bureau of Labor Statistics, 2023; National Academies of Sciences, Engineering, and Medicine, 2010; National Science Board, 2018; National Science Foundation, 2022; Zilberman & Ice, 2021). There exists a misalignment between ideal STEM pathway progression and secondary to postsecondary transition as evidenced in the literature (National Academies of Sciences, Engineering, and Medicine, 2007). One strategy to ameliorate this apparent leak in the STEM pipeline has been the implementation of dual credit opportunities for students (Zinth, 2018).

According to the Texas Administrative Code: Chapter 19, dual credit is defined as “a system under which an eligible high school student enrolls in college course(s) and receives credit for the course(s) from both the college and the high school” (Texas Administrative Code, 2023). Dual credit is also referred to as “concurrent course credit; the terms are equivalent.” The Texas Administrative Code also defines dual enrollment as “a system under which a student is enrolled in more than one educational institution” (including a high school and a public institution of higher education). When students in a dual enrollment system enroll in courses, they earn appropriate course credit from each distinct educational institution that offered the course.” The authors of *Dual Enrollment: A Comprehensive Review* (Southern Regional Education Board, 2020), note the lack of consensus around formal definitions for “dual enrollment,” and “dual credit.” For the purposes of this study, minimal distinction is made between dual credit, dual enrollment, and concurrent enrollment. Dual enrollment programs have shown substantial benefit related to a variety of outcomes linked to postsecondary enrollment, perseverance, performance, and degree completion, according to a recent meta-analysis of dual credit research (Schaller et al., 2023). While the justifications for dual enrollment differ, they frequently center around meeting workforce demands and achieving educational objectives through reducing the time and cost of higher education (Southern Regional Education Board, 2020).

Dual enrollment programs across the United States and, specifically, in Texas have grown significantly over the last decade. In addition to earning college credit and academic competencies that would be beneficial after high school, dual credit students complete the requirements for high school graduation (Horn et al., 2018). Dual credit programs aim to produce

high school graduates who can seamlessly transition from secondary to postsecondary coursework.

Beginning in 1995, Texas has required public high schools to offer dual credit courses for their students (Miller et al., 2017). Legislators have further refined rules and guidelines to bolster dual credit participation in the state (Act of June 10; Act of June 14, 2019). Going beyond the legislative mandates, the University of Texas Tyler University Academies (UTTUA) aim to prepare students for STEM post-secondary vocations or college majors through a dual credit program with the expectation that all UTTUA high school students participate in dual credit coursework.

The UTTUA are open enrollment, public K–12 charter schools in East Texas whose mission is to prepare students for STEM postsecondary work or study and are affiliated through their charter with the University of Texas at Tyler (University of Texas at Tyler, 2011). The University of Texas at Tyler (UT Tyler) is not only the sponsor of the UTTUA charter, but also the dual credit provider for the UTTUA. That is, the college credits earned by participating UTTUA dual credit students are awarded through UT Tyler as an accredited institution of higher education. While this arrangement may appear to be ideal, the disparities in reporting, objectives, funding, data collection, and resource allocation may have impacted dual credit program outcomes and implementation.

Dual credit courses can be implemented in various formats. Ideally, dual credit courses are taught by university of college professors with the same curriculum and expectations for their high school students as for their traditional postsecondary students (Horn et al., 2018). While considered by many to be the ideal dual credit format, the full immersion of high school students in all aspects of university coursework is dependent on active participation by UT Tyler.

Alternatively, dual credit can be taught by certified secondary teachers who have also qualified to teach dual enrollment by possessing a master's degree and at least 18 graduate level credit hours in the content area (19 Tex. Admin. Code §4.85, 2023). While these secondary instructors are classified as qualified to teach dual credit courses, there has been some concern about the rigor of dual credit courses not taught by university instructors (Taylor et al., 2018).

Challenges have been identified regarding access to a full array of dual credit course offerings for the UTTUA which would represent a STEM ready, core complete degree plan. Throughout the college system at UT Tyler, all departments have been given the option to participate in dual credit programming. However, many of the departments do not offer courses that allow dual credit participation. For example, in English Language Arts and Mathematics, the dual credit coursework is offered solely by UTTUA faculty, while the dual credit history courses are taught by UT Tyler faculty with facilitation by UTTUA faculty. There is a perception among the various stakeholders that there is a wide variance in course rigor between content areas as well as between courses with same course codes but different instructors. Due to UT Tyler departmental reluctance, few science courses have been offered in a dual credit format.

The UTTUA campuses offer dual credit coursework through a variety of modes depending on availability. While the preferred mode of delivery might be face-to-face on the university campus (Hu & Chan, 2021), two of the UTTUA campuses are not within reasonable proximity to the main campus to make in-person attendance feasible. Another option for dual credit delivery is via online synchronous coursework with university faculty. There are currently no courses delivered in this manner at the UTTUA. A few of the dual credit courses at the UTTUA are delivered asynchronously online by university faculty including history and astronomy. Lastly, some of the dual credit courses are offered by the UTTUA high school

faculty who are qualified to teach dual credit coursework and function as UT Tyler ad hoc adjuncts teaching only these specific courses.

Recruiting and retaining students who intend to complete dual credit coursework in a STEM major can be challenging. The UTTUA does not offer the extra-curricular programs that most traditional high schools offer such as band, theater, drill team, or athletics. The UTTUA focuses its resources on academics rather than dividing time and resources across these non-academic extra-curricular programs. While this format may be attractive to some students, the model may be unattractive to students for whom extra-curricular participation is a deciding factor. In addition to this academics-only focus, each campus also carries unique community perceptions that may influence student recruitment and retention in dual credit focused STEM pathways in their high school coursework.

As open-enrollment public charter schools, the UTTUA offers three schools of choice. Presumably, students and their families choose to enroll at the UTTUA schools in order to avail themselves of the opportunity to attend a STEM-focused school and participate in dual credit opportunities. Students and their families may have various reasons for seeking this specialized pathway including the opportunity to defray the tuition for a portion of higher education in a STEM major. They also may choose the UTTUA schools in order to take advantage of more challenging coursework or to prepare for a postsecondary career in a STEM field. In spite of the theoretical appeal of dual enrollment opportunities at the UTTUA, enrollment in these courses has declined over time. While over 90% of high school students in grades 9-12 participated in dual credit coursework when those grade levels were initially offered at the UTTUA in the fall semester of 2016, the percentage of students participating in dual credit courses has declined to slightly over 50% as of the spring semester 2023.

A notable effect that supports high school student participation in university level dual credit coursework is student experience with other university students (Alsup & Depenhart, 2020). For students and their families, this represents a promising program which fails to fully deliver. For UTTUA administration and faculty, the obstacles result in ongoing frustration in their ability to deliver a complete slate of STEM core content dual credit/dual enrollment courses. The internal and external obstacles present in the dual credit program between the University of Texas Tyler University Academies and the University of Texas Tyler have resulted in a progressive broadening of informal objectives as well as drift from the original intended focus. The declining enrollment and diminishing efficacy of the dual credit program implementation compels further examination to recalibrate the system.

Intentional measures and controls are required in order to implement, assess, and refine an optimal program. Ideally, the measures and processes are in place at the outset of program implementation and are comprehensive in nature. Having guidelines and recommendations for data collection, monitoring, and evaluation from which to work when implementing a program can be an obvious benefit. Unfortunately, multiple chasms have been revealed within the dual credit universe. The first apparent gap is between outcomes and drivers. While there are multiple studies, reports, and policy recommendations at the state and national level published by researchers, organizations, legislatures, and accrediting bodies that focus on aggregated outcomes for dual credit participants (DesJardins et al., 2019), these publications have failed to unearth the causal mechanisms for the effects (Giani et al., 2023). Another gap in the literature is between the outcomes at the postsecondary level and the outcomes within the secondary systems. That is, published research covering enrollment and persistence outcomes as well as possible factors influencing those outcomes between the 8th and 12th grades are lacking. Finally, there is

a gap between the national and state mandates for K–12 dual credit implementation and informative, explicit recommendations for program implementation, monitoring, and evaluation.

Problem of Practice

Since the first year in which the UTTUA began graduating students (academic year 2018/2019), dual credit enrollment and persistence has declined.

Purpose of the Study

The purpose of this study is to determine primary defects in a dual credit program in place at an open, public charter district whose goal is to prepare students for postsecondary success in STEM disciplines. This study focuses on components within the UTTUA dual credit program. The presence or absence of adequate measures and strategies in addressing a complex system with limited locus of control is considered in this study. Specific purposes of the study will be as follows:

- to evaluate the current system of dual credit programming at the UTTUA accredited by the UT Tyler;
- to identify possible trends and causes in dual credit participation and persistence; and
- to identify recommended measures and methods for implementation monitoring and evaluation of secondary dual credit programs

Theoretical Framework

In *A Review of Empirical Studies on Dual Enrollment: Assessing Educational Outcomes*, the authors assert that the theoretical or conceptual frameworks around dual credit are somewhat

limited (An & Tayler, 2019). While there has been a good amount of research documenting correlations between dual credit and potential postsecondary benefits for students, less attention has been paid to underlying factors that might be driving these results. In short, a causative link has been difficult to disentangle from merely correlative factors (Wang et al., 2015). It has been suggested that dual enrollment lowers the chance of a delayed college entrance, thereby supporting seamless high school to postsecondary pathways (Wang et al., 2015). Early studies on postsecondary persistence found that increasing students' levels of involvement in an institution was directly linked to student development and success (Astin, 1999). Relatedly, one study demonstrated an empirical relationship between students' participation in activities designed to further their education and their actual or perceived progress toward learning objectives (Strayhorn, 2008). In the study, students' self-reported gains in personal and social learning were moderately and positively connected with faculty-student contacts, peer relationships, and active learning.

It's possible that students' abilities and knowledge of expectations from their primary and secondary school won't transfer smoothly to a postsecondary setting. For example, compared to their high school counterparts, college instructors typically have different expectations for their students, teach their curriculum more quickly, and prioritize information that exhibits key thinking abilities (Conley, 2007). Experiencing postsecondary expectations in a well-supported secondary environment may provide a benefit for dual credit students that translates to increased postsecondary enrollment upon high school graduation as well as increased persistence in college coursework.

While many studies and reports offer recommendations for data, analysis, and policy at the state or federal level (Schaller et al., 2023), there is a conspicuous lack of published research

or recommendations for specific best practices in dual credit implementation at the K–12 institution level. Additionally, while there is copious aggregate information available for dual credit metrics such as postsecondary enrollment, graduation rate, and time to graduation, there is a dearth of published research on factors which might influence dual credit persistence in the secondary environment.

Research Questions

In order to prepare students for success in STEM fields in postsecondary education, the UTTUA implemented a dual credit program. The aim of this study is to identify the program's primary obstacles to successful implementation. This study also examines the existing strategies and measures in place to address a complicated system with a limited locus of control. The following research questions were considered for this study:

1. How is the UTTUA dual credit program's implementation and progress being monitored and evaluated, and how do these activities align with effective program monitoring and evaluation?
2. What variables may be affecting dual credit participation at the UTTUA, and to what degree?

Evaluation Plan

With the explicit goal of preparing students for STEM post-secondary careers or college majors, the UTTUA is an open enrollment, public K–12 charter school district located in East Texas. The UTTUA also has an expectation that its high school students participate in dual credit coursework. This study aims to examine monitoring and evaluation systems used by the UTTUA for its dual credit program. Additionally, since there appears to be declining enrollment in dual

credit coursework among the UTTUA high school population, this study will also examine available data on enrollment with the intent of identifying variables which may be impacting dual credit participation.

The UTTUA was opened in 2012, initially accepting students in 3rd–6th grade (The University of Texas at Tyler, 2011). Over the next seven years, additional grade levels were added until the original 6th grade cohort graduated in 2019. From fall semester of 2018 forward, the UTTUA served students from kindergarten through 12th grade (see Table 1).

Table 1

UTTUA Grade Band Expansion by Year

Program Year	Academic Year	Grade Band
1	2012-13	3 rd - 6 th grade
2	2013-14	2 nd - 7 th grade
3	2014-15	1 st - 8 th grade
4	2015-16	1 st - 9 th grade
5	2016-17	1 st - 10 th grade
6	2017-18	1 st - 11 th grade
7	2018-19	K - 12 th grade

Note. The district has offered K - 12th grades since 2018-19.

High school students have been expected to take college entrance assessments beginning in the fall of the freshman year (grade nine) with their first dual credit coursework to begin in the spring semester of the same year in a fine arts course. Students who do not initially pass college entrance assessments were given repeated opportunities to qualify for college admission. As sophomores, the UTTUA high school students begin their first core content coursework with dual credit U.S. History (HIST 1301) followed by HIST 1302 in the spring. Again, any students

who have not yet qualified for college admissions continue their attempts with the state designated assessments. In their 11th grade year, students are expected to be enrolled in dual credit courses in the core content areas including ENGL 1301/ENGL 2323, MATH 2312, POLS 2305, and ECON 1301. Dual credit offerings in science have not been offered each year. As seniors, students are expected to enroll in dual credit English coursework, but their participation varies in both mathematics and history for dual credit course selection (see Appendix A). The dual credit courses have been available via a variety of modalities, locations, and instructor designations. These courses have been provided to the UTTUA students free of cost. Textbooks have also been provided at no cost to the student.

A decline in overall dual credit enrollment from the original cohort of potential dual credit participating students through the current group of seniors (2019-2023) has been the premise for closer examination of the dual credit program. The mission of the UTTUA includes full dual credit participation for its high school students, but an initial review of enrollment at the UTTUA revealed that students enrolled in dual credit coursework in available courses for that subject and year has declined from a maximum of 91% in 2018 to 62% in 2023. Additionally, the cost of providing asynchronous, virtual courses for non-dual credit students in courses required for graduation has risen from approximately \$7,000 in 2012 to over \$25,000 for the 2023-24 academic year. The dual credit program has been dependent on course options provided by the University of Texas at Tyler. Dual credit enrollment is also impacted by the self-selection of the students into the UTTUA. That is, while it has been assumed that student elect to enroll at the UTTUA in order to take dual credit coursework, that may not be a valid assumption. While these dependencies have an obvious impact on the dual credit program, this study will focus on components of the program within the actionable domain specific to the UTTUA.

Intentional measures and controls would appear to be required for the implementation, assessment, and optimization of an effective program. The best practices for measures and procedures would be comprehensive in nature and established at the outset of the program's execution. As a formative evaluation exercise, the following questions have arisen:

- How is the dual credit program addressed in district needs assessments and planning?
- What metrics have been used to monitor the program's implementation?
- What necessary metrics may be absent?
- What can be learned from the existing metrics?

An audit of dual credit program measures and indicators will be conducted to ascertain what data collection, retention, and dissemination systems are in place. Further, the audit will examine available analytics for the existing data. The evaluation will compare existing monitoring and implementation strategies with recommended strategies for comparable programs. Finally, existing data will be analyzed with the intent of identifying variables which may be impacting program success. Statistical tests will be chosen based on the types of data available.

Research Design

The complex nature of this endeavor necessitates an approach which combines a formative evaluation based on program theory with a convergent design, mixed methods exercise. While a convergent designed mixed methods approach would appear to be a more simplistic and straight-forward attack, the initial review of program monitoring and implementation revealed a need for deeper exploration of possible deficits in those elements.

Formative evaluation, in this context, refers to the methodical use of processes for program assessment and analysis as a means of supplying continuing data to impact policy, resource allocation, and program operations decision-making and action (McClintock, 1984). The usual emphasis on assessing program outcomes tends to suppress discussion about the program processes and necessity of gathering evidence to assess implementation fidelity. Simply put, questions about program implementation are often obscured by questions focused on overall program efficacy and outcomes-based evidence (Finney et al., 2021). To reap the intended benefits, research-informed programming creation is insufficient. For participants to achieve the results of the intended or designed program, it must be implemented as intended or designed.

Dual credit research is built on weak program theory. Implementation fidelity is predicated on an explicit implementation plan. An implementation fidelity assessment can assess how a program as it was designed may diverge from how that program was delivered (Gerstner & Finney, 2013). Lack of information on the fidelity of implementation undermines any inferences one might make about outcomes. (Mathers et al., 2018). In a complex system with external collaborators, the implementation of the program may be diverted due to external constraints and changes beyond the control of the institution in question.

Mixed method designs have been increasingly used in implementation research to create a scientific foundation for comprehending and removing obstacles to effective implementation (Palinkas et al., 2011). The goal of mixed methods designs is to gather, examine, and incorporate both qualitative and quantitative data into one or more investigations. The fundamental idea behind these designs is that, when combined, quantitative and qualitative methods offer a deeper comprehension of research questions than do either approach alone (Creswell & Plano, 2011). In these designs, quantitative methods are used to test and validate hypotheses based on an existing

conceptual model and to obtain a broad understanding of predictors of successful implementation, while qualitative methods are used to explore and obtain depth of understanding as to the reasons for success or failure to implement evidence-based practice or to identify strategies for facilitating implementation (Tashakkori & Teddlie, 2003).

An effective variation of mixed method research is convergent design (Creswell & Plano Clark, 2018). To achieve triangulated results in this design, qualitative and quantitative methods are combined. In this method, quantitative and qualitative data are collected and then independently analyzed (Creswell & Plano Clark, 2018). When using a convergent design, combining the two types of data will enable a researcher to fully comprehend the information that may be obtained from the quantitative or qualitative results alone. This methodology combines two data sets to provide a comprehensive understanding of the problem under investigation (Dawadi et al., 2021). There is growing support for the use of a mixed method approach specific to the analysis in implementation research (Aarons et al., 2011). The use of this approach has matured enough to make distinctions in convergent mixed method design toward program implementation phases such as pre-implementation, implementation and maintenance or enhancement (Fixsen et al., 2009).

