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The Alignment Between the Algebra Curriculum at a Texas High School and the Mathematics Section of the Texas Success Initiative Assessment

Kathryn Kober
Walden University

Walden University

College of Education

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Kathryn Leigh Kober

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Review Committee
Dr. Katherine Garlough, Committee Chairperson, Education Faculty
Dr. Krystal Lupo, Committee Member, Education Faculty
Dr. Joanna Karet, University Reviewer, Education Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
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Abstract

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Kathryn Leigh Kober

MBA, Indiana University Purdue University at Indianapolis, 2001

BS, Ball State University, 1993

Dissertation Submitted in Partial Fulfillment

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Abstract

The primary purpose of this qualitative study was to examine the Algebra I and Algebra II mathematics course curriculum documents at a local high school to determine alignment to the mathematics section of the Texas Success Initiative Assessment (TSIA) and to identify content necessary for students to demonstrate college readiness in mathematics on the TSIA. Revised Bloom's Taxonomy (RBT) was used to analyze the curriculum documents for alignment to the TSIA content and answer the research question that look for alignment between the Algebra I and Algebra II curriculum documents and the TSIA for mathematics. This study used a qualitative methodology and a basic design. Data were collected through document analysis with several iterations, including familiarization, identification, indexing, charting, and interpretation, which was used as the qualitative methodology with a basic qualitative design. Key results from the document analysis showed a misalignment between the Algebra I and Algebra II curriculum documents and the TSIA sample questions. The first theme was major misalignment occurring when most content taught in Algebra I and Algebra II needed to be tested on TSIA. The second theme was minor misalignment when some content tested on TSIA needed to be taught in Algebra I and Algebra II. The third theme was that minor alignment occurs when some content tested on TSIA is taught in Algebra I and Algebra II. The implications for positive social change may be that college admissions will be more accessible for students at the local site by improving the local mathematics curriculum implementation.

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Dedication

I dedicate this project study work to my family, who taught me that I could do anything I set my mind to. My loving parents, Claudia and Eugene, constantly encourage me to be my best version of myself. My exceptional children, Madison, Delaney, Courtney, and Wyatt, have always believed in me, supported my efforts, and helped me keep my head up to focus on my goals. Their love has sustained me through this journey to reach the goal of graduation.

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Section 1: The Problem

The Local Problem

The problem addressed in this study is that according to the Texas Success Initiative Assessment (TSIA) data for the 2018-2019 academic year, most students in a local high school in Central Texas are not prepared for introductory-level college mathematics (TEA TAPR, 2021). While more than half of students (52.1%) in the state of Texas were not college-ready in mathematics, 70.9% of the students at the local site were not prepared, per the Texas Education Agency's Texas Academic Performance Report (TEA TAPR, 2021). Test scores have been trending downward by 1% per year for students across Texas, as measured by college readiness in mathematics from the previous school year (TEA TAPR, 2021 & 2020). The Texas high school in the study had a drop of 3% in test scores for college readiness in mathematics of the prior year (TEA TAPR, 2021 & 2020). When students do not meet the minimum score on the mathematics section of the college placement exam, they must pass a zero-credit mathematics course to be eligible to enroll in the entry-level college mathematics course (Barringer-Brown & Lynch, 2022). The gap in practice examined in this study was that the content required to perform well in the mathematics TSIA section was assumed to be provided in the curriculum of the study site's Algebra I and Algebra II courses.

Historically, course-taking patterns have been how many colleges deemed students ready for introductory-level college mathematics courses and the benchmark scores on college admission exams (Woods et al., 2018). There needs to be more investigation regarding traditional thoughts about rigor, how rigor is utilized in K-12 mathematics, and assessing students' mathematical abilities (Dana Center, 2020). Rigor means a balance of procedural skill and fluency, conceptual understanding, and application in K-12 mathematics (Dana Center, 2020; Egodawatee, 2022; Mahaffey, 2021). Rigor can be accomplished in all secondary mathematics courses, dependent upon implementing curriculum, instructional materials, and teacher competencies; however, higher education institutions still believe high school Algebra II indicates rigor. Higher education institutions base many admissions decisions on completing the Algebra II course, even if other mathematics classes have more rigorous instruction and curriculums (Dana Center, 2020).