Assumptions, Delimitations, and Limitations

One of the assumptions of this study is that of student self-selection by enrolling in one of the UTTUA schools. The expectation for dual credit participation for all high school students is explicit in the school and district materials and is a key feature in student application briefings. From this, it can be assumed that all students enrolled at the UTTUA are aware of the dual credit participation expectation and self-select into this system.

Delimitations in this study include the selection of enrollment data collection and analysis that focus on the core dual credit coursework. For this study, the quantitative component is limited to the collection and analysis of 11th and 12th grade English enrollment data at the UTTUA. Both dual credit and non-dual credit participants were included as were students who dropped out or left the school. English III and English IV were selected as they represent the most common pathway for dual credit students at the UTTUA. By the 11th grade, most students have succeeded in scoring high enough on the Texas Success Initiative Assessment (TSIA) or Texas Success Initiative 2.0 (TSIA2) to qualify for college admission and dual credit participation. Restricting the data collection and analysis to this group of students virtually eliminates the effect of TSIA/TSIA2 achievement as a factor. Also, in the 11th grade, students begin to diverge in their dual credit math pathways with some enrolling in statistics and others taking calculus. This divergence would present an undesirable complication of analysis. By limiting the data pool to English III and English IV (dual credit and non-dual credit), the study can capture data on the greatest number of UTTUA high school juniors and seniors within a common pathway.

The limitations in the original iteration of this study provoked the necessity of the second layer of this study. Specifically, the limitation of inadequate data resources and the limitation of an undefined implementation plan for the UTTUA dual credit program gave rise to the examination of the program through an implementation evaluation lens. The limitations imposed by a lack of robust data systems constrain the range of statistical analyses that can be performed on the existing data. While dual credit and non-dual credit enrollment data linked to course modality, instructor qualifications, and course location was available, the data for student performance on the assessment for college admissions, namely data on TSIA and TSIA2

performance, was incomplete and in an unusable format. The availability of student readiness data in the context of this study would have, theoretically, been an important component in gaining a deeper and more accurate understanding of the dynamics at work in the system. Individual student failure data in dual credit courses were not available for this study. This data deficit results in a less than complete analysis to reveal factors that may impact student persistence in the dual credit program. An additional limitation for this study was the low response rate to the survey deployed as the qualitative component in the mixed methods design. The low response rate was compounded by the limited distribution of the survey.

Limitations related to the implementation component of this study are minimal. It should be noted, however, that the results and subsequent recommendations of this study may not be as transferable to other dual credit programs due to the unique nature of both the UTTUA and UT Tyler dual credit program, specifically the expectation that all UTTUA high school students participate in dual credit. Though these expectations are unique among Texas K–12 public schools, the insights gained from this study bear consideration by other public high school dual credit programs that they might adapt them to their specific needs.

Summary

This study sought to understand what factors might be impacting a dual credit program at a public, STEM charter district, as well as provide a formative evaluation of the program's implementation monitoring and evaluation activities. As most previous research on dual credit has focused on postsecondary outcomes, there is a knowledge gap as to outcomes and causes on the secondary side of the equation. Additionally, this study aimed to audit the data collection and analyses efforts of the district's dual credit program toward optimal implementation. While this district is unique in that all high school students are expected to participate in dual credit, the

results may serve to guide other public secondary schools in program implementation, monitoring, and evaluation.

The study will be detailed in four chapters. Chapter II provides a comprehensive review of the literature covering dual credit to strengthen STEM pathways and literature covering general dual credit research. In Chapter II, an important focus is the gap in the literature related to research related to outcomes within the secondary components of dual credit partnerships, as well as the gap in the literature which would guide secondary dual credit program implementation, data collection, and analyses for improvement of the program. In Chapter III, the research design and specific details of how the study was conducted are discussed. The research results are provided in Chapter IV, followed by a discussion of the findings as well as recommendations for future research in Chapter V.

REVIEW OF THE LITERATURE

The need for a robust science, technology, engineering, and mathematics (STEM) workforce has been well documented for decades. The use of dual credit programs to help strengthen the transition from secondary to postsecondary coursework has grown and continues to do so. Both STEM education mandates and dual credit education initiatives are well represented in federal and state policy. While many studies and policy recommendations have touted the benefits of STEM education and dual credit participation, much of the data used in many of the studies of dual credit have involved aggregated data focused on student activities in postsecondary endeavors. Dual credit studies have primarily focused on the impact and cost to institutions of higher education and potential benefits for students. The divide between the objectives, reporting and accrediting of public school systems and their partnering colleges or universities has been identified. Less attention has been paid to student decision-making around dual credit entrance and persistence at the secondary level. Additionally, there is a dearth of analysis of and recommendations for K-12 systems in their dual credit programming.

STEM Pathways

That the progress and prosperity of the United States is dependent upon a knowledge-based economy requiring a dynamic, motivated, and well-educated workforce with superior STEM skills is a viewpoint held by many, and as such, has received a good deal of attention over the last several decades. The National Academy of Sciences, National Academy of Engineering, & Institute of Medicine (2007) undertook a study of America's competitiveness in the rapidly evolving global marketplace at the prompting of the U.S. House of Representatives. This study

resulted in the report *Rising Above the Gathering Storm: Energizing and employing America for a brighter economic future* (RAGS) and concluded that America's ability to compete in the global economy would be dependent on the creation of jobs in STEM fields. The study identified the state of P-12 and postsecondary education systems as one of the primary obstacles to continued innovation and achievement in the United States. In *Rising Above the Gathering Storm Revisited: Approaching Category 5* (RAGSR), the National Academies asserted that not only had the problems identified not been resolved, but in many cases, they were continuing to decline (National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2010). Jobs in STEM fields are projected to rise at more than double the overall rate of employment within the next ten years by 8.0 percent by 2029, according to U.S. Bureau of Labor Statistics 2019–29 employment forecasts, while all occupations are expected to grow by 3.7 percent (Zilberman & Ice, 2021). Occupations in STEM-related fields, in general, are expected to increase at a rate nearly five times that of non-STEM occupations between 2022 and 2023 (Bureau of Labor Statistics, 2023). Despite a slight improvement over the last 20 years, America's high school and college graduates basic STEM skills remain well behind those of many other first world countries, according to national metrics as reported in the *Science and Engineering Indicators* of 2018 (National Science Board, 2018).

In the 2022 *State of U.S. Science and Engineering* report by the National Science Foundation, it is also noted that in the United States, the STEM labor force represents 23% of the total U.S. labor force. They also noted that while some STEM workers go directly from high school into the STEM workforce, the United States is dependent on STEM workers with postsecondary degrees. Further, they noted the increased cost for students attending postsecondary institutions (National Science Foundation, 2022).

Dual Credit as a STEM Pathway

While many studies considered STEM pathways in general or the benefits of college credit acquisition opportunities in the secondary grades, including dual credit, few studies examined the efficacy of dual credit programs specific to STEM pathways. One policy report that explicitly called out the need for linkage between STEM pathways and dual credit or dual enrollment programming was *STEM Dual Enrollment: Model Policy Components* (Zinth, 2018). In the aforementioned report, the author defines STEM dual Enrollment as traditional academic coursework within STEM career and technical education coursework or integrated coursework within the commonly accepted STEM disciplines.

One study that focused on dual credit programs with information technology components noted the general nature of most dual credit programs and the lack of linkage to STEM pathways but is undertaking a project aiming to research that specific dynamic and results within that framework (Chamberlain & Said, 2022). To support creative education partnerships between local school districts and public community or technical colleges for the development of new career and technical education early college high school opportunities, the Texas Education Agency (TEA), in collaboration with the Texas Higher Education Coordinating Board (THECB), and Texas Workforce Commission (TWC) offered funding for early college high school's STEM related career and technology pathways. As part of the program, the students could earn at least 60 credit hours toward an associate of applied science degree (Texas Education Agency, 2014).

From its Skills Development Fund grants, the Texas Workforce Commission (2019) also provided funding to colleges to support the expansion of career and technical dual-credit programs. These grants supported specific joint-credit courses that school districts offered in collaboration with public junior colleges, public state colleges, or public technical institutions.

While these are examples of career and technology specific initiatives in the realm of dual credit, the hope that dual credit programs can help alleviate the general STEM proficient needs of the state and the nation is implied.

The Dual Credit Landscape

Over the past ten years, dual enrollment programs have demonstrated notable growth. Dual credit students fulfill the requirements for high school graduation while obtaining college credit and academic competencies that will be useful after high school graduation (Horn et al., 2018). Approximately one-third of high school students in the United States reported enrollment in dual credit coursework. These programs, which are sometimes known as dual enrollment, concurrent enrollment, or dual credit, aim to increase college enrollment and degree completion, particularly for student populations who are not as highly represented in higher education. There are various advantages to earning high school and college credit concurrently in order to fulfill graduation requirements (Regan, 2017). Dual enrollment programs facilitate the acquisition of college credits and the achievement of a degree through three potential pathways. First, providing high school students the opportunity to take college-level courses helps them to prepare for the social and academic demands of higher education while offering them access to the extra supports that high school students do not often have. Second, there is a greater chance of college degree attainment for students who earn college credits while still in high school. Lastly, many dual enrollment programs provide free or heavily discounted tuition, which lowers the total cost of attending college and allows for more students from lower socioeconomic backgrounds the ability to enroll and finish their postsecondary coursework (Institute of

Education Sciences, 2017). It has been demonstrated that taking dual enrollment courses helps students prepare for and complete college programming (Grubb et al., 2017).

Dual Credit Implications for Students

A variety of student outcomes have been researched with regard to dual enrollment participation. These include enrollment, persistence, grade point average (GPA), performance in courses, performance according to demographic and socioeconomic characteristics, and economic variables such as cost savings and future earnings. Strong evidence is presented by a number of research projects supporting the significant correlation of dual credit participation and enrollment in an institution of higher education upon high school graduation. Within a five-year follow-up period, 88% of dual enrollment participants from 2010 continued their education in college following high school, according to one study (Fink et al., 2017). Dual credit participants have also been shown to have a higher graduation rate at four years, as well as a higher graduation rate at six years. Student enrolled in dual credit were also shown to maintain a higher grade point average as well and took less time to graduate from post-secondary institutions. While it has been suggested that some of these results may be due to sample self-selection, research has shown that these benefits transcend that dynamic (Giani et al., 2014). One study (Hemelt et al., 2019) indicated that participation in dual credit coursework had a significant effect on middle achieving students, prompting them to move toward more advanced coursework. Additionally, these students were more likely to enroll in four-year institutions rather than community college.

Compared to their classmates, dual enrollment students seem to maintain similar achievement levels after enrolling in college. For example, researchers found that students who

had participated in dual credit had higher persistence rates (Alsup & Depenhart, 2020). Additionally, a Texas study concluded that dual credit students not only experienced positive postsecondary outcomes, but that the effect size increased for each dual credit course taken (Giani et al., 2014). In the same study, the researchers found that the effect from dual credit participation was greater for those students than for those who participated in other advanced coursework.

Students who participate in dual enrollment are more likely to apply to and attend college upon graduating from high school (Johnson et al., 2021), and dual enrollment participation is generally linked to greater rates of college enrollment and graduation (Delcours & Carmona, 2019). As more and more students choose to enroll at the college with which they participated in dual credit coursework, colleges are becoming more accommodative to dual enrollment students and view these programs as important recruiting tools (Jagesic et al., 2022).

The necessity for additional research into the components of dual enrollment programs that influence students' academic performance has been stressed in recent research (Alsup & Depenhart, 2020; Johnson et al., 2021; Schaller et al., 2023).

Dual Credit in Federal Policy and National Trends

Dual credit participation has continued to increase across the United States, and as such, has been codified in most states with 219 bills proposed seeking to increase student access to dual credit or dual enrollment offerings (Field, 2021). While research continues as dual credit programming evolves, it is clear that dual credit and dual enrollment will be a presence for the foreseeable future. Dual credit and dual enrollment policies have been formalized in 48 U.S. states. Over half of these states require secondary or post-secondary institutions to communicate

state policy regarding dual credit or dual enrollment offerings to students and parents. Student eligibility criteria is formalized by state policy in 41 states, and dual credit or dual enrollment instructor qualifications are dictated by state policy in 42 states (Wilkins, 2022).

One of the four pillars of the U.S. Department of Education's Pathways Initiative is dual enrollment, which is also the subject of a \$200 million grant to Career-Connected High Schools as part of the President's 2023 Budget. Recently, the U.S. Department of Education convened a group of experts to deliberate on the most recent research, best practices, and expansion initiatives related to dual enrollment (Rhine, 2022).

Dual Credit in State Policy

Texas has passed laws since 1995 that facilitate student participation in dual-credit courses and Institutes of Higher Education's (IHEs) ability to provide dual-credit education programs. This legislation mandated that high schools provide students with the option to enroll in at least 12 hours of advanced coursework, which may include dual-credit courses, in addition to providing clear financial streams for the delivery of such courses. The Texas legislature took an additional step in 2015 toward expanding access to dual credit by passing HB 505, a bill that forbids the THECB from restricting dual-credit participation to high school juniors and seniors and from limiting the number of dual-credit courses a student may take while enrolled in high school (Miller et al., 2017). The issue of dual credit was further defined in 2017 via House Bill 1638 by requiring that a memorandum of understanding (MOU) outlining the parameters of the cooperation between public school districts and institutions of higher education (IHE) must be established for all dual credit programs. More recently, Texas legislation involving dual credit were included in HB 3650 and SB 25 of the 86th legislative session (Act of June 10; Act of June

14, 2019) and in HB 8 and SB 1887 of the 88th legislative session (Act of May 23; Act of June 14, 2023).

The THECB introduced the 60x30TX plan in 2015 to ensure that Texas will have a workforce that is competitive worldwide by 2030 (Texas Higher Education Board, 2015). Dual credit programs are an integral part of the 60x30TX plan (Miller et al., 2017). The THECB also created the FAST program as a result of HB 8 passed during 88th legislative session, which offers financing to public higher education institutions who elect to participate (Texas Higher Education Board, 2023). Under the program, dual credit courses are made available to students from educationally disadvantaged backgrounds at no cost to them by participating public institutions.

In order to support Texas's economic growth, the Tri-Agency Workforce Initiative was created in March 2016 linking the TEA, the THECB, and the TWC with a mission of connecting the education and workforce agencies and communities (Office of the Governor, 2016). As part of the initiative, Priority 1: Strategy 1, explicitly calls out dual credit as a primary pathway for accomplishing its goals (Tri-Agency Workforce Initiative, 2022).

Texas provides substantial public-facing statistics on the postsecondary outcomes of former dual enrollment students. Users can compare postsecondary persistence and completion rates by the institution where students received dual credit and by the institution where former dual enrollment students matriculated after high school using the state's dual enrollment outcomes data. Additionally, it enables analysis based on the quantity of dual credits obtained in high school and the student's matriculation status at the same or a different 2- or 4-year college (Texas Higher Education Coordinating Board, 2022).

Dual Credit Implications for K-12 Public Education Systems

Much has been written about the pros and cons of dual credit for colleges and universities and a great deal of attention has been paid to the benefits of dual credit for students. Federal and state dual credit policies are plentiful. Accrediting agencies also give their fair share of attention to requirements for dual credit. What has not been well addressed regarding dual credit is consideration of the impact on and the cost to public secondary schools and school districts. A search was conducted for research on the pressures that dual credit programs cause for local education agencies. Search parameters included staffing and advising implications, reporting requirements, vertical alignment considerations, and actual costs. While some slight attention has been paid to staffing qualifications and pressures on high school dual credit teachers, there is an overall dearth of research around the implications of dual credit implementation for K-12 systems.

Dual Credit Implications for Institutes of Higher Education

While some institutes of higher education appear to take on dual credit partnerships from a compliance standpoint, some studies indicate that the IHEs may be missing potential benefits from partnering in a robust dual credit program. Colleges and departments within a university generally have enough autonomy to make departmental or college choices about their participation in programing. In *Dual enrollment from two points of view: Higher education and K-12* (2017), Wagner and Kilgore surveyed higher education stakeholders and discovered that while college or university faculty agreed that dual credit participation improves post-secondary affordability and access for participants, they also considered questions about student preparedness and a stated lack of higher education staffing as obstacles to program

implementation. In the same study, higher education stakeholders also expressed a concern about dual credit programming costs for the IHE and potential impact on their culture (Kilgore & Wagner, 2017).

Some higher education stakeholders have also expressed concern about accreditation issues. With that in mind, some researchers suggest that regional accrediting body assessments should inform the framework for evaluating dual credit programming. Criterion within those considerations might include assessments of quality, productivity, and viability of dual credit collaborations (Kinnick, 2012). Fairly simple assessment measures to evaluate program viability and sustainability indicated positive impact in public perception, student recruitment and retention, and student achievement though the authors noted that internal and external tensions may discourage some institutes of higher education from securing systemic support for program evaluation (Kinnick, 2012; Mace, 2009).

There is evidence that dual credit or dual enrollment programs have a positive impact for institutes of higher education in recruitment of high-achieving students, enhancement of the classroom environment and community image (Kinnick, 2012). Additionally, higher education faculty reported that most dual credit or dual enrollment students are more capable than typical first year students. Increased community engagement is considered a significant factor as well as enhanced community perception (Mokher & McLendon, 2009).

In higher education settings, retention is becoming a more important consideration for student success. As a result, dual enrollment is being integrated with other strategies and initiatives that encourage perseverance among students (Hunter & Wilson, 2019). Leadership in higher education have mostly backed the quick development of dual enrollment programs, as

seen by requests to establish a national office to oversee early college policies and initiatives (College in High School Alliance, 2021)

Past studies and position papers suggest that regional accrediting bodies assessment programs should inform the framework for assessing dual enrollment (Kinnick, 2012). Quality, productivity and viability are examples of criterion that were considered. In 2013, The Higher Learning Commission published a study of dual credit practices and a comparison of state policies regarding dual credit and accreditation. In this study, they note the rapid evolution of dual credit policies and practices. At the time of the study, the authors note concern about the disparity between state policies or standards and regional accreditation standards. The authors also noted concern about the increasing demands placed on postsecondary institutions and accrediting organizations, which extend beyond the traditional focus on postsecondary academic program integrity issues (Higher Learning Commission, 2013). In 2020, the Higher Learning Commission published updated guidelines in their document, *Dual Credit for Institutions and Peer Reviewers*. These guidelines add a level of explicitness about dual credit to the Higher Learning Commission's criteria for accreditation. The guidelines cover topics that are addressed by the criteria, such as learning objectives, resources, and the qualifications of the teachers as well as academic rigor (Higher Learning Commission, 2020). Further, the guidelines list five requirements that institutions of higher education must fulfill in order to guarantee the dual credit's academic integrity. The guidelines also offer a framework for evaluating dual credit activities consistently among institutions (Higher Learning Commission, 2020).

Dual Credit Systems Data and Analyses

Due to the need to balance secondary and postsecondary systems, dual enrollment programs must gather data on students' high school and college progress, necessitating the participation of researchers from both the school district and the institution of higher education. In *STEM Dual Enrollment: Model Policy Components*, published by the Education Commission of the States, the top recommendation is improved evaluation and alignment of high school and postsecondary schools (Zinth, 2018). Programs should benefit from looking at institutional and program results as well, even if student performance is one of the most critical and significant outcomes to assess (Purnell, 2014). While numerous studies or reports exist that offer state level recommendations for data, analysis, and policy, there is a notable lack of published research or recommendations for best practice at the student level, program level, as well as partnering institution level beyond enrollment and graduation metrics.

Dual Credit Student Recruitment and Retention

A review of the literature was conducted for studies that investigated patterns in high school students' long-term participation in dual credit or dual enrollment prior to high school graduation. Research on dual credit persistence before high school graduation is conspicuously lacking, despite the persistence of dual credit or dual enrollment students receiving a lot of attention in relation to post-secondary results. Furthermore, there is a lack of research on the potential impact of dual credit options on students' high school enrollment decisions. It is unclear whether variations in dual credit programs have an impact on students' decisions to transfer to another high school, should they have the option, because there has not been much research done in this area. Furthermore, since there has been little research on this topic, factors that could affect students' participation in dual credit courses throughout their high school

careers are yet unknown. A nationwide analysis of the incentives offered to students enrolled in dual credit courses shows that, although very few states have regulations supporting dual credit participation, the incentives that do exist are primarily restricted to paying for books or tuition for underprivileged students. (Wilkins, 2022). Texas mandates that dual credit courses be offered to students in all secondary schools (Texas Administrative Code, 2023).

Student Readiness for Dual Credit Coursework

Efforts have been made to systematize tools that would assess high school students' readiness to engage in postsecondary coursework. While the need for more comprehensive and equitable assessments of college and career readiness have been highlighted (Darling-Hammond et al., 2014), the onus of this decision is generally left to the state. The Texas Success Initiative Assessment was introduced by the THECB in 2013. This examination was created to evaluate the academic skills of undergraduate students entering college (Cui & Bay, 2016). The correlation between Texas Success Initiative Assessment (TSIA) results and performance in related courses was computed to ascertain the connection between TSIA placement test scores and achievement in college courses (Texas Higher Education Coordinating Board, 2017). A statistically significant, positive correlation was found between both the math and writing scores and a grade of C or better in related post-secondary coursework. The differences between the TSIA and the Texas Success Initiative Assessment 2.0 (TSIA2) are generally considered to be minimal and include merging the English Language Arts sections and reducing the number of diagnostics tests. A review of the websites of the College Board, the Texas Higher Education Board, and other affiliated entities involved with the deployment of the TSIA2, yielded no published research or reports more recent than 2020.

In order to enroll in dual credit courses in Texas, students must meet a minimum standard as determined by the College Board on the TSIA2 in English Language Arts and Reading as well as the TSIA2 in mathematics (College Board, 2021). The TSIA2 writing and reading assessment is reportedly aligned with the Texas Essential Knowledge and Skills (TEKS) for English III, as well as the College and Career Readiness Standards as published by the THECB (2018), and the Texas Adult Literacy & Content Standards 2.0 as published by the TWC (2018). While assumptions may be made about the alignment of the TSIA (or TSIA2) and the State of Texas Assessments of Academic Readiness (STAAR) or End of Course (EOC) English assessments based on the alignment report by the College Board to the Texas Higher Education Board (The College Board, 2021), an early study on the alignment of the two measures was conducted by the Texas Education Research Center at the University of Texas in Austin indicating some misalignment (Texas Education Research Center, 2014). In this study, the format used to evaluate writing abilities on the TSI assessment was found to be significantly different from that used on the English III STAAR. Some editing abilities were evaluated on STAAR but not on the TSI test. Additionally, there is a misalignment between TSI and STAAR on the essay section of the tests in that analytical writing is evaluated on STAAR while persuasive writing is evaluated on TSI. A search for more current, peer reviewed research on the alignment between the STAAR EOC in English III and the TSIA2 for Reading and Writing yielded no results. Up to date information regarding the alignment of these two diagnostic tools would potentially aid in understanding the state of college readiness for Texas students.

Dual Credit Participation Culture

According to a few small studies, students who prefer a regular high school experience may be less likely to enroll in advanced coursework rather than the variety of extracurricular

activities that conventional high schools offer (Mansell & Justice, 2014). Additionally, studies have shown that suburban and small-town populations differ in terms of STEM course availability, academic preparation, and student goals (Saw & Agger, 2021). The NCES classifications were employed by the previously described study to classify geographic locations. A report by the National Center for Education Evaluation and Regional Assistance at the Institute of Education Sciences described that rural students' rates of dual enrollment access were comparable to those of city students, but lower than those of town and suburban students (Gagnon et al., 2021). However, the researchers also discovered that compared to students in suburbs and cities, dual enrollment participation rates were generally greater for students attending rural or town schools as designated by the NCES. The potential reasons for this anomaly have not yet been investigated, however, additional research may yield some insight into dual credit participation patterns. While comparisons have been made between systems where students are required to participate in post-secondary credit bearing coursework, such as in Early College High Schools (ECHS), and those where dual credit is optional (traditional, comprehensive high schools), the actual impact of the requirement for full dual credit participation versus optional dual credit participation has not been examined in the research as a discrete variable. Additional research in this area would be particularly helpful for schools in which dual credit participation is expected but not required, and how those factors might influence enrollment and participation in the schools' dual credit programs.

Student Affective Considerations

Variations in students' aspirations to pursue STEM-related fields of study represent an additional illuminating measure of program impact or effectiveness. A recent study investigated the connection between interest in a STEM career and dual credit or dual enrollment, concluding

that dual credit is a successful method of encouraging interest in STEM subjects among all high school students, irrespective of their gender, race, socioeconomic status, or academic standing (Corin et al., 2020).

Researchers found that students in the UT System Dual Credit Study acquired broad skills that benefited them throughout their undergraduate studies (Troutman et al., 2018). The students listed their improved academic habits which they believed resulted from completing dual credit coursework, including time management, self-discipline, interacting with teachers, taking notes, studying well, practicing critical thinking, using research resources, and using academic language. A study of potential predictors of academic achievement in the context of cognitive and non-cognitive factors found that self-concept had a significant positive correlation with student achievement in dual credit coursework (Dyer et al., 2022). Numerous concepts, including self-efficacy and educational expectations, that dual enrollment programs aim to cultivate in students have been found to be predictive of dual enrollment student achievement in a few studies. However, while correlations between the effects have been demonstrated, causality has not been proven (Giani et al., 2023). It is worth noting that these studies may contain sample bias due to student self-selection into dual credit curriculum. In *The Role of Student Beliefs in Dual-Enrollment Courses* (Giani et al., 2023), the authors suggest a notable lack of empirical research demonstrating how and to what degree students' experiences in dual enrollment programs influence their self-perceptions. The extent to which high school students alter their goals to attend college, how they do so, and what elements may be involved, are not well understood. In a recent study seeking to assess how high school students' college enrollment aspirations may change over time, the authors found that individual "college-going" aspirations change but are concealed in the aggregate results of most research on this dynamic

(DesJardins et al., 2019). They further suggest that for researchers to fully understand how and why high school students' postsecondary aspirations change, longitudinal data and analyses of multiple facets of student college enrollment plans and preparation are necessary.

Dual Credit Course Instructors

In general, instructors of dual credit courses can be employed as university or college faculty, as well as certified high school teachers with an earned master's degree in the subject matter or with an earned master's degree plus an extra 18 credit hours of graduate-level coursework focused on the subject matter (19 Tex. Admin. Code §4.85, 2023). Some K–12 schools replace the course requirement by hiring licensed high school instructors who meet the additional dual credit requirements, even though many K–12 institutions have agreements with partner universities or colleges that feature a wide choice of dual credit options. Although this technically satisfies the requirements for the introduction of dual credit courses, there have been doubts and concerns raised over the caliber of education provided by these substitute professors. Concerns include probable conflicts of interest, grade inflation, and course rigor (Troutman et al., 2018). As dual enrollment programs continue to expand, it is imperative to guarantee that the courses taught by high school instructors are on par with those taught by college faculty. Although requirements for teacher qualifications have always been a component of efforts to regulate the quality of education, certain state officials and accrediting agencies have started to give these criteria more consideration (Horn et al., 2018; Zinth, 2018). The Higher Learning Commission (HLC) has more precise guidelines governing instructor qualifications, but the Southern Association of Colleges and Schools (SACS) has a more general policy regarding instructors qualified to teach dual credit courses (Southern Association of Colleges and Schools, 2019). Instructors are required by the HLC to possess a minimum of a master's degree and 18

graduate credit hours in the subject area of instruction. Texas regulations, as outlined in the Texas Administrative Code (19 Tex. Admin. Code §4.85 (2023)), reflect this expectation.

The lack of teachers in all K–12 systems is most noticeable in dual credit programs that need higher credentials. States have employed a variety of tactics to raise the proportion of high school instructors qualified to teach in dual enrollment programs (Zinth, 2018). To expedite the completion of graduate credentials, these efforts can fall into the following categories: (1) general program support; (2) financial aid for high school teachers to complete graduate credits; (3) teacher bonuses to encourage professional development; (4) increased awareness of graduate program options; and (5) using alternative course delivery models (Horn et al., 2018).

Dual Credit Course Modalities and Locations

Research shows that dual credit students, whether attending classes at a local high school or a university, perform better than other students in terms of their dedication to their studies and scholastic conscientiousness (Troutman, 2018). Nonetheless, depending on the modality, some research has revealed a substantial variation in the overall postsecondary persistence scores of dual-enrolled high school students; those who attended classes on a university campus outperform those who completed their dual credit courses on the high school campus (Alsup & Depenhart, 2020; Hu & Chan, 2021). It has been proposed that there may be some variation in student outcome by modality of delivery (An & Tayler, 2019). Additional research on how differences in the classroom environment affect dual-enrolled students' academic progress would aid in crafting dual credit courses for greater efficacy (Taylor & Yan, 2018). In addition to modality and location effects, there may be differences in outcome by course content area (Villarreal, 2017). To ascertain whether factors like classroom location and instructor type affect the final grades of dual enrollment students, more research must be done (Burns et al., 2000).

Dual Credit Course Alignment, Consistency and Rigor

It is challenging to locate a widely acknowledged definition of academic course rigor in the field of education. Though there have been many different conceptualizations of course rigor observed, both experimentally and anecdotally, the field has yet to adequately operationalize the concept and perform research using the operationalize parameters. (Wyse et al., 2018).

According to a recent article, a course's rigor can be defined by five factors: challenge, critical thinking, mastery of challenging material, time and labor intensity, and production of credible work (Johnson et al., 2018). While a valid attempt at defining the concept, these factors can also be seen as somewhat subjective. Within the context of dual credit coursework, scholars have considered possible variations in rigor or perceived rigor, as well as ways that pressures on or limitations of K–12 systems might affect the rigor of this coursework, especially in classes taught by high school teachers (Duncheon & Relles, 2020).

Misalignment of dual credit courses can occur at multiple levels. The components that are most frequently considered when addressing alignment concerns are course objectives, teaching and learning activities, and assessments. Horizontal alignment (between different instructors of the same course) as well as vertical alignment between the prerequisite courses, the dual credit course, and subsequent upper-level courses are areas to be considered, along with other areas for potential disconnect. The misalignment between high school and college content standards has been found to be a source of struggle for dual credit instructors (Duncheon & Relles, 2020). The alignment between these pieces can be determined using a number of different techniques (Polikoff & Porter, 2014). The Surveys of Enacted Curriculum (Porter & Smithson, 2001) are protocols that seeks to analyze and align curriculum based on topic coverage and cognitive demand level. Constructive alignment is an additional technique for evaluating these elements'

alignment (Biggs, 1996). There is some evidence that high school teachers have difficulty differentiating various levels of cognitive demand and frequently rate curriculum elements (activities or assessment items) at a higher level of cognitive demand than their university level counterparts (Atchison et al., 2022; Herman et al., 2004).

Practically speaking, developing new infrastructure capable of supporting dual credit aims within distinct systems is advisable. In *"We're Caught in Between Two Systems": Exploring the Complexity of Dual Credit Implementation* (Duncheon & Relles, 2020), the authors detail the necessity of systematic communication to dual credit teachers in both systems of pedagogical, curricular, and grading requirements that are not just aligned but also well defined. Further, the researchers suggest efforts to combine professional development opportunities such that K–12 and higher education agents experience frequent engagement. Lastly, the authors posit that stakeholders on both sides of these relationships should determine accountability standards and methods as well as creating suitable mechanisms for each system to exchange data and track institutional compliance.

Research indicates that it would be ideal to implement exams that are used by both the high school and university teachers to guarantee uniformity in dual credit courses. To provide independent measurements for course rigor and student accomplishment, additional external tests, such as the College-Level Examination Program (CLEP) exam or the Advanced Placement (AP) exam, should be administered.

Dual Credit Faculty and Staffing

High school instructors' reputation and their capacity to instruct college-level courses have come under scrutiny due to concerns about the rigor and consistency of college courses given to high school students (Zinth, 2015). Cynics and doubters who point out the contradiction

of the curricula and teaching requirements have taken notice of the popularity of dual enrollment and the appeal of these programs. Furthermore, according to the literature, the steady expansion of dual enrollment course offerings has sparked concerns about the quality of instruction and the credentials of the instructors, with particular focus on high school teachers who hold credentials from a community or technical college (Horn et al., 2018). While many universities and colleges accept dual enrollment coursework for transfer credit, some institutions still have reservations about the caliber of course instruction and the degree to which the dual enrollment courses are rigorous when they are taught by qualified high school teachers (Martinez, 2018).

According to Taylor et al. (2018), some researchers questioned the academic preparation of the students participating in dual credit courses offered in diverse classroom settings as well as the quality of instructor, rigor, and coursework. Other researchers who reported that dual credit programs given in many places raised concerns about unfair practices, such as biased self-evaluations and grade inflation, echoed this opinion (Burns et al., 2019). Additional research has demonstrated that students' academic success varies depending on the setting of the classroom, the location of the course, and how teaching is delivered (Arnold et al., 2017).

Conclusion

It has been well-established that a strong workforce in STEM is necessary for continued growth and prosperity in a changing world. Dual credit programs are increasingly being used to support students as they move from secondary to postsecondary education. Federal and state policies prominently feature dual credit education programs as well as demands for STEM education. Almost exclusively, the data used in many dual credit studies has featured aggregated data focusing on student involvement in postsecondary efforts. The effects and expenses of dual

credit on higher education institutions as well as the possible advantages for students have been the main subjects of study. The disparity in the goals, reporting, and accreditation between public education systems and the institutions or universities with whom they partner has been noted in the literature but not deeply examined. Student decision-making regarding dual credit admission and perseverance at the secondary level has received less attention. Furthermore, there is a paucity of advice and study regarding dual credit programming data collection and evaluation for K–12 public school systems.

METHODS

The University of Texas at Tyler University Academies (UTTUA) launched a dual credit program to help students prepare for success in STEM fields in postsecondary education. This study aims to determine the main challenges facing the program's successful implementation. An evaluation of program implementation was conducted investigating the program's data collections and systems analysis, monitoring strategies, resource deficits, and progress toward intended outcomes. This chapter provides a brief background on the STEM dual credit landscape and the specific program needs for implementation evaluation as well as narrative detailing the theory of change and related logic model. The methods for quantitative and qualitative components are detailed including setting, participants, data collection, and analyses.

Background

In *Rising Above the Gathering Storm*, (National Academies of Sciences, Engineering, and Medicine, 2007) it was noted that the United States has a growing shortage of STEM-trained students and workers. Despite multiple regional, state, and federal initiatives, in its follow-up report, *Rising Above the Gathering Storm: Revisited*, it was found that the pool of secondary students who are prepared to pursue STEM fields of study or STEM careers after high school continues to grow too slowly (National Academies of Sciences, Engineering, and Medicine, 2010). The literature demonstrates that there is a misalignment between the growth of the ideal STEM pathway and the transition from secondary to post-secondary education. In order to address issues with postsecondary education, such as declining college enrollment, rising tuition costs, the need for a more diverse student body, and undergraduate students enrolled for five or more years to earn a college degree, higher education officials and K–12 policy makers have

proposed various solutions (Karp et al., 2007; Smith, 2007; Texas Education Agency, 2019). Implementing opportunities for students to earn dual credit or dual enrollment is one technique aimed at resolving this STEM pipeline leak. Dual credit, which is also known as dual enrollment or concurrent enrollment (Karp et al., 2007), is one strategy that has been investigated to deal with problems such as timely degree completion and rising tuition expenses. High school students can enroll in both a college course and a high school course while receiving credit for both (Karp et al., 2007) thanks to concurrent/dual enrollment/credit programs. According to Karp et al. (2007), entering higher education with credits can shorten the time it takes to earn a degree, which could also lower the overall cost of tuition (Texas Higher Education Review Board, 2018).