Rationale

Students who are not college-ready in mathematics are disadvantaged when attempting to attend college (Brower et al., 2021; Mokher & Jacobson, 2021). This disadvantage is due to learning deficiencies that make deep reading, deep learning, and active learning challenging for the students while still critical for college preparation (Sullivan et al., 2020). Preparing students for success in introductory-level mathematics courses in college was hindered by the school curriculum and course-taking patterns (Bicak et al., 2022; Tyson & Roksa, 2016). Although primary high school coursework is sufficient preparation for passing introductory-level college mathematics courses, and honors courses help increase the likelihood of success for students (Armstrong et al., 2021; Woods et al., 2018), students need to focus on the content in their secondary mathematics courses to ensure they are thriving on university entrance exams such as the

TSIA, the SAT, or the ACT to prepare for college-level mathematics courses (Hennessey et al., 2021; Hodges et al., 2021).

Another factor in assessing the college readiness of high school graduates was the misalignment of mathematics (Johansson et al., 2022). Alignment may indicate that high school preparation was adequate and that high school exit and college entrance standards are comparable (Johansson et al., 2022; Ngo & Melguizo, 2021). In contrast, misalignment showed a disconnect between high school and college standards, along with disjointed systems (Brower et al., 2021; Ngo & Melguizo, 2021). The alignment or misalignment of mathematics content measured the student support, social agreements, and transition processes to college that students will need to succeed (Johansson et al., 2022; Ngo & Melguizo, 2021).

In the 1920s, the Scholastic Aptitude Test (SAT) was developed to assess students' potential for college success and began the era of standardized testing. President Jimmy Carter signed the Department of Education Organization Act into law in 1979 (US Department of Education, n.d.). The Department of Education's mission is to "promote student achievement and preparation for global competitiveness by fostering educational excellence and ensuring equal access" (US Department of Education, Overview and Mission Statement, para. 1). The American College Testing (ACT) program was first introduced in 1959. The SAT and ACT have been standard requirements for many universities in the United States since their inception (US Department of Education, n.d.).

ACT reported that 39% of the 1,782,820 high school graduates in 2019 met the ACT benchmark for college readiness in mathematics (ACT, 2019), with previously reported statistics of 42% in 2015, 41% in 2016 and 2017, and 40% in 2018 (ACT, 2019). This national data demonstrate the same downward trend as the Texas data from the TAPR, showing that in the 2019-2020 school year, 47.9% of students across Texas were college-ready in mathematics, according to the TSIA, down from 48.6% the year before. A local high school had 29.1%, down from 32.1% the previous year, of students demonstrating college readiness in mathematics (TEA TAPR, 2021).

The Texas state legislature put into law the requirement to have the Texas Success Initiative Assessment (TSIA) in reading, writing, and mathematics to place students in appropriate classes through Texas Legal Code §51.333. There have been policy changes since the original law was passed, including House Bill 5 (HB5), which removed the requirement for students to complete the Algebra II and English III STAAR End Of Course (EOC) exams for high school graduation (THECB, 2017). The Texas Higher Education Coordinating Board (THECB) has proposed several strategies to improve students' achievement toward college readiness, including evaluations like the TSIA (THECB, 2017). The data received from the TSIA is intended to help counselors provide better guidance in course selection for college-level courses, including placement in developmental education courses or corequisite courses as needed by the student (THECB, 2017). The TSI is used to assess students' academic skills level to determine the most appropriate placement in courses for first-year students in college (19 TAC §4.55). This allows an individual plan to be created for students' academic achievement that may not meet the standard for college readiness (19 TAC §4.58).