The goal of this study is to identify possible obstructions in the UTTUA dual credit program that may have interfered with students' ability to transition smoothly from secondary to post-secondary education by graduating STEM core complete. It also aims to provide recommendations for the dual credit program that may help other similar initiatives such as data strategies and implementation processes.

Problem of Practice Evaluated

Since the first year in which the UTTUA began graduating students (academic year 2018–2019), dual credit enrollment and persistence has declined.

Research Questions

In order to prepare students for success in STEM fields in postsecondary education, the UTTUA instituted a dual credit program. The aim of this study is to identify the program's

primary obstacles to successful implementation. This study also examines the existing strategies and measures in place to address a complicated system with a limited locus of control. The following research questions were considered for this study:

1. How is the UTTUA dual credit program's implementation and progress being monitored and evaluated, and how do these activities align with effective program monitoring and evaluation?
2. What variables may be affecting dual credit participation at the UTTUA, and to what degree?

Evaluation

Program

The UTTUA is an open enrollment, public K–12 charter school district in East Texas with the stated objective of preparing students for STEM post-secondary careers or college majors (The University of Texas at Tyler, 2011) through dual credit coursework.

Logic Model

A holistic evaluation of a program is predicated on adequate measures in place over a period that capture relevant, meaningful data to consider. In order to assess program reach and activity efficacy, measurable objectives should be clearly defined, encompassing both coarse and fine-grain data. Coarse-grained data lead to an overall assessment of progress, while fine-grained data help to reveal specific areas in need of adjustment or improvement. Additionally, both short and long-term objectives and measures allow for a more valid assessment of programmatic features. Protocols to perform systematic data collection regarding stakeholder and participant perceptions and effects allow mid-stream analysis for formative purposes as well as summative assessment over time. Programs, especially systemic programs with multiple partners, are rarely static. Over time, changes may occur by design or unintentionally. This study examined the data

and analysis systems in place at the UTTUA and the variables that may have impacted the dual credit program at the UTTUA. This study also aims to identify any data deficits that may hamper full program evaluation.

To execute, evaluate, and fine-tune an effective program, intentional measures and controls are needed. A comprehensive, focused data strategy enables a school district or university to consider factors other than the immediate needs and goals of data gathering and utilization. A data strategy enables an organization to consider how data from various collections might be utilized to address specific queries, dispose of inconsistencies, make processes clear, and align goals across the organization. A well-defined, site-specific data strategy also enables a school to prepare for the future by considering how both past and present data will contribute to the knowledge required to establish and work toward relevant goals. A best practice is to match the data strategy with the school's broad strategic objectives and more specifically, toward its Comprehensive Needs Assessments and Improvement Plans (National Forum on Education Statistics, 2021). Despite numerous publications on educational data mining, it remains challenging for educators to successfully apply these methods to their unique academic issues (Alyahyan & Düşteğör, 2020).

A theory of action is a framework that identifies the important components of the project or program and explains the theoretical and practical connections between the important program components and related outcomes (U.S. Department of Education, 2015). A logic model consists of outcomes and outputs resulting from activities that are driven or made possible by program inputs. The use of logic models in an evaluative context is detailed in Joy Frechtling's book, *Logic Modeling Methods in Program Evaluation* (Frechtling, 2007). Frechtling noted that logic models created to support evaluation can be used to determine evaluation questions, improve

communication amongst stakeholders, and clarify intended outcomes of the project. The author further posited that in program theory, "theory-driven" does not always imply that the chosen strategy is based on research. Frechtling asserted that it is quite feasible to have program theories that are founded on practitioner experience rather than driven purely by research. This approach is well-aligned with a logic model developed in collaboration with a Networked Improvement Community (NIC). A NIC is a professional learning community where members concentrate on a program or issue and work together to identify plans and solutions, measure the results of those plans and solutions, and modify strategies in response to analytic results (Russell et al., 2017). Due to the evaluative nature of this study, the logic model developed encompasses data and analyses inputs and activities rather than the somewhat more conventional approach of direct programmatic intervention. This approach was implemented to reveal missing metrics to improve program management.

The following logic model is presented from the perspective of the UTTUA with input from the NIC (Network Improvement Committee) to clarify the dual credit program objectives, identify necessary metrics for program monitoring and evaluation, and investigate potential factors impacting the program (see Table 2).

Table 2*UTTUA Dual Credit Program Logic Model*

Determinant (Data resource)	Activity	Output	Outcome
Dual Credit & Non-dual Credit enrollment data	Analyze persistence data for trends and causes	Identify variables with statistically significant impact	Data-driven intervention development to improve dual credit persistence
District Level Planning Artifacts	Review artifacts for dual credit related data collection, analysis, interventions or goals	Identification of dual credit priorities, resources, activities and metrics	Improved program implementation
Dual credit stakeholder survey	Review responses for emergent themes	Identify benefits or concerns held by stakeholders	Improved dual credit programming

An evaluation was conducted to determine which factors within the UTTUA locus of control could be influenced to improve program outcomes and the necessary measures to guide those efforts. Ultimately, the program objectives focus on student outcomes including full dual credit participation and on-time graduation with students graduating STEM core complete, prepared to enter any post-secondary field of study. This over-arching objective is linked to other beneficial outcomes including an increase in college or university major options and a decrease in overall cost to attend an institution of higher education (IHE) for these STEM core complete students, as well as improved accountability ratings and mission fidelity for the secondary school and district. These comprehensive outcomes are dependent on numerous prior conditions. One prerequisite for student participation in a full array of dual credit offerings is student readiness for post-secondary coursework which is, itself, dependent on academic maturity, scholarly habits, and adequate knowledge and skills acquisition as defined by post-secondary qualifying

examinations such as the Texas Success Initiative Assessment 2.0 (TSIA2). The TSIA was first introduced by the Texas Higher Education Coordinating Board (THECB) in 2013. This examination was created to evaluate the academic skills of undergraduate students entering college (Cui & Bay, 2016). Student readiness for post-secondary coursework is further dependent on preceding coursework that is vertically aligned to college and career readiness frameworks of adequate rigor. Student participation in a full slate of dual credit coursework is also contingent on having access to adequate infrastructure including qualified instructors, funding, space, and time to participate in the post-secondary coursework. This dependency yields further subordinate pre-conditions such as programs to support qualifications for high school instructors or access to university faculty. While the previous description of dependencies does not encompass all the finer details of the system, the dual credit landscape, particularly at the UTTUA, presents wicked problems. Rittel and Webber (1973) coined the term "wicked problem" to describe multi-stakeholder planning problems that are dynamic, extremely complicated, interact with other problems, and entail stakeholder conflict. The majority of decision-makers find it discouraging that there are no clear-cut, objectively superior solutions to wicked situations. Interagency projects may be more prone to wicked problems given the differing structures, objectives, regulations, and reporting requirements of the participating entities (Sydelko et al., 2021). Complexity theory is predicated on the idea that organizations are complex systems that take time to adapt to reform demands (Kershner & McQuillan, 2016). Progression or improvement is slow as agents engage with and react to fresh policy data (Cowan et al., 1994). The variable and, sometimes, contradictory objectives, structures, funding, and regulations of the stakeholders represented in the dual credit programming at the UTTUA present a wicked problem.

Design and Evaluation

In 2018, the University of Texas System undertook an extensive study of dual credit programming at UT system institutions in Texas (Troutman et al., 2018). Six suggestions were made for UT System academic institutions based on the researchers' findings outlined in *The University of Texas System Dual Credit Study: Dual Credit Success in College*, with a particular emphasis on dual credit data collection, research, and communication. The study recommends that UT system institutions of higher education:

- improve student record-level data collection for students participating in Texas dual credit programs;
- encourage UT System academic institutions' dual credit programs to conduct program evaluation;
- continue to monitor and research the relationship between dual credit participation and student success;
- enhance dual credit communication with students and families to enable informed decisions;
- establish a list of dual credit-related policies, empirical dual credit research findings, and dual credit practices that can be communicated to staff at the UT System institutions; and
- improve dual credit program alignment among high schools, and two-year and four-year institutions.

While various publications offer recommendations for enhancing dual credit programming from the perspective of institutions of higher education, and others call for enhanced data collection at the national or state level, the recommendations for dual credit program implementation, monitoring and evaluation at the high school level are scant. In *Dual Enrollment Research: A Comprehensive Review*, the Southern Regional Education Board

(SREB) articulated or provided recommendations for programs without limiting these recommendations to states or IHEs (Southern Regional Education Board, 2020). Unlike the collection of data limited to post-secondary metrics recommended in other publications, these data practices are a better fit for dual programs in action, that is, dual program data collection during the secondary years rather than after the fact. These recommendations for data collection include disaggregated, longitudinal student-level data such as:

- location of course delivery;
- modality of course delivery;
- instructor qualifications;
- initial dual credit enrollment student motivation;
- alignment between secondary and post-secondary curricula; and
- student characteristics that may influence dual credit success.

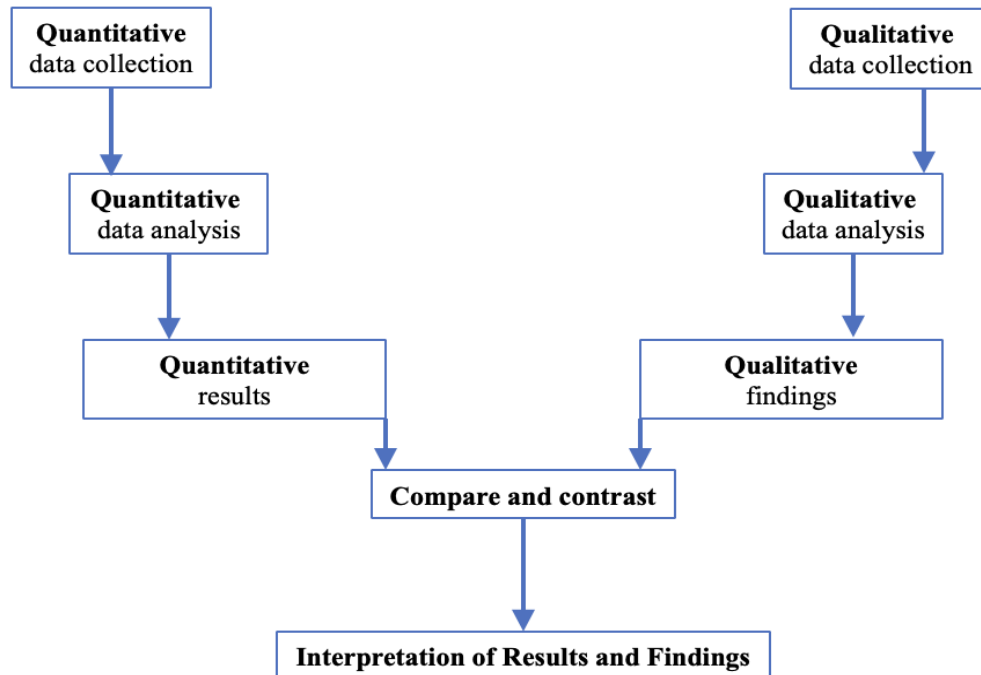
The recommendations for data collection should be paired with an implementation plan for analysis, monitoring, and evaluation that stays tuned to trends or correlations which might be impacting the success of the program. In light of these recommendations, this study aims to examine data collection and analyses, and program evaluation of the dual credit program within the framework of the UTTUA locus of control. The following sections offer a narrative overview of elements that informed the program logic model.

Mixed Methods

Implementation research uses mixed method designs to establish a scientific basis for understanding and eliminating implementation barriers (Palinkas et al., 2011). Collecting, analyzing, and incorporating qualitative and quantitative data into one or more investigations is

the aim of mixed methods designs. This approach is based on the core premise that integrated quantitative and qualitative methodologies provide a better understanding of research topics than either approach does on its own (Creswell & Plano Clark, 2011). In these designs, qualitative methods are used to explore and gain a depth of understanding as to why evidence-based practice implementations succeed or fail, or to identify strategies for facilitating implementation (Tashakkori & Teddlie, 2010). Quantitative methods are used to test and validate hypotheses based on an existing conceptual model and to obtain a broad understanding of predictors of successful implementation.

Convergent design is a useful variant of mixed method research (Creswell & Plano Clark, 2011). Qualitative and quantitative methodologies are utilized in this design to obtain triangulated results. This approach gathers data, both quantitative and qualitative, and analyzes them separately (Creswell & Plano Clark, 2011). A researcher will be able to completely understand the information that may be gathered from the quantitative or qualitative results alone when employing a convergent design when the analyses of the two forms of data are combined. A graphic overview of a mixed methods triangulation design: convergence model as described by Creswell (2008) is show in the following graphic (see Figure 1).

Figure 1*Mixed Methods Triangulation Design: Convergence Model*

According to Dawadi et al. (2021), this methodology integrates two data sets to offer a thorough comprehension of the subject being studied. The application of a mixed method approach tailored to the analyses of implementation research is gaining traction (Aarons et al., 2011). The application of this approach has progressed to the point where it can now distinguish between convergent mixed method design phases related to program implementation, including pre-implementation, implementation, maintenance, and augmentation (Fixsen et al., 2009).

Dual Credit Student Recruitment and Retention

It may be difficult to attract and keep students who want to take dual credit courses in a STEM major. Band, drama, drill team, and athletics are just a few of the extracurricular activities that are not available at the three schools subsumed within the UTTUA. Rather than distributing time and resources among numerous extracurricular programs, the UTTUA concentrates its

resources on academics. This approach might be appealing to certain students; however, it might prevent students for whom participation in extracurricular activities is a decisive issue from enrolling at the UTTUA schools. Each campus has a distinct community impression that may affect student recruiting for dual credit STEM courses in their high school coursework in addition to this academics-only concentration. Communications and platforms were reviewed for student or community surveys that might inform these questions around student choice and community perception.

While a great deal of attention has been paid to the persistence of dual credit or dual enrollment students regarding post-secondary outcomes, there is a pronounced lack of research on dual credit persistence prior to high school graduation. Additionally, research that speaks to how dual credit offerings might influence student enrollment choices is also thin. Due to a lack of research in this area, it is unknown whether students are influenced by differences in dual credit offerings when choosing between high schools if choices are available. Furthermore, specific factors that might influence student participation in dual credit courses throughout their high school years remain hidden due to the dearth of research around this topic. A national review of incentives for students to participate in dual credit courses reveals that few states have policies that provide incentives for dual credit participation and of those that do, the incentives are limited to funding for tuition or books for underserved populations (Education Commission of the States, 2022). The state of Texas requires high schools to provide students the opportunity to participate in dual credit courses (Texas Administrative Code, 2023). To be more specific, Texas high school students have the option to participate in dual credit even when it may not be the expectation. Therefore, the dynamic of student pathway with regards to dual credit at the UTTUA schools differs from traditional public high schools. Across the UTTUA district,

students are expected to take dual credit courses unless they fail to demonstrate college readiness or they earn a failing grade in their regular or dual credit coursework (The University of Texas at Tyler, 2011). The UTTUA dual credit program also differs from Early College High School (ECHS) programs in that ECHS programs dismiss students who are failing dual credit classes or who decline participation in dual credit classes. In these cases, the students are sent back to their home high school. At the UTTUA, students who fail dual credit courses or who decline to participate in dual credit classes must be offered on-level instruction in core content classes to earn course credits required for graduation.

Communications, archives, and platforms were reviewed for use of longitudinal surveys that might reveal trends or factors influencing student dual credit retention within the high school years as well as STEM persistence beyond secondary school experiences.

Student Readiness for Dual Credit Coursework

Students at the UTTUA are expected to begin dual credit study in their 9th grade year with a fine arts subject. Dual credit students must fulfill post-secondary admission requirements, including a passing score on the TSIA2 in order to be admitted to UT Tyler (The University of Texas Tyler, 2023). Therefore, in order to take dual credit courses at the UTTUA, students must pass the TSIA2 in Mathematics as well as in English Language Arts and Reading. The TSIA2 in English Language Arts and Reading is reportedly aligned with the Texas Essential Knowledge and Skills (TEKS) for English III, as well as the College and Career Readiness Standards (CCRS) as published by the Texas Higher Education Coordinating Board (2018) and the Texas Adult Literacy & Content Standards 2.0 as published by the Texas Workforce Commission (2018). While information regarding TSIA and TSIA2 passing rates in comparison to other districts within the state might reveal overall trends, thereby informing this study, the THECB

does not include the UTTUA district in its annual reporting (Texas Higher Education Board, 2022). Student performance data on the TSIA and the TSIA2 were collected for the years for which the data were available, which spanned from 2018–2023. Information on specific testing windows, such as fall, spring, or summer was not available. The gaps and lack of detail in these data rendered it unusable in this study. While this represents a missed opportunity for a more robust quantitative analysis of the data set, it does highlight an omission in data systems relevant to the program implementation evaluation.

Dual Credit Participation

Limited studies have found that student desire for a traditional high school experience may reduce their likelihood of enrollment in schools that focus on advanced coursework in lieu of the range of extra-curricular activity offered at a conventional high school (Mansell & Justice, 2014). Research has also indicated a disparity in student STEM aspirations, academic preparedness, and STEM course offerings between small town and suburban populations (Saw & Agger, 2021). The aforementioned study used the National Center for Education Statistics (NCES) designations for their categorization of geographical location. By these designations, none of the UTTUA campuses were classified as suburban. Each of the UTTUA campuses had designations ranging from town to small or mid-sized city (National Center for Education Statistics, 2009).

An analysis of student dual credit participation versus non-dual credit participation at the UTTUA schools from 2017–2023 was conducted. Dual credit instructor qualification, course mode of delivery, and gender were considered to unearth factors which might influence dual credit persistence within the UTTUA district. Detailed discussion of the methodology and results are offered in their respective sections of this chapter.

Dual Credit Persistence

Data sources. Data were collected from the UTTUA Public Education Information Management System (PEIMS) enrollment records. The Texas Education Agency (TEA) created the PEIMS data collection system (Texas State Board of Education, 1986) to offer a centralized method for gathering data on school districts and to keep these data in a single, unified database for accountability and functions as the official state record of enrollment. The enrollment data collected were of nominal type and is detailed in the following (see Table 3).

Table 3

UTTUA Dual Credit Enrollment Nominal Data

Course Enrollment	Instructor Qualifications	Course delivery modality	Gender
Dual Credit	University Faculty	Face to face instruction	Female
Non-dual credit	High school Instructor	Remote instruction	Male

Sample

English was chosen as the course of focus for the study as students diverge in their dual credit math pathways in the 11th grade, with some choosing to take calculus, while others enroll in statistics. Data were collected on 11th grade students at the UTTUA enrolled in either dual credit or non-dual credit English between the years of 2017 and 2023. Paired data were collected on this sample of English dual credit and non-dual credit participants that identified their subsequent enrollment in either English IV dual credit, non-dual credit or withdrawn from UTTUA. Descriptive statistics of the initial data sample are detailed below (see Table 4).

Table 4*UTTUA 11th Grade Dual Credit Enrollment Frequency Table*

Enrollment type	Dual Credit		Non-Dual Credit	
	n	%	n	%
Total	237	73.38	86	26.62
Gender				
Female	124	52.32	49	56.98
Male	113	47.68	37	43.02
Mode of Delivery				
Face to face	159	67.09	51	59.30
Virtual	78	32.91	35	40.70
Instructor Qualifications				
University faculty	84	35.44	34	39.53
High school instructor	153	64.56	52	60.47

Analysis

The analysis of the data set was limited to a sample consisting of students who were enrolled in dual credit English as 11th grade students ($n = 237$). This sample allowed for an investigation of persistence in dual credit coursework rather than overall participation. Data on enrollment for individual students in the 12th grade year was available as dual credit course, non-dual credit course or no longer enrolled at the UTTUA. The number of students who were enrolled at the UTTUA in dual credit as juniors, but no longer enrolled at the UTTUA as seniors was small. Given that the dependent variable chosen in or for this analysis was persistence in dual credit English coursework, the data were split into two nominal categories of enrollment in dual credit English or non-enrollment in dual credit English. That is, the categories of non-dual

credit enrollment and withdrawn from or dropped out of UTTUA were combined into one category of non-enrollment in dual credit English coursework. The resulting dependent variable was dichotomous with possible outcomes of enrolled in 12th grade dual credit English (coded as 1) or not enrolled in 12th grade dual credit English (coded as 0). The predictor variables considered were: gender (female = 1, male = 0), mode of delivery (face-to-face = 1, virtual = 0), and instructor qualifications (university faculty = 1, high school teacher = 0). A multivariate binary logistic regression was used for this data set with multiple independent variables and one dichotomous dependent categorical variable.

Dual Credit Student Affective Domains

A recent study examined the relationship between dual credit or dual enrollment and STEM career interest. Dual credit was shown to be an effective strategy to stimulate interest in STEM fields among all high school students, regardless of their gender, race, financial level, or academic standing (Corin et al., 2020). Measuring change in student interest and intent to engage in STEM postsecondary coursework is a relevant indicator for program evaluation given that the initial charter is aimed toward preparing students for post-secondary STEM coursework and promoting enrollment in STEM disciplines. Communications and platforms were reviewed for use of longitudinal surveys that might reveal trends or factors influencing student interest and intent in STEM and dual credit participation.

In the University of Texas System report, *Dual Credit Study: Dual Credit and Success in College*, researchers found that students gained general skills that were helpful to them throughout their undergraduate careers (Troutman et al., 2018). The students mentioned time management, self-discipline, engaging with instructors, taking notes, studying effectively, exercising critical thought, using research databases, and using academic language as academic

habits that improved for them as a result of participating in dual credit coursework. In the same study, researchers noted that the expectations for high-quality work, normal college workloads, college-specific pedagogies, registration or advising procedures, and college services like tutoring, writing centers, peer study groups, and office hours were all practices that students said they became more familiar with due to their participation in dual credit courses. Other studies have shown that many of the skills that dual enrollment programs are intended to foster in students, such as self-efficacy and educational expectations, were predictive of dual enrollment student achievement (Dyer et al., 2022). The effects have been shown to be correlational, however causation has not been established (Giani et al., 2023). Communications and platforms were examined for the presence of surveys that might reveal trends or factors influencing student affective domains relevant to dual credit participation.

Dual Credit Course Instructors

While many public districts and high schools have agreements with partner universities or colleges that include a wide array of dual credit offerings, other K–12 schools fill the gap in course offerings by employing certified high school teachers who have the additional dual credit qualifications. While this technically fulfills the mandates for dual credit course implementation, there have been concerns and questions around the quality of instruction offered by these alternative instructors. Concerns include questions about course rigor, potential grade inflation, and possible conflict of purpose (Troutman et al., 2018). Ensuring that the courses taught by high school teachers are of equal quality to those taught by college faculty is a crucial concern as dual enrollment programs continue to grow. Standards for teacher qualifications have always been a part of efforts to control educational quality, and some accrediting bodies and state officials have begun to pay more attention to these standards (Horn et al., 2018; Zinth, 2018). While the

Southern Association of Colleges and Schools (SACS) has a broad policy regarding instructors qualified to teach dual credit courses (Southern Association of Colleges and Schools, 2019), the Higher Learning Commission (HLC) has more specific rules governing instructor qualifications (Higher Learning Commission, 2020). The HLC mandates that instructors must have at least a master's degree with 18 graduate credit hours in the field of instruction. This expectation is reflected by Texas regulations as defined in the Texas Administrative Code (19 Tex. Admin. Code §4.85 (2023)).

Teacher shortages throughout K–12 systems are even more pronounced for dual credit courses requiring additional qualifications. Different strategies have been used by states to increase the number of high school teachers who are competent to instruct in dual enrollment programs (Zinth, 2018). These efforts can include the following strategies: (1) general program support; (2) financial aid for high school teachers to complete graduate credits; (3) teacher bonuses to encourage professional development; (4) greater awareness of graduate program options; and (5) using alternative course delivery models to speed up the completion of graduate credentials (Horn et al., 2018).

The Comprehensive Needs Assessments and District Improvement Plans for the UTTUA from 2017–2022 were reviewed to determine staffing objectives or priorities related to the dual credit program as well as incentives for promoting dual credit qualification. UTTUA dual credit schedules and syllabi were also reviewed to examine the range of course offerings and teaching assignments. Instructor credentials were reviewed to determine qualification level. UT Tyler and UTTUA handbooks were examined to assess both institutional and district policies related to dual credit teaching positions, incentives for teaching or incentives for teachers to earn the necessary credentials to qualify to teach dual credit. Data connecting instructor qualification

level with dual credit persistence was collected and will be discussed in greater detail in the quantitative section of this chapter.

Dual Credit Course Modalities and Locations

Numerous academic studies emphasize the value of dual enrollment, and regardless of the course format, research shows that dual enrollment students reap benefits (Lile et al., 2017). Evidence suggests that dual credit students outperform other students in their degree commitment and scholastic conscientiousness, whether they are studying on a university campus or their local high school campus (Hu & Chan, 2021). However, certain studies have found a significant difference between the overall post-secondary persistence scores of dual credit high school students based on the location of study, with those who attend classes on a university campus scoring higher than those who take their dual credit classes on their high school campus (Alsup & Depenhart, 2020). Course delivery modality and location goals or priorities for the dual credit program were reviewed in the UTTUA's 2017–2022 Comprehensive Needs Assessments and District Improvement Plans. Syllabi and schedules for the UTTUA dual credit program were also examined to determine the delivery methods of dual credit courses as well as the location of course delivery. Data relating course modality to persistence were also collected and will be discussed further in the quantitative section.

Dual Credit Course Consistency, Alignment, and Rigor

Within education, a generally accepted definition of academic course rigor is difficult to find. Even though numerous conceptualizations of course rigor have been noted, both empirically and anecdotally, a widely accepted operationalized definition of rigor remains elusive. A recent article outlines five elements that are essential to defining course rigor: challenge, critical thinking, mastering difficult content, time and labor intensity, and creation of

credible output (Johnson et al., 2018). Regarding questions of rigor, researchers have begun to examine not only the potential differences in rigor or perceived rigor, but also the ways in which the pressures or constraints of K–12 systems may influence the rigor of dual credit coursework particularly in courses taught by high school instructors (Duncheon & Relles, 2020).

Course misalignment can occur at multiple levels. When considering alignment issues, the elements of standards, teaching and learning activities, and assessments are the primary items which are most often examined. Misalignment can occur between each of these elements. While the previously mentioned components are potential areas of misalignment within one course, the potential for misalignment between courses adds yet another layer of complexity to be considered. Additionally, vertical alignment is a consideration. While the State of Texas Assessment of Academic Readiness (STAAR) English I and English II end of course (EOC) exams assess student proficiency in 9th and 10th grades, respectively, the TSIA2 is administered to UTTUA students at the beginning of their 9th grade year. Additionally, current materials related to the alignment of the TSIA2 and the STAAR EOC assessments focus on alignment with the English III TEKS standards (College Board, 2021). In short, 9th grade students complete the TSIA2 to assess college readiness presumably aligned with knowledge and skills acquisition related to a course two to three years in the future. An assessment of vertical alignment from middle school English language arts and reading (ELAR) standards and assessments through high school ELAR standards and assessments with the TSIA2 expectations would be a logical starting point to garnering a better understanding of student readiness and developing strategies for deficits.

There are a variety of methods that may be used to ascertain alignment between curricular elements. One method that can be used is the Surveys of Enacted Curriculum (Porter

& Smithson, 2004). Another method used to assess alignment of these elements is Constructive Alignment (Biggs, 1996). Both methods require the coding or assessment of elements based on topic, depth of knowledge, higher order thinking and weight. To assess these components, coders examine course artifacts including syllabi, course assignments, assessments, student products and assessment tools. Full access to these course artifacts is necessary in order to accurately evaluate alignment, and multiple coders must be employed in order to consistently and accurately quantify coverage, weight, and rigor (Polikoff & Porter, 2014). Ideally, assessments common to university faculty and high school instructors would be employed to ensure consistency across the dual credit courses. Additionally, external assessments, such as the Advanced Placement (AP) exam or College-Level Examination Program (CLEP) exam could be given to provide independent measures for course rigor and student achievement. Archived and current district Comprehensive Needs Assessments, District Improvement Plans and district curriculum documents were reviewed for evidence of alignment activities and independent measures of rigor.

Stakeholder Survey

Participants. Stakeholders of the UTTUA dual credit program were invited to participate in an anonymous, voluntary survey. These stake holders included district and campus administrators, district and university advisors, district and university dual credit instructors, and parents or guardians of UTTUA high school students.

Data collection. A survey was created on the Qualtrics platform based on a survey used by researchers on behalf of the University of Texas System in their 2018 report, *Dual Credit Study: Dual Credit and Success in College* (Troutman et al., 2018). The survey employed branching logic to guide respondents to questions specific to their role in relation to dual credit

programming at the UTTUA with a series of questions for each respondent category: administrator, advisor, instructor, and parent or guardian. A copy of the survey has been included in this manuscript (see Appendix B).

Analysis. Responses to the open-ended questions in the dual credit stakeholder survey were analyzed for common themes or topics as well as coded as primarily negative or positive.

Ethical Considerations

For the quantitative component of this study, student data were anonymized prior to storage and analysis. Each student specific linked data set was assigned a random number in order to retain variable linkage. For the qualitative survey, no information which could identify an individual respondent was collected or included in the survey questions or response options. Those receiving the survey were advised of the nature of the survey which was approved by the University of Texas at Tyler Institutional Review Board (IRB).

Limitations, Delimitations, and Assumptions

The choice of enrollment data collection and analyses that concentrated on the essential dual credit coursework is one of the study's delimitations. Data collection and analyses restricting the data pool to English III and English IV (dual credit and non-dual credit) students allowed for the greatest number of UTTUA dual credit students to be considered.

The study's underlying assumption is that students who enroll in UTTUA institutions do so voluntarily. All high school students are expected to participate in dual credit courses; this requirement is made clear in both district and school publications, and it is emphasized heavily in student application briefings. This communication procedure suggests that every student enrolled

at UTTUA is aware of the participation requirement for dual credit and has chosen to self-select into the system.

Summary

There is a gap in the literature regarding dual credit implementation for secondary institutions. This study provided a formative assessment of the program's implementation monitoring and evaluation efforts, as well as an analyses of factors that may have affected a dual credit program at a public STEM charter district. This study also attempted to assess the district's dual credit program data gathering and analyses activities in order to ensure optimal implementation. The intricate nature of this project demanded a process that blends a mixed-methods, convergent design exercise with a formative assessment grounded in implementation science. Although this district is unique in that dual credit is required of all high school students, other public secondary schools may find the results useful in implementing, overseeing, and assessing their own dual credit programs.

Chapter IV presents the research findings. The results are discussed and suggestions for additional investigation are made in the upcoming Chapter V.

RESULTS

This chapter contains the findings of the program evaluation of the University of Texas at Tyler University Academy (UTTUA) as a convergent mixed methods study. The results and findings of the evaluation and analyses were intended to answer the following research questions:

1. How is the UTTUA dual credit program's implementation and progress being monitored and evaluated, and how do these activities align with effective program monitoring and evaluation?
2. What variables may be affecting dual credit participation at the UTTUA, and to what degree?
3. This chapter also includes discussion of how the analyses related to the research questions.

Included in this chapter are tables used to present data summaries and detail to complement the narrative discussion.

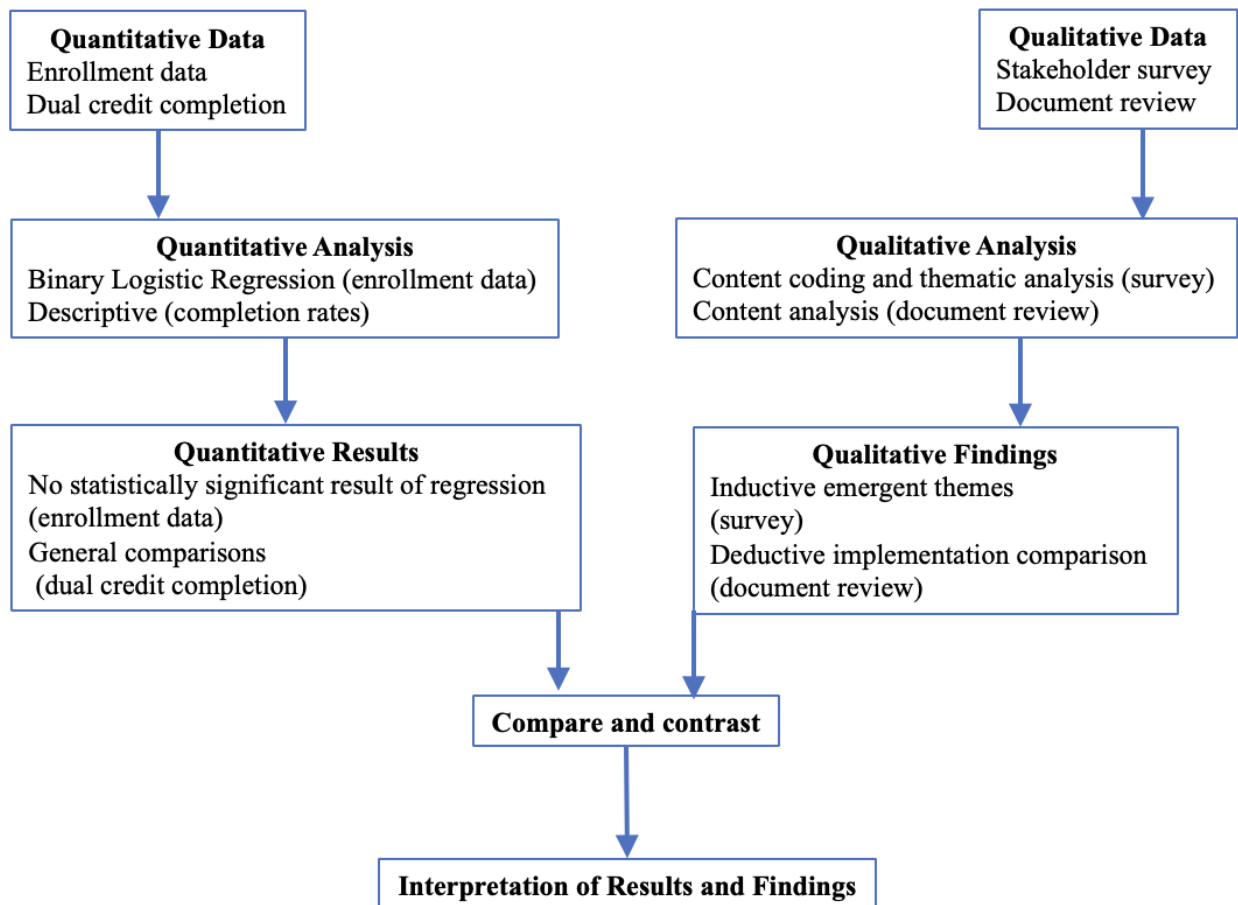
Evaluation

A comprehensive review of the UTTUA dual credit program was conducted. The evaluation included the examination of current and archived artifacts for evidence of program monitoring activities, intervention activities and outcomes, and data strategies, collecting activities and analyses. Documents or systems examined as part of the process evaluation included District Improvement Plans, district-wide platforms, and communications such as meeting minutes or emails. No comprehensive implementation or monitoring plan for the dual credit program existed. A mixed methods triangulation design, convergent model (Creswell, 2008) was used for this study. Quantitative data included student enrollment data and dual credit completion rates. Qualitative data included stakeholder survey responses and district-wide

document and systems review. The following graphic illustrates the convergent model of the dual credit program mixed methods triangulation design (see Figure 2).