The TSIA is utilized as a diagnostic test for determining placement in developmental education as appropriate (College Board, 2020); however, there are exemptions that students may be able to qualify for exemption from taking the TSIA, including meeting specific SAT and ACT scores or completing an approved high school College Preparatory Course (College Board, 2020). Other measures, such as academic background, goals, and interests, may be used by counselors and academic advisors to place students in the appropriate course to match the student's achievement level (Caruth, 2018; College Board, 2020). The TSIA was updated, and the new TSIA2 was first administered in January 2021, covering four content categories: quantitative reasoning, algebraic reasoning, geometric and spatial reasoning, and probabilistic and statistical reasoning (THECB 2021).

THECB's strategic plan from 2000, *Closing the Gaps by 2015, Texas*, intended to improve student achievement and close the educational gaps in mathematics (THECB, 2016). THECB, with their current strategic plan, 60x30TX, set several new goals: a) at least 60% of Texan residents that are between the ages of 25 to 34 to have a certificate or degree by 2030, b) at least 550,000 students will complete a certificate or degree from a higher education institution in Texas, c) graduates from Texas public institutions of higher education to complete programs with identified marketable skills, and d) undergraduate student loan debt not exceeding 60% of the first year wages for graduates (THECB, 2021). Texas House Bill 2223, passed in 2017, requires higher education institutions to develop corequisite remediation models to pair developmental education courses with freshman-level mathematics courses to help more students reach college-level mathematics and, eventually, undergraduate degree completion (Texas HB 2223, 2017).

Completing the required mathematics courses in college is a significant barrier for many students and makes the goal of a college degree elusive. Preparation for college readiness in mathematics in high school is an intervention to help students be more successful (Armstrong et al., 2021; Mokher & Jacobson, 2021). The design of developmental education courses, either through prerequisite or corequisite courses, must consider comprehensive interventions to offset the negative connotations of developmental education and help support students' future success (Boatman, 2021; Zhang, 2018).

The alignment of high school mathematics standards and college-level mathematics courses is a critical component, as well as showing readiness through the currently accepted measures that higher education reviews (Hong et al., 2019; Barnett et al., 2018). Texas HB 2223 requires using TSIA to place students into college-level coursework, thus limiting the number of classes students take that do not count toward a degree to meet the THECB 60x30TX plan and improve the educational outcomes of Texas residents (THECB, 2021).

The Texas Higher Education Coordinating Board first adopted College and Career Readiness Standards (CCRS) in January 2008 based on a law passed by the Texas Legislature in 2006 requiring their development (THECB, 2021). The Texas College and Career Readiness Standards (TxCCRS) provide a framework for what students should know and be able to do to succeed in entry-level college courses after graduation from high school (THECB, 2021). These standards were written in response to a need to try to help high school graduates be better prepared for college-level courses by improving the alignment between secondary and post-secondary curricula and that high school graduates complete Algebra II and a mathematics course after Algebra II to be better prepared for entry-level college mathematics courses (THECB, 2021). This qualitative study aimed to examine the Algebra I and Algebra II mathematics course curriculum documents at the local high school to determine alignment to the mathematics section of the TSIA and to identify content necessary for students to demonstrate college readiness in mathematics on the TSIA.

Definition of Terms

ACT: This organization works to help people achieve education and workplace success. One of the tools they utilize for this purpose is the ACT assessment, which allows for determining the college readiness of students (ACT, 2019)

College readiness in mathematics: In Texas, college readiness in mathematics is defined by the Texas Administrative Code (TAC) to include numeric reasoning, algebraic reasoning, geometric and spatial reasoning, probabilistic reasoning, statistical reasoning, functions, problem-solving and reasoning, and connections (Texas Administrative Code, Title 19, Part 2, Chapter 74 Subchapter A, Rule §74.6(b)).

Content: Content refers to the amount and organization of knowledge that a person can share with others and is the “what” of instruction (Deng, 2018).

Corequisite: Corequisite is a strategy that requires students to enroll in a developmental education course simultaneously with the introductory level course to provide support for the student to complete the college credit course (Texas Administrative Code, Title 19, Part 1, Chapter 4 Subchapter C, Rule §4.53 (7)).

Curriculum: The curriculum outlines concepts to be taught and a framework of expectations for student learning (Deng, 2018).