Figure 2

Dual Credit Program Evaluation: Mixed Methods Triangulation Design: Convergence Model



Data Strategy

A comprehensive data strategy for the dual credit program was also absent. Suggested metrics were identified from a review of literature featuring recommendations for dual credit program implementation, monitoring, or improvement for secondary schools. These metrics can be found below (see Table 5).

Table 5*Recommended Metrics for Dual Credit Programs*

	Domain	Desired Outcome	Qualitative Measure	Quantitative Measure
Student Level	Academic preparation	Academic maturity	Student Surveys	
	Academic readiness	Content specific knowledge & skills acquisition Understanding of post-secondary expectations	Instructor feedback Student surveys	Assessment scores Enrollment data
	Affective adjustment	Time management Metacognitive skills		
	Student achievement & academic progress	Completion of post-secondary requirements Persistence	Student surveys	Transcripts Enrollment data
Program Level	Program monitoring & evaluation	Data collection and analyses Identified goals, activities, metrics, and progress	Data systems review District Improvement Plans Evaluator artifacts	
	Course design Curriculum	Vertical alignment Course content & rigor Internal & external course consistency	Curriculum audit Observations	Course offerings Common assessment External assessments
	Faculty & staffing	Qualified dual credit instructors for all core classes	Instructor credentials	Teaching assignments
	Communication	Improved understanding of dual credit program for parents and families	Student surveys Family surveys Artifacts	

A review of the UTTUA District Improvement Plans (DIP) from academic years 2020–2021 through 2023–2024 found minimal evidence of targeted data collection and analyses,

program monitoring, planned intervention activities, or other elements related to the dual credit program. In each of the DIPs examined, there was a performance objective referenced under overall student achievement that referenced dual credit. This goal was that “90% of students will receive the Performance Acknowledgement in dual credit on their high school transcript to support college completion.” Qualification for a dual credit performance acknowledgement is defined by the Texas Education Agency (TEA), as the student earning at least 12 credit hours in postsecondary coursework with a grade of 3.0 or higher on a traditional 4.0 scale or the student earning an associate degree while in high school. Evidence of activities targeted toward this goal or interventions to support this goal was not present.

Further, the examination of these artifacts found no evidence of metrics or activities to address the areas of student persistence in dual credit, non-cognitive post-secondary readiness, academic habits, course consistency or rigor, or enhanced communications around dual credit. While readiness to begin dual credit coursework is determined by student performance on the TSIA2, the review of available TSIA2 data found that the data collection and distribution was not of sufficient quality for meaningful use.

In the DIP for academic year 2022–2023, a need to measure changes in post-secondary intent and interest in STEM majors was mentioned in order to comply with Title IV requirements. The first deployment of this survey occurred on 31 August 2023 and provided a baseline for these items, however no additional data were provided to measure change.

In the current DIP (academic year 2023–2024), dual credit readiness was identified as a priority problem statement with “a need to increase the number of freshman and sophomore students who qualify for dual credit enrollment.” While this item was listed as a prioritized problem, no activities or interventions were included to address the stated problem. A simple

problem statement (not priority) was also included as “a need to increase the amount of Dual Credit courses in the Sciences.” Again, while this problem was noted, there were no interventions or activities defined to address this problem.

Furthermore, within District Goal #4, the UTTUA stated that they intend “to promote high quality, ongoing professional staff development and strategies to maintain highly qualified teachers.” And, under activities associated with the goal, “Increase the number of teachers who are approved to teach dual credit in high school.” These statements would have more aptly been defined as an intended outcome or output rather than as an activity. The DIP did not explain what intervention or activity would be implemented to result in an increase in dual credit qualified teachers. Examination of the DIPs found no further evidence of program monitoring, district objectives, data gathering, or analyses related to the district’s dual credit program.

Other archives were reviewed for evidence of UTTUA dual credit program implementation activities or interventions. The UTTUA School Board Minutes for the past two years were reviewed, as were the minutes of Leadership Team meetings that occurred over the last year. A review of these documents found two items related to dual credit. Both items were documented on the Leadership Team meeting minutes of 6 February 2023. The first item provided notice to the attendees of changes in dual credit enrollment to better accommodate UT Tyler. The second item referenced the lack of dual credit instructors across the three campuses and stated that the district leadership would be considering stipends for high school dual credit teachers. The lack of science dual credit course availability was also noted.

Enrollment records linking UTTUA dual credit enrollment and subsequent enrollment at UT Tyler were reviewed. These records include aggregated UTTUA dual credit enrollment without reference to course and enrollment at UT Tyler as a high school graduate. While these

records would seem viable in the examination of the transition between secondary and post-secondary coursework regarding this dual credit program, substantial discrepancies were found. These discrepancies should be resolved prior to use for program monitoring or evaluation.

Survey Data

Participants. Participants in the UTTUA dual credit program were asked to take part in a voluntary, anonymous survey. Parents or guardians of UTTUA high school students were among the stakeholders, along with district and campus administrators, advisers, dual credit instructors, and advisors from the district and university.

Data Collection. Based on questions utilized by researchers for the University of Texas System in their 2018 study, *Dual Credit Study: Dual Credit and Success in College* (Troutman et al., 2018), a survey was constructed on the Qualtrics platform, with a sequence of questions for each respondent category—administrator, advisor, instructor, and parent or guardian. The survey used branching logic to direct respondents to questions pertinent to their function in relation to dual credit programs at the UTTUA. The questions were intended as an initial iteration in the identification of key issues as perceived by the participants. These precursor queries included dual credit experiences from the stakeholder's perspective, influence of dual credit program on secondary or postsecondary choices, perception of student readiness, and recommendations for the program.

Analysis. Content analysis was employed to code the responses from the dual credit parent survey (n=25). The open-ended responses were categorized through sentiment analysis as predominantly positive or negative, mixed or neutral. The responses were also reviewed for emergent topics based on frequency of words or phrases within the open-response fields.

Respondents who identified as administrators (n=0), counselors (n=2), or instructors (n = 2), were not coded or analyzed for emergent themes due to the small number of respondents.

Findings. The findings from the parent survey are presented below arranged by question. An overview of the administrator, counselor, and instructor responses is included at the end of this section.

- Question 1: “In what ways do dual credit opportunities impact or influence your choice of high school for your student?”

The mean for the coded values was 1.09 indicating moderate influence on choice. The most commonly report themes expressed by the respondents were: increased opportunities for students upon graduation, a positive impact on the student’s future, and increased options for post-secondary activities.

- Question 2: “In what ways do dual credit opportunities impact or influence how you advise your student regarding choice of college or university?”

The mean for the coded values was 0.3 indicating a generally neutral response to how dual credit opportunities influenced how parents or families advise their student about choice of college or university. The responses to this question were primarily about transferability of dual credits to other universities and indicate misperceptions around this topic.

- Question 3: “From your perspective, what are the advantages and disadvantages of dual credit participation?”

The emergent themes in response to this question included: perceived advantages of dual credit including decreased cost associated with post-secondary coursework, decreased time to graduation for post-secondary degree, and higher expectations for students. One perceived disadvantage of dual credit which emerged in response to this question was the increased stress

for students participating in dual credit coursework. Several respondents also questioned student readiness for the expectations of dual credit coursework. Rigor as an emergent theme was seen by some respondents as an advantage and by others as a disadvantage. Other respondents questioned the general rigor of dual credit coursework in comparison to traditional post-secondary coursework.

- Question 4: “How do you think dual credit programs can be improved to meet the current structures, goals, and requirements of college or university education?”

Themes which emerged in response to this question included: a need for better alignment, a need for increased course options, and a need for more dual credit science offerings.

- Question 5: “How does or should the existence of dual credit change the ways that institutions view college and high school? What new possibilities should colleges or universities embrace?”

The most common themes emerging in response to this question pair included: the need for better collaboration between secondary and post-secondary components of the program, the need for a smoother transition from high school to college or university, and the need for improvement in student preparation for dual credit coursework. It was noted that the responses may have been mostly directed toward the second question. Emergent themes were not distinguished between the two questions.

- Question 6: “Thinking about all that has been discussed here today, what 1-2 key pieces of information do you want to communicate to high school and university personnel about dual credit opportunities for your student?”

The emergent themes in response to this question included: a need for more dual credit course options, the need for better support for student development of academic habits, and a need for improvement in counseling and advising for dual credit students.

- Question 7: “In 2015, House Bill 505 removed the limitation of the number of dual credit hours for public school students, how should post-secondary education respond?”

The responses to this question were primarily focused on a need for improved communication and the need for increased dual credit course offerings.

The overarching themes for the parent survey were the perceived benefits of dual credit participation, need for more course offerings, and a concern for student readiness. General topics mentioned by the faculty or counselor respondents included concerns about student readiness for dual credit coursework, and the need for more dual credit course options. The need for improved readiness indicators was noted in the literature (Darling-Hammond et al., 2014). Concerns about student readiness were of note in *The University of Texas System Dual Credit Study: Dual Credit Success in College* findings as well (Troutman et al., 2018).

Quantitative

Data sources. The data was collected from enrollment records in the UTTUA Public Education Information Management System (PEIMS). The PEIMS data collection system (Texas State Board of Education, 1986) was developed by the Texas Education Agency (TEA) to provide a centralized way to collect data on school districts. The data is kept in a single, unified database for accountability purposes and serves as the official state record of enrollment. Enrollment data were collected for all English course offered at the UTTUA in 11th or 12th grade between the fall of 2017 and the fall of 2023.

Sample. Enrollment data at the UTTUA in either dual credit or non-dual credit English between the years of 2017 and 2023 were collected from the PIEMS records. Since students choose different dual credit math courses in the 11th grade, such as calculus or statistics, English was selected as the study's focus. The study's focus on English (dual credit and non-dual credit) participants allowed collection of the greatest number of UTTUA enrollment data points. In order to track the subsequent enrollment of the sample of English dual credit and non-dual credit 11th participants in either dual credit or non-dual credit (for 12th grade), or in withdrawal from UTTUA, each students' 11th grade enrollment status was paired with data reflecting their enrollment status in 12th grade the following year. This convenience sampling exercise employed no further restrictions on the sampled population.

Variables. It was not possible to draw any conclusions regarding what might have influenced 11th grade English students' enrollment in dual credit or non-dual credit programs due to a lack of data on student preparation. As a result, the data set analysis was restricted to a sample of students ($n = 237$) who were enrolled in dual credit English as 11th graders. The results' scope was limited to dual credit class perseverance rather than total participation. Individual student enrollment information for the 12th grade was accessible as dual credit, non-dual credit, or no longer enrolled at UTTUA. The data was divided into two nominal categories: enrollment in dual credit English coursework and non-enrollment in dual credit English. The dependent variable for this analysis was defined as persistence in dual credit English coursework. In other words, there was just one category for non-enrollment in dual credit English coursework, which combined the categories of non-dual credit enrollment and withdrawal from or dropout of UTTUA schools. With the options of enrolling in dual credit 12th grade English

(coded as 1) or not (coded as 0), the dependent variable that resulted was dichotomous. The predictor variables considered were:

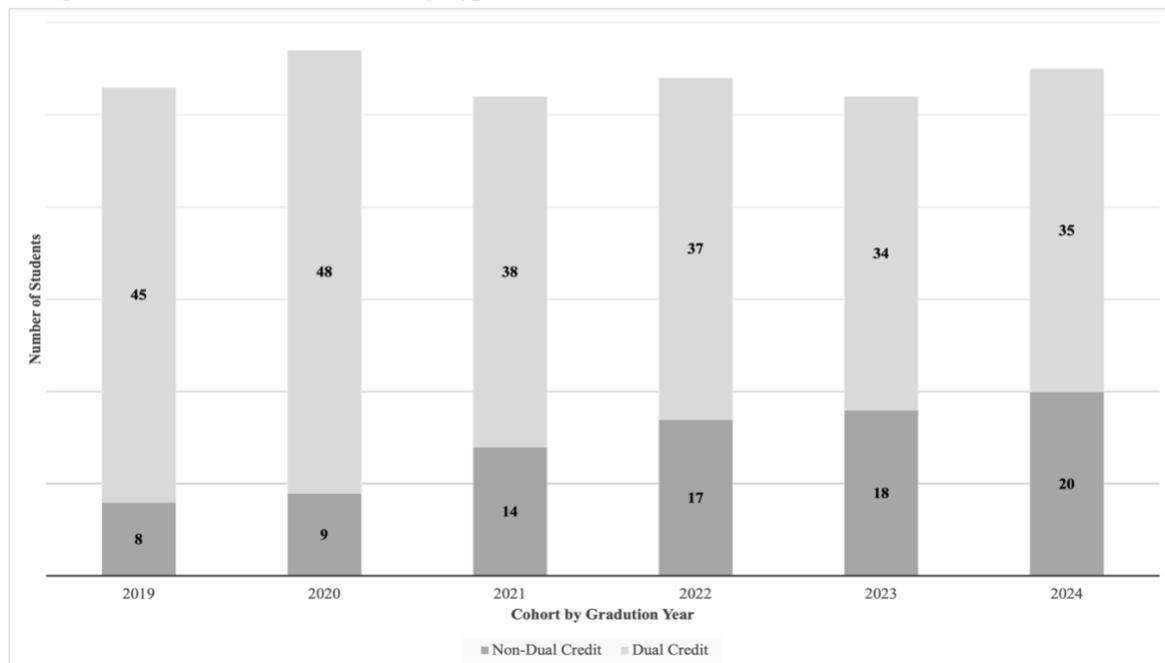
- gender (female = 1, male = 0),
- mode of delivery (face-to-face = 1, virtual = 0),
- instructor qualifications (university faculty = 1, high school teacher = 0),

Data Entry and Analyses. Data entry and analyses were conducted using the statistical software package JAMOV. Descriptive statistics analysis was used to show the frequency distributions. Binary logistic regression modeling was used to assess and identify the influence of variables on student persistence in dual credit coursework.

Results. Coarse grain review of 11th grade English dual credit and non-dual credit enrollment data indicate declining participation in dual credit English by 11th grade students as illustrated below (see Figure 3).

Figure 3

English Enrollment in 11th Grade by Type & Cohort



Enrollment data to be used in the binary logistic regression are shown in Table 6. Regarding their gender, 124 (52.3%) of the students were males and 113 (47.7%) were females. Mode of delivery for dual credit by student was 78 (32.9%) for virtual course delivery and 159 (67.1%) for face-to-face. Students receiving dual credit instruction from high school teachers numbered at 153 (64.6%) and from university faculty at 84 (35.4%). The frequencies can be found in Table 6.

Table 6

Frequencies for 11th Grade Dual Credit English by Nominal Variables

Predictor Variable	<i>n</i>	%
Gender		
Female	113	47.7
Male	124	52.3
Mode		
Virtual	78	32.9
Face to Face	159	67.1
Instructor Qualification		
High School Teacher	153	64.6
University Faculty	84	35.4

For the binary logistic regression, assumption checks included collinearity statistics of Variance Inflation Factor (*VIF*) and Tolerance. Caution is necessary if the tolerance is less than 0.25 or the *VIF* is higher than 4, which generally suggests the possibility of multicollinearity. The *VIF* and Tolerance of each of the 3 predictor variables was found to be within the acceptable range indicating no multicollinearity. A summary of *VIF* and Tolerance for the predictor variables can be found in Table 7.

Table 7*Collinearity Statistics*

	<i>VIF</i>	<i>Tolerance</i>
Gender	1.03	0.97
Mode	1.38	0.72
Instructor Qualification	1.40	0.71

A binary logistic regression was performed to assess the effects of gender, mode of delivery, and instructor qualifications on the likelihood of 12th grade dual credit English enrollment for students previously enrolled in 11th grade dual credit English at the UTTUA. The Overall Model Test was not statistically significant, $\chi^2(3) = 0.81$, $p = 0.85$, $R^2_{McF} = 0.003$. The results are summarized in Table 8.

Table 8*Results of Overall Model Test with 3 Predictors in Binary Logistic Regression for 12th grade Dual Credit English Enrollment*

	<i>df</i>	<i>X²</i>	<i>p</i>	<i>R²_{McF}</i>
Overall Model Test	3	0.808	0.848	0.003

The individual predictors were examined further and indicated that gender ($p = 0.4$), mode ($p = 0.8$) and instructor qualifications ($p = 0.9$) were not significant predictors. The results of these regressions are summarized below (see Table 9).

Table 9*Results of Binary Logistic Regression with 3 Predictors for 12th Grade Dual Credit English Enrollment*

Predictor Variable	<i>Estimate</i>	<i>SE</i>	<i>Z</i>	<i>p</i>	<i>Odds Ratio</i>
Gender	1.19	0.3	-0.85	0.4	0.77
Mode	0.09	0.3	0.26	0.8	1.10
Instructor Qualification	0.05	0.4	0.13	0.9	1.05

In summary, no statistically significant predictors of participation in 12th grade dual credit English were identified from the available data.

State Measures of Postsecondary Readiness

A review of the Texas Education Agency's annual Texas Academic Performance Reports (TAPR) from academic years 2018–2019 through 2020–2021 found that the UTTUA annual graduates exceeded the dual course credit acquisition of annual graduates at other schools in Region 7 and statewide (see Figure 4 below for the map illustrating service area with school districts).

Figure 4*Region 7 Education Service Center: Regional Profile Map*

Further, the UTTUA students in grades 9–12 exceeded dual course credit completion in English, Mathematics and Social Studies. It should be noted, however, that the dual credit science course completion for UTTUA students in grades 9–12 of the same period falls for short of the dual credit science course completion in comparison to the state or region. Additionally, dual credit course completion is noticeably lower in science than for any other core subject.

Table 9

Texas Academic Performance Reports: Postsecondary Indicators
(Texas Education Agency) 2018/2019 - 2020-2021

	Academic Year	State (%)	Region (%)	District (%)
Dual Course Credits in Any Subject (Annual Graduates)				
	2020-2021	25.9	30.7	91.3
	2019-2020	24.6	31	96.4
	2018-2019	23.1	31.1	92.9
Dual Credit Course Completion (Grades 9-12)				
Any Subject				
	2020-2021	42.5	37.4	84.2
	2019-2020	46.3	40.1	83.4
	2018-2019	44.6	40.5	84
ELA				
	2020-2021	16.3	14.2	45
	2019-2020	18.2	15.2	54.6
	2018-2019	17.8	16	42.4
Mathematics				
	2020-2021	19.3	17.7	38
	2019-2020	20.7	18.8	29.1
	2018-2019	20.4	19.3	34.7
Science				
	2020-2021	20.6	21.3	11.6

	2019-2020	22.4	21.9	10.1
	2018-2019	21.7	21.3	8.8
Social Studies				
	2020-2021	22.8	14.1	54.7
	2019-2020	24.6	14.7	51.4
	2018-2019	23.6	14.9	63

While the overall dual course credit acquisition for UTTUA students is greater than that of students at other public schools in Texas, it falls short of the goal of all UTTUA students succeeding in dual credit coursework. The discrepancy in dual course credit completion between science and other core subjects will be discussed in Chapter 5.

Summary

While the state TAPR reports indicate the dual credit program outperformed other state and regional dual credit programs, the evaluation of program implementation has identified opportunities for improvement. Overall, the findings of the program implementation evaluation indicate that the program was instated without an implementation and monitoring plan or data strategy. While a lack of implementation plan or data strategy is not uncommon for public secondary schools' dual credit programs, this missing component has implications for the program's sustainability. The study failed to identify predictors for dual credit persistence indicating the need to employ additional measures to reveal factors influencing dual credit perseverance. The findings of the program evaluation and related components identified a broad set of diverse needs for improved program implementation and the creation of a comprehensive

data strategy. Further discussion of the findings of this evaluation, as well as implications and recommendations, are documented in Chapter V of this study.

DISCUSSION

The University of Texas at Tyler University Academy (UTTUA) dual credit program outperforms other public schools across the state in dual credit completion, however, there is evidence of declining dual credit enrollment in both initial dual credit participation and persistence. Numerous variables outside of its organizational control have contributed to the UTTUA's dual credit programs performing less than optimally. While the objective of graduating UTTUA students core complete in STEM would allow these students to enter any field of study after high school graduation, the performance of the dual credit program implemented by the UTTUA, and the University of Texas at Tyler (UT Tyler) exhibits significant opportunity for growth in fulfilling this objective. While full realization of the program is hampered in some ways by factors on the UT Tyler side of the collaboration, this study's primary focus has been on implementation of the district's dual credit program. Based on the evaluation findings there have been numerous factors that may have impacted dual credit participation at the University Academy. While some of these factors are structural and process-related, others are related to policies and procedures. Program implementation lies at the nexus of these interrelated factors.

Interpretation of the Findings

The following section includes a discussion of the results and findings articulated in Chapter 3, including factors with potential impact on student persistence in dual credit

coursework, qualitative findings related to stakeholder perceptions, and an evaluation of the UTTUA dual credit program implementation.

Dual Credit Persistence

Enrollment data for 11th and 12th grade, dual credit and non-dual credit English classes across the campuses within the UTTUA district was the focus of this component. With dual credit English participation in 12th grade as the dependent variable, the potential predictors of gender, instructor qualifications, and mode of delivery were analyzed by binary logistic regression. This analysis was intended to examine dual credit persistence in the program. None of the available factors yielded a statistically significant result. It can be concluded that gender has not been a factor in dual credit persistence. It can also be concluded that the level of instructor qualifications (qualified high school instructor versus university faculty) has not influenced students' retention in the dual credit course of work at the UTTUA. Additionally, it can be inferred that the mode of delivery for dual credit English classes (face-to-face or virtual) has not had an impact on dual credit student retention in the program.

Stakeholder Considerations

Several interesting themes emerged from the qualitative exercise in this study. The main themes that emerged from the parent poll were the need for more dual course offerings in science, the perceived advantages of dual credit participation, and the need for improved student preparation. The parent respondents also indicated that dual credit opportunities did impact their choice of high school for their student, citing increased opportunities or options as the basis for their choice. The parent responses revealed misperceptions about the transferability of credits between colleges and universities with many parents stating that they advised their student to attend the institution where the credits were earned demonstrating a lack of understanding about

articulation agreements and common course numbering systems. Themes related to the need for more dual credit course options, the advantages of dual credit participation, and the need for improved student preparation emerged from responses to multiple questions throughout the survey. The specific need for improved communication with the parents and families of dual credit students surfaced in response to one question but could be considered as related to emergent themes for other survey items.

Program Implementation

A thorough review and evaluation of the UTTUA dual credit program was conducted for this study. In order to find evidence of program monitoring activities, intervention actions and outcomes, and data strategies, the evaluation included a review of both current and historical artifacts. District platforms, communications, and district improvement plans were among the records and systems that were reviewed throughout the process evaluation.

Review of the UTTUA District Improvement Plans (DIPs) of the last 4 years (2020–2023) indicated that the dual credit program has not been a priority for the district during this period. While there were goals related to the dual credit program in each of the DIPs, the measures needed to assess the accomplishment of these goals were absent, as were the activities or interventions intended to achieve them. An examination of the school board minutes, and the leadership minutes also revealed a lack of prioritization for the dual credit program and its monitoring. Public schools serve diverse stakeholders. These schools are responsible for general student achievement and safety, as well as providing services for their special education students and English language learners; all while navigating a critical teacher shortage. Given the explicit focus of the UTTUA as a school that intends to prepare students for post-secondary success

through their STEM-focused dual credit programming, and the status of the UTTUA as schools of choice, there may have been an assumption that students attending the UTTUA have been fully committed to readiness for and engagement with dual credit coursework. This assumption may have fueled the perception that program monitoring was unnecessary.

Measures of student academic readiness were limited to Texas Success Initiative Assessment 2.0 (TSIA2) scores and yet these data were not collected or compiled. Data or analysis connecting students' longitudinal achievement in middle school grades on the State of Texas Assessments of Academic Readiness (STAAR) to the expectations of or performance on the TSIA2 were also absent. The program also lacked measures of other potential indicators of post-secondary readiness such as academic maturity, metacognitive skills, or student understanding of post-secondary expectations.

Examples of data related to dual credit student recruitment or retention might include student entry surveys, annual student surveys, enrollment contracts, or dual credit failure rates. Measures of this type that would inform trends or causes for dual credit recruitment or retention were not collected.

Questions or concerns around dual credit alignment, rigor, and course consistency are present in the general literature. Measures to assess these elements could include common assessments, vertical alignment audits, external assessments, or curriculum audits. A proposal to have dual credit students take an Advanced Placement (AP) test at the culmination of a related dual credit course in order to gauge student achievement against a national measure was offered in the 2022–2023 district documents. However, a follow up to this proposal was not found in the 2023–2024 artifacts. Furthermore, activities or data intended to assess course consistency, vertical alignment, or curriculum rigor were not found in the examination of district artifacts.

Access to dual credit courses and qualified faculty have continued to negatively impact the UTTUA dual credit program. Dual credit course options were primarily driven by the availability of university-based courses that were open to dual credit students. Due to the lack of available courses, many of the UTTUA dual credit courses have been taught by qualified high school teachers, however offerings have been limited due to the additional requirements for dual credit instructors as defined by the state. Efforts to increase the number of teachers qualified to teach dual credit could include recruitment of external candidates or incentives for existing UTTUA teachers to complete the necessary graduate coursework. Incentives and alternate pathways for teachers to complete the necessary coursework were being explored at the culmination of this evaluation.

Implications

The dual credit program lacks a thorough implementation and monitoring plan as well as a related data strategy to facilitate monitoring of the program. The implications of the underlying program implementation deficits threaten the long-term viability of the dual credit program at the UTTUA. With the overall consequence of questionable sustainability of the UTTUA dual program as the overarching theme, the following section addresses the implications of implementation deficiencies as discrete elements.

Recruitment/Retention

Though studies abound that examine the relationship between dual credit participation and post-secondary student achievement, there is a dearth of research on student recruitment and retention or persistence in dual credit coursework in the secondary environment. As most public high schools offer dual credit as an option, and early college high schools (ECHS) require dual credit participation as a condition of enrollment, the UTTUA exists in a purgatory between the

two in that it holds an expectation of dual credit participation for its high school students without an infrastructure for those who do not participate.

When 11th and 12th grade levels were first offered at the UTTUA in the fall semester of 2016, more than 90% of students in those grades participated in dual credit coursework. However, by the spring semester of 2022, that number had dropped to just over 50%. The price of offering non-dual credit students asynchronous, online courses that are necessary for graduation has increased from about \$7,000 to over \$25,000. This imposes a significant financial burden on the UTTUA schools as well as allowing for deviation from the UTTUA's stated goals for their students.

Due to the lack of data related to student readiness, no assumptions can be made about factors that might have influenced student dual credit enrollment. The decline in dual credit enrollment could be due to student readiness, related to student post-secondary intent, or could be attributed to other factors. Without adequate metrics for students entering the UTTUA schools in high school or 8th graders as they advance to high school, student recruitment into dual credit coursework remains an aspiration rather than an expectation with targeted interventions for improvement.

The students have been made aware by the district counselor that if they should fail to meet expectations or qualifications for dual credit coursework, they will participate in on-level, asynchronous courses to complete their graduation requirements. While this has provided some flexibility in allowing students to complete their basic requirements, it may have created a culture of least effort and allowed the students a path of least resistance. The mission and elements of the school charter have established the focus and intent of the UTTUA, however, the school is an open-enrollment charter and, as such, accepts all students for whom there is an

opening. Over time, there may have been erosion of the expectation that all UTTUA students will participate in dual credit coursework and graduate not only STEM college ready, but also core content complete. As an open enrollment charter having difficulty retaining students transitioning between 8th and 9th grade and recruiting new high school students, an effort to appease these pressures may have resulted in lowered rigor and many students migrating from the more challenging dual credit coursework to asynchronous, on-level coursework. The students also may have been moving from dual credit coursework into on-level classes in order to bolster their grade point average to be more competitive when applying to college or to escape the higher expectations of dual credit coursework. UTTUA students may have also migrated away from dual credit coursework due to failing one or more dual credit classes. Without metrics to unearth the reasons for students failing to persist in dual credit coursework, interventions to address those drivers will be, at best, uninformed. The culture may have devolved from an expectation of excellence and achievement to one of meeting basic requirements and compliance. As some of the campuses have, anecdotally, garnered the reputation as a catch-all for students who are struggling in a traditional high school rather than as a rigorous college preparatory institution, the culture has continued to devolve. Without specific targeted outcomes, outputs, activities, and data systems for monitoring progress, there is no reason to expect this trend to reverse itself.

Student Affective Considerations

According to Troutman et al. (2018), researchers discovered that participants in the *UT System Dual Credit Study* developed broad skills that helped them in their post-secondary coursework. The students surveyed highlighted time management, self-discipline, communicating with teachers, taking notes, studying carefully, practicing critical thinking,

accessing research tools, and using academic language as examples of their improved academic habits as a result of completing dual credit coursework. Numerous abilities that dual enrollment programs aim to develop in students, such as self-efficacy and educational expectations, have been described by other research studies to be predictive of dual enrollment student achievement as well (Dyer et al., 2022). However, as relevant as these measures may be, UTTUA students have not been surveyed in a systematic manner with regard to these habits of mind or elements of academic maturity. Any change in student perceptions of dual credit coursework and any change in associated understandings of college-level coursework expectations, time requirements, necessary study habits, or feelings of self-efficacy have remained unaddressed within the UTTUA dual credit program. These elements have not been assessed from feeder courses to graduation, nor at the beginning or end of any specific course. Without an understanding of student growth in their academic habits, feelings of self-efficacy, or other non-cognitive characteristics that may promote dual credit success, the UTTUA dual credit program will be disregarding elements critical to dual credit achievement as well as elements supportive to general student success.

Course Components

Course components include dual credit course offerings, instructor qualifications and availability, alignment, rigor, and consistency. A limited body of research has indicated that the academic performance of students may be contingent upon the classroom environment, course location, and mode of instruction (Arnold et al., 2017). Additionally, concerns over the consistency and rigor of dual credit courses taught by high school instructors have been noted across the literature (Zinth, 2015).

A review of the literature did not reveal studies examining the range of dual credit course offerings available to partnering secondary schools. Although Texas mandates that dual credit courses be offered to students in secondary schools (Texas Administrative Code, 2023), there is no requirement for colleges or universities to formally agree to provide a set of courses that would constitute a core complete assemblage. Accessing the entire range of dual credit course offerings from their accrediting university, which would reflect a STEM ready, core complete degree plan, has proven difficult for the school and district. The departments within the colleges of the UT Tyler have the option to take part in dual credit programming within the college system. However, many of the departments choose not to offer courses that provide dual enrollment or dual credit, resulting that faculty at the UTTUA have provided dual credit courses in mathematics and English language arts. Only a small number of science courses are provided for dual credit due to university departmental resistance. Texas Performance Ratings System (TPRS) data indicated that in the academic year 2020–2022 dual credit course completion rates in the UTTUA district for science were less than 20% in comparison to other core content courses. The lack of availability of dual credit science courses at UTTUA through the UT Tyler reflects poorly on both institutions. Students who wish to graduate core complete may choose to attend other schools contributing to declining dual credit enrollment at the UTTUA and perhaps UT Tyler as well.

Constrained by availability, the UTTUA schools offer dual credit coursework through a variety of platforms. It has been suggested that the mode of delivery may have some bearing on the differences in student outcomes (An & Tayler, 2019). Even though face-to-face interaction on the university campus might be the preferred delivery method, two of the UTTUA campuses are located at significant distances from the main campus to make in-person attendance

impractical. Online synchronous coursework with university faculty is another alternative for dual credit delivery. However, the UTTUA does not currently offer any courses that are delivered in that modality. A few of the UTTUA's dual credit courses, such as astronomy and history, are taught asynchronously online by academic staff. Even if certain University departments were willing to collaborate with the UTTUA on certain courses, there are currently insufficient dual credit course lab facilities across the three campuses to offer lab-linked courses. Studies on how variations in the classroom setting impact dual-enrolled students' academic development would be helpful in developing dual credit courses with higher efficacy (Taylor & Yan, 2018). The virtual delivery of dual credit courses at the UTTUA may not be something that can be rectified in the foreseeable future, especially given the distance of two of the district campuses from the main UT Tyler campus.

Some of the dual credit courses are taught by UTTUA high school teachers who are certified to instruct dual credit courses and serve as ad hoc adjuncts at UT Tyler for these specific classes. For these courses, the students located at the home campus of the course instructor participate in the course in-person while the students at the other campuses participate virtually. Academics have noted a lack of research in the area and suggest the need for additional studies (Burns et al., 2000). This patchwork of dual credit course formats is less than ideal but is driven by need.

Even though the literature on the benefits of dual credit has identified high school students' exposure to older students' college-going mindset as a possible benefit, this is not the norm at the UTTUA schools. With exception of the Tyler campus, students in the UTTUA dual credit program are separated from traditional college classmates and placed in homogeneous classes with only high school students who are pursuing dual credit as peers. According to some

research, there is a significant difference in the overall postsecondary persistence scores of high school students who are enrolled in dual credit; students who attend classes on a university campus perform better than those who finish their courses on the high school campus (Alsup & Depenhart, 2020; Hu & Chan, 2021). As with mode of delivery, the location of dual credit classes may not be an element of the program amenable to change considering the distribution of the campuses across three counties in East Texas.

The analysis contained in this study did not reveal effects on dual credit persistence related to mode of delivery, student gender, or instructor qualification level. While there may be implications of these course characteristics for dual credit persistence or achievement, they have yet to be well defined in the literature. The local implications for these choices remain unknown as well.

The various stakeholders have expressed the impression that there is a difference in the level of rigor between subject areas as well as between courses with the same course code but different instructors. Scholars have examined how pressures or constraints on public secondary systems may affect the rigor of their dual credit coursework, particularly in classes offered by high school instructors (Duncheon & Relles, 2020). While the high school faculty who instruct the dual credit courses at the UTTUA are expected to employ syllabi approved by the UT Tyler, the instructors are free to deliver the curriculum as they see fit. Researchers have noted that some colleges and universities have seen dual enrollment courses taught by certified high school teachers as having questionable rigor and quality of instruction (Martinez, 2018). The university faculty who deliver courses as part of the UTTUA dual credit program also follow a prescribed syllabi with full autonomy on depth and rigor of curriculum. Common assessments that might inform curriculum or instructional alignment are limited in the UTTUA dual credit courses. As

an example, in the dual credit English courses, the only item which might be considered a common assessment is a writing assignment that employs a rubric which is shared by the university equivalent courses but only impacts a mere 10% of the final grade. The application of the rubric, however, remains the purview of the instructor. Improved assessment and alignment of high school and postsecondary institutions are the main reform suggestions in *STEM Dual Enrollment: Model Policy Components*, which was released by the Education Commission of the States (Zinth, 2018). Without substantial measures of curriculum alignment or instructional methods across courses, it is not possible to accurately evaluate the consistency between courses. Dual credit instructors have reported difficulty due to the misalignment in curriculum standards between high school and college (Duncheon & Relles, 2020). Considering vertical alignment of the dual credit course at the UTTUA, there have also been no systematic guidelines, measures, or activities that would assist in determining alignment of curriculum and instruction from either the preparatory coursework feeding into the dual credit courses or alignment with postsecondary courses that would follow them. While other elements related to course characteristics or features may be less accommodating to change due to distance constraints, the elements of alignment, rigor, and consistency are more conducive to assessment and intervention. Failure to provide evaluative metrics for dual credit course consistency, rigor, and alignment may serve to undermine student, family and institutional trust. Additionally, the absence of assessments of course consistency, rigor, and alignment renders moot any proposed activities designed to prepare and support students entering or enrolled in dual credit programming.