Developmental education: Developmental education is assistance received before college coursework to help ensure a student's success in introductory level college courses (Texas Administrative Code, Title 19, Part 1, Chapter 4 Subchapter C, Rule §4.53(10)).

Instructional focus documents: These documents are curriculum documents prepared for Algebra I and Algebra II courses that package the Texas Essential Knowledge and Skills (TEKS) into units of study, along with the specificity of each standard within that unit (TEKS Resource System, n.d.)

Mathematics literacy: Mathematics literacy refers to mathematical and content knowledge, mathematical reasoning, understanding of the social impact of mathematics, understanding of the utility of mathematics, and the ability to problem-solve at levels of proficiency necessary to be a productive member of the community (Hayati & Kamid, 2019).

SAT: The SAT is a standardized test colleges use for admissions in the United States. The first tests were administered in 1926 and continue to be a standard assessment used to demonstrate college readiness and are administrated by the College Board (College Board, 2022).

TEKS: The TEKS provided educators with the origin of instructional content they are to deliver to students in conjunction with the TxCCRS standards. TEKS and TxCCRS provide the foundation on which the TSIA is written as the assessment instrument for college readiness in mathematics. The connection between standards, curriculum, and assessment is intended by the state of Texas (Texas Administrative Code, Title 19).

Texas Higher Education Coordinating Board (THECB): This board was created in 1965 by the Texas legislature to develop policies and practices to meet higher education requirements, including serving as a resource, partner, and advocate for Texas higher education (Texas Higher Education Coordinating Board, 2021).

Texas Success Initiative (TSI): TSI was mandated by the 78th Texas legislature. The purpose of TSI is to measure competency in reading, writing, and mathematics to provide developmental studies in identified deficiencies. Texas students not eligible for an exemption or waiver must take an approved placement test before enrolling in any Texas public college or university (Texas HB 2223HB17).

TSIA: Since 2013, the approved assessment has been the Texas Success Initiative Assessment (TSIA) (Texas Success Initiative Overview, 2017).

TxCCRS: Texas College and Career Readiness Standards (TxCCRS) were established by the Texas Higher Education Coordinating Board (THECB) to establish the knowledge and abilities that students should be able to demonstrate to succeed in entry-level courses at higher education institutions (THECB Report, 2021 & 2017).

Significance of the Study

The findings of this study may help high school educators in Texas make course curriculum adjustments to meet college preparation needs in mathematics. Providing a college-readiness curriculum through assignments and formative assessments can allow time for secondary schools to support student growth and development, enabling students to be college-ready by the end of high school (Mokher, 2019). By analyzing the alignment of Algebra I and Algebra II curriculum documents with the TSIA in mathematics, the research site can adjust its delivered curriculum to support students successfully demonstrating college readiness in mathematics on the TSIA. The study provided the local site with an understanding of the curricular gaps that exist to create a complete experience for students and allow students to effectively demonstrate their college readiness by being fully prepared for the TSIA in mathematics. Implementing an improved curriculum will support student preparation and confidence to perform the assessment successfully. The enhanced curriculum will support teachers in matching the written curriculum to the intended and enacted curriculum to improve student success as determined by the TSIA. The qualitative results provided the foundation for professional development initiatives to improve instructional strategies for secondary mathematics teachers to address college readiness in mathematics in Texas public schools while improving the alignment of the curriculum to the assessment.

Research Question

Nearly 60% of the students from the research site need to prepare for introductory college-level mathematics (TEA TAPR, 2021). While many reasons contribute to the issue, one issue may be the alignment of Algebra I and Algebra II curricula and the TSIA mathematics section content. Determining the points of content alignment through a document analysis could provide the research site with the knowledge needed to improve the Algebra I and II curriculum.

RQ: How do the content in the Algebra I and II curriculum documents in a central Texas high school and the TSIA for mathematics align?