Calibration or evaluation of student achievement in the UTTUA dual credit coursework as it might align with external standards has also not been employed. The UTTUA administers neither the Advanced Placement (AP) tests or College Level Examination Program (CLEP) tests

to dual credit students although the inclusion of these metrics would aid in ensuring that course offerings were adequately preparing participating students for subsequent coursework and that courses were well aligned with universal college coursework expectations. Internal dual credit course assessments have not been measured against possible universal assessments, such as released AP or CLEP tests, in order to gauge consistency of rigor and scope. The consequence of not engaging in external assessments may be minimal, but the potential information that could be gained by gauging the achievement of UTTUA dual credit students against a national norm could guide intervention efforts.

General Data Strategy

Researchers from the school district and the institution should collaborate on dual enrollment program implementation to collect data on students' progress in both high school and college, in order to make necessary adjustments between the secondary and postsecondary systems. Even though student performance is one of the most important and crucial outcomes to evaluate, programs should also consider monitoring institutional and program success (Purnell, 2014). Even though many studies and reports provide recommendations for data, analysis, and policy at the state level, there is a noticeable absence of published research exploring dual credit program implementation and the necessary measures at the student, program, and accrediting institution levels beyond enrollment and graduation metrics.

While data is collected by the district as required by state law and data focusing on student achievement in general, there has not been an overarching data strategy for the dual credit program at the UTTUA. As an example, the UTTUA dual credit program does not collect comprehensive data on the dual credit students before enrollment, during participation, or after completion. While some of the needed information on these students' demographics, academic

performance, and post-secondary intent and pathway is available, much of it is deep within various platform databases with limited access and is not intentionally and thoroughly collected regarding dual credit programming. Thorough, meaningful data has not been collected that would help evaluate the intended, implemented, and assessed curriculum, both within the same code of courses and across content. Without implementation of a strategic data strategy, data are not collected with intention, if collected at all. Without data to reveal correlations or trends, the development of corrective or improvement strategies have been built on hunches. Best-guess interventions that are uninformed by data leading to poorly identified objectives generally result in outcomes obscured by layers of impact from other variables.

Recommendations

The University of Texas System conducted a thorough analyses of dual credit offerings at Texas UT system universities in 2018 (Troutman et al., 2018). Based on the research findings published in *The University of Texas System Dual Credit Study: Dual Credit Success in College*, six recommendations were made for UT System academic institutions, with a focus on data collecting, research, and communication related to dual credit. The report suggested that universities within the UT system:

- increase data collection at the student record level for dual credit students;
- conduct dual credit program evaluations;
- examine the connection between taking dual credit courses and student achievement;
- improve communication with students and families about dual credit programs;
- assemble dual credit-related guidelines, empirical research findings, and practices; and

- improve the alignment of dual credit programs between four-year, two-year, and high school institutions.

While this report was directed at UT System institutions, the recommendations hold for public secondary institutions in general, and specifically for the UTTUA dual credit program. These recommendations are reflected in the updated logic model found later in this chapter.

Data Strategy

The recommendations shared by The Southern Regional Education Board (SREB) in *Dual Enrollment Research: A Comprehensive Review* (Southern Regional Education Board, 2020) are more specific to data collection and applicable to dual credit programs in action; that is, dual credit program data collection during the secondary years rather than after the fact. The SREB suggested that when gathering data, include longitudinal, disaggregated student-level data that considers the following:

- initial dual credit enrollment student motivation;
- alignment between secondary and post-secondary curricula;
- student characteristics that may influence dual credit success;
- location of course delivery;
- modality of course delivery; and
- instructor qualifications.

Given the current level of data for this program component, there is inadequate information to determine the underlying cause for the declining percentage of students persisting in dual credit coursework at the UTTUA. While the general decline in initial dual credit enrollment as well as the declining number of students persisting in dual credit coursework was noted, the factors influencing those trends are still unknown. Additional data collection to

include grades for dual credit coursework and audits of community, family, and student communications are recommended. Lastly, data collected should be shared across the district as well as with the accrediting university and should be accessible to district leadership as well as campus directors, dual credit faculty, and instructional coaches. Ideally, the data review would also be embedded in professional learning conversations tracking student progress and overall program health.

Activities

In addition to the recommendation for the development of a comprehensive data collection plan, this study identified activities and recommendations for overall program improvement. Immediate priority recommendations focus on student readiness and communication.

Efforts to ensure that students are ready for dual credit coursework should begin in middle school given that students are expected to begin dual credit coursework in their freshman year (9th grade). There has not been a formal preparatory program in place for these students beyond their core content coursework. Targeted instruction on post-secondary course expectations, effective academic habits, improving metacognitive skills, note-taking, reading and writing in the content areas, development of self-discipline, organization and critical thinking is recommended starting in 7th or 8th grade in order to more deliberately prepare students for dual credit coursework. Pre and post assessments are recommended to track student longitudinal effects in these non-cognitive components. Alternatively, an intensive summer course designed to prepare students for dual credit coursework may be considered.

An audit specific to the alignment between 8th grade coursework and the knowledge and skills necessary for improved achievement on the TSIA2 is recommended to identify gaps that

might prevent more students from qualifying for post-secondary coursework. Additional curriculum audits to assess the entire sequence of coursework may be added sequentially, for example, these audits could expand up (to 9th grade) and down (to 7th grade) to provide a more cohesive assessment of vertical alignment. If the identified gaps do not correlate well with the Texas Essential Knowledge and Skills (TEKS) of the assessed grade level and content area, these gaps should be addressed in dual credit preparatory class.

It is recommended that communication related to the dual credit program be improved through more frequent and more clear messaging with all communities in which the campuses function, including the families and students. Further, it is recommended that conversations, social media posts, bulk emails, newspaper articles, and parent night presentations include students and families from 5th through 12th grade with messaging dependent on audience. These communiques should include specific information on the benefits of dual credit participation, how dual credit transfer works, and academic expectations for dual credit classes.

Students entering the UTTUA schools in 5th through 8th grade should be explicitly counseled on the expectation of dual credit participation for 9th through 12th grade students as well as the benefits for dual credit achievement. Developing a culture reflecting the district's mission of graduating students ready for post-secondary STEM coursework through dual credit participation is dependent on consistent messaging and necessary for the program's sustainability. Students considering transfer to the UTTUA from a traditional high school or home school should be counseled about the expect of dual credit participation and achievement with no room for opacity. In ECHS programs, all students sign a contract affirming their understanding that their continued enrollment is dependent on their full participation in dual

credit coursework. While a non-variable contract like this is not feasible for the UTTUA, a contract outlining dual credit expectations is recommended.

Program Monitoring

It is recommended that the creation of a program monitoring and evaluation plan coincide with the development of the data strategy. The program monitoring and evaluation plan should include specific outcomes or objectives as well as measurable outputs. Further, the plan should identify frequency and methods of data collection and analysis, as well as specify departments or individuals accountable for data collection and analysis, program activities, implementation improvement, and intervention development. The suggested logic model (see Table 10) provides a framework within which to begin the development of implementation monitoring and includes evaluation specifics.

Table 10

UTTUA Dual Credit Program Logic Model

Determinant (Data resource)	Phase 1 Activity	Intermediate Output	Phase 2 Activity	Output	Outcome
Dual Credit & Non-dual Credit enrollment data	Analyze persistence data for trends and causes	Identify variables with statistically significant impact	Develop & deploy intervention based on impact variables	Increase in college credits earned	Decrease in credits needed for postsecondary degree attainment/decreased cost for students
				Reduction in on-level enrollment	Decreased cost for additional instructional platforms
Comprehensive Needs Assessment/District Improvement Plan	Review CNA/DIP for dual credit interventions	Formative evaluation of CNA/DIP priorities and resources	Recommend addition/refinement of dual credit implementation issues to CNA/DIP	Dual credit program explicitly addressed in CNA/DIP	Improved PDSA cycle

			Evaluate deficit of qualified instructors and extant incentives	Implement incentives or alternative pathways for instructor qualifications	Increased number of qualified instructors
			Recommend external testing for state and national comparison	Planning stage for external testing	Insurance of course rigor and consistency
				Increased postsecondary intent	Increased postsecondary enrollment and major options
Student survey: postsecondary intent & academic habits	Recommend student survey	Student survey development & deployment as part of DIP	Intervention development/deployment based on survey results	Improved academic habits Increased postsecondary intent	Increased academic achievement
Vertical alignment data	Recommend alignment analysis of K-12 system with CCRS	Formative evaluation of alignment of K-12 steps with CCRS	Develop training & materials to improve vertical alignment	Improved systemic vertical alignment	Improved accountability ratings of student achievement and post-secondary readiness
	Recommend alignment analysis of TSIA2 with 8 th grade TEKS	Formative evaluation of TSIA2 & 8 th grade ELA/math alignment		Improved transitional alignment to TSIA2	Increased dual credit eligibility for 9 th & 10 th grade students

While this study has focused on the elements of dual credit program implementation and monitoring within UTTUA's locus of control, research examining the dual credit relationship between the UTTUA and UT Tyler would be an important activity for overall program improvement for both entities. Improved data collection at the university level to include UT Tyler enrollment rates of UTTUA graduates, grade point average, and selection of majors would allow the university and UTTUA to consider comprehensive program improvements. The UTTUA is a Project Lead The Way (PLTW) school district, with each of the 3 campuses offering 4-year pathways for biomedical and engineering courses for all their high school

students. Considering this, the dual credit program should resolve the deficit of dual credit course availability in science as well as provide access to core requirements for students participating in biomedical and engineering pathways. The use of open educational resources (OER) such as OpenStax as a cost-saving strategy should be considered, along with consistent course design across all dual credit classes whether employing university faculty or qualified high school instructors. Currently, UT Tyler does not offer online or evening graduate courses that would allow UTTUA teachers to become dual credit qualified. A cost-benefit analysis of adding these courses may demonstrate feasibility for the UTTUA dual credit program.

Recommendations for Research

Dual credit opportunities for high school students as a state mandate are a relatively new dynamic. The need for well-constructed studies in the field is notable given the current lack of research specific to secondary dual credit programs. The research on cognitive and non-cognitive benefits of dual credit participation in general has identified correlations but has yet to fully investigate causation. Studies that investigate interventions which might impact secondary student post-secondary intent are recommended.

Research investigating the alignment of TSIA2 items with STAAR assessments should be conducted to ensure alignment with post-secondary academic expectations as well as to inform preparatory activities for secondary schools. An examination of the TSIA2 results statewide and by grade level may also yield important results. Although outside of this research, there is a need to educate university faculty and administration on the benefits of dual credit. Despite UT System reports and other reports describing the benefits of dual credit, there are a number of barriers that appear to be artificial, and philosophy-driven versus data-driven.

Conclusion

The UTTUA program outperforms other Texas high schools in terms of dual credit completion; nonetheless, there appears to be a decline in dual credit enrollment, both in terms of initial involvement and persistence. Challenges have made it difficult for UTTUA administration and faculty to offer a full menu of STEM core content, dual credit courses, resulting in a lack of optimal alignment to the school mission and charter as well as frustration for the district, campuses, and students. The internal and external barriers existing in the dual credit program between the University of Texas Tyler University Academies and the University of Texas Tyler have resulted in a progressive broadening of informal goals as well as deviation from the original mission for the district and the program. This study has identified multiple obstacles impacting the UTTUA dual credit program through a thorough program evaluation. The study has also made specific recommendations for attainable goals toward overall program improvement and monitoring.

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APPENDIX A

University Academy Courses

HS Grade offered	College Course	High School Equivalent Course	College Credit Hours	Delivery Method*
10	HIST 1301	US History I	3	2
11	ENGL 1301	College Composition I	3	1 / 3
12	ENGL 1302	College Composition II	3	1 / 3
11	POLS 2305	Introductory American Government	3	2
12	MATH 2413	Calculus I	4	1 / 3
12	MATH 1342	Statistics I	3	1 / 3
12	CHEM 1311	General Chemistry I	3	1 / 3
12	CHEM 1111	General Chemistry I Lab	1	3
09	MUSI 1306	Music Appreciation	3	2
10	HIST 1302	US History II	3	2
11/12	ENGL 2323	English Lit from the 1780's to Present	3	1 / 3
11/12	ENGL 2363	World Lit from the Renaissance	3	1 / 3
11	ECON 1301	Intro to Economics	3	2
11	MATH 2312	Pre-Calculus	3	1 / 3
12				

Charge if not all dc 12	PHYS 1303	Intro to Astronomy	3	2
Charge if not all dc	POLS 2306	Introductory Texas Politics	3	2

Delivery Methods

1.**High School Campus:** A credentialed high school instructor teaches the course on the high school campus and serves as the Instructor of Record. These courses are offered during Fall, Spring, or Year-Long terms. Some courses could be available during Summer terms.

2.**Online or Hybrid Dual Credit (UT Tyler faculty):** Online or hybrid dual credit course taught at the high school with UT Tyler faculty as instructor of record and high school teacher as facilitator/coach. This method also includes hybrid courses with online content and face-to-face requirements at either high school or college campus. These courses are offered in Fall, Spring, or Year-Long terms. Some courses could be available online during Summer terms.

3.**UT Tyler Campus (UT Tyler Faculty):** A UT Tyler faculty member serves as the Instructor of Record on UT Tyler's campus and students are responsible for reporting to the location for class meetings.

APPENDIX B

Dual Credit Stakeholder Survey

Survey Flow

Block: Stakeholder Roles (1 Question)
Branch: New Branch If If Please select your role with regards to dual credit programs. Counselor, advisor, registrar, admissions or student mentor Is Selected
Standard: Counseling, admissions, mentoring or advising (8 Questions)
Branch: New Branch If If Please select your role with regards to dual credit programs. UTT or UTTUA dual credit faculty Is Selected
Standard: Dual Credit Faculty (8 Questions)
Branch: New Branch If If Please select your role with regards to dual credit programs. UTTyler or UTTUA Administrator Is Selected
Standard: Administrators (5 Questions)
Branch: New Branch If If Please select your role with regards to dual credit programs. Parent Is Selected
Standard: Parents (7 Questions)

Start of Block: Stakeholder Roles

Q1 Please select your role with regards to dual credit programs.

- ☐ UTT or UTTUA dual credit faculty
- ☐ Parent
- ☐ UTTyler or UTTUA Administrator
- ☐ Counselor, advisor, registrar, admissions or student mentor

End of Block: Stakeholder Roles

Start of Block: Counseling, admissions, mentoring or advising

Q3 What types of challenges have you experienced in advising students with dual credit?

Q4 Does your advising approach differ based on the type of major (STEM/non-STEM) for dual credit students?

Q5 From your perspective, what are the advantages and disadvantages of dual credit participation? <div>a. Does this vary by major (STEM/Non-STEM)? </div><div>b. Does this vary by specific courses?</div>

Q6 Based on your experience as an advisor, mentor or counselor, what information would you like for high school students to have and consider when they are contemplating college credit earned during high school?

Q7 How do you think dual credit programs can be improved to meet the current structures, goals, and requirements of post-secondary education?

Q8 . In 2015, House Bill 505 removed the limitation of the number of dual credit hours for public school students, how should post-secondary education respond?

Q9 Thinking about all that has been discussed here today, what 1-2 key pieces of information do you want to communicate to high school personnel, parents, students, law/policy makers, the general public about dual credit and success at UT {campus}?

Q10 We are happy to have had a chance to discuss dual credit and its impact on academic success. Is there anything else we missed? Anything else we need to know?

End of Block: Counseling, admissions, mentoring or advising

Start of Block: Dual Credit Faculty

Q11 What skills, experiences and dispositions are necessary for success in post-secondary courses in your discipline?

Q12 From your perspective, what are the advantages and disadvantages of dual credit participation?

Q13 How does the readiness of students with dual credit (in general or for particular courses) compare to that of more traditional students or transfers from two-year institutions?

Q14 What else do we need to know about dual credit participation as it relates specifically to your campus and its programs or your discipline at your college?

Q15 How do you think dual credit programs can be improved to meet the current structures, goals, and requirements of post-secondary education?

Q16 How does or should the existence of dual credit change the ways that institutions view college and high school? What new possibilities should post-secondary institutions embrace?

Q18 Thinking about all that has been discussed here today, what 1-2 key pieces of information do you want to communicate to high school personnel, parents, students, law/policy makers, the general public about dual credit and success at UT Tyler?

Q24 We are happy to have had a chance to discuss dual credit and its impact on academic success. Is there anything else we missed? Anything else we need to know?

End of Block: Dual Credit Faculty

Start of Block: Administrators

Q19 . How does or should the existence of dual credit change the ways that institutions view college and high school? What new possibilities should post-secondary institutions embrace?

Q20 How do you think dual credit programs can be improved to meet the current structures, goals, and requirements of post-secondary education?

Q21 In 2015, House Bill 505 removed the limitation of the number of dual credit hours for public school students, how should post-secondary education respond?

Q22 Thinking about all that has been discussed here today, what 1-2 key pieces of information do you want to communicate to high school personnel, parents, students, law/policy makers, the general public about dual credit and success at UT Tyler?

Q23 We are happy to have had a chance to discuss dual credit and its impact on academic success. Is there anything else we missed? Anything else we need to know?

End of Block: Administrators

Start of Block: Parents

Q25 In what ways do dual credit opportunities impact or influence your choice of high school for your student?

Q26 In what ways do dual credit opportunities impact or influence how you advise your student regarding choice of college or university?

Q27 From your perspective, what are the advantages and disadvantages of dual credit participation?

Q28 How do you think dual credit programs can be improved to meet the current structures, goals, and requirements of college or university education?

Q29 How does or should the existence of dual credit change the ways that institutions view college and high school? What new possibilities should colleges or universities embrace?

Q30 Thinking about all that has been discussed here today, what 1-2 key pieces of information do you want to communicate to high school and university personnel about dual credit opportunities for your student ?

Q31 In 2015, House Bill 505 removed the limitation of the number of dual credit hours for public school students, how should post-secondary education respond?

End of Block: Parents