Review of the Literature

Conceptual Framework

Revised Bloom's Taxonomy (RBT) (Anderson et al., 2001; Radmehr & Drake, 2019) is the conceptual framework that supported this study. RBT is a two-dimensional framework that analyzes curriculum documents and educational objectives in more detail than could be achieved from a one-dimensional framework (Radmehr & Drake, 2019). The two dimensions are the knowledge dimension and the cognitive process dimension. The knowledge dimension has four types of knowledge: factual, conceptual, procedural, and metacognitive (Anderson et al., 2001). The cognitive process dimension has six categories: remember, understand, apply, analyze, evaluate, and create (Anderson et al., 2001). Each knowledge and cognitive process category is broken down into subcategories: 11 in the knowledge and 19 in the cognitive process dimensions (Anderson et al., 2001). The 11 subcategories of the factual, conceptual, procedural, and metacognitive knowledge dimensions help analyze the curriculum. Factual and conceptual knowledge involves the "what," with conceptual going deeper through a systematic, organized, and integrated approach to knowledge (Anderson et al., 2001).

Procedural knowledge is the "how" knowledge that supports action (Anderson et al., 2001). Metacognitive knowledge is based on the knowledge of thought and understanding (Anderson et al., 2001). The 19 subcategories in the cognitive processes of remembering, understanding, applying, analyzing, evaluating, and creating help identify ways to transfer learning and retain learning (Anderson et al., 2001).

A comparison of RBT with other significant theories and frameworks used to study the teaching, learning, and assessment of mathematics showed that while the other frameworks can be aligned to RBT, they tend to overlook other elements of RBT that make RBT a more robust framework to use for alignment between Algebra I, Algebra II, and TSIA (Radmehr & Drake, 2019). Frameworks will benefit those that adapt those frameworks for their purpose (Anderson et al., 2001). The RBT seeks to keep the fundamental essence of the original framework while incorporating ideas from other frameworks that will create a revised version to be more user-friendly as it supports educators in their work (Anderson et al., 2001).

The logical connection between the framework presented and my study is that RBT has been used for the Mathematics in Texas in the Texas Essential Knowledge and Skills (TEKS) for mathematics adopted in 2012 for all grades K-12. The TEKS can be divided into competencies associated with the domains of RBT, as seen in Table 1 (19 TAC Chapter 111).

Table 1

Mathematics Process Standards of the TEKS and RBT Verbs

TEKS Competencies	RBT Domain
Selecting tools to solve problems	Remembering
Communicate mathematical ideas, reasoning, and implications.	Understanding
Apply mathematics to problems.	Applying
Use a problem-solving model.	Applying
Analyze mathematical relationships to connect and communicate mathematical ideas.	Analyzing
Display, explain, and justify mathematical ideas and arguments	Evaluating
Create and use representations to organize, record, and communicate mathematical ideas.	Creating

Note. From TEKS mathematical process standards from TEKS for mathematics, 19 TAC Chapter 111 and Anderson et al., (2001).

The mathematics process standards of the TEKS help describe how students engage with the content, while the process skills are incorporated into the assessment questions for a more accurate evaluation (TEA, 2021). I used RBT to analyze the curriculum documents using framework levels for a priori categories. RBT connected the components of the mathematics curriculum resources through levels of cognitive complexity provided by the framework's 31 subcategories of educational objectives of the cognitive domain (Anderson et al., 2001). RBT identifies six levels: remembering, understanding, applying, analyzing, evaluating, and creating (Anderson et al., 2001). The framework further identified four areas of knowledge: factual, conceptual, procedural, and metacognitive (Anderson et al., 2001). Each knowledge and cognitive process category has two to seven subcategories that allow for detailed alignment analysis through the framework to analyze curriculum content (Anderson et al., 2001). The RBT was used over the original Bloom's Taxonomy (1956) as the TEKS were written based on the RBT and provided the basis of the course curriculum for Algebra I and Algebra II. RBT made a robust framework to analyze the TEKS because the adjusted definitions of knowledge and cognitive processes are a better fit for examining the curriculum as it aligns with assessments (see Krathwohl, 2002). Applying RBT supported the students' process of developing solutions to mathematical problems and understanding their knowledge through the questioning process (Steyn & Adendorff, 2020).

Review of the Broader Problem

A review of the literature on the problem of the alignment of high school Algebra I and II curriculum documents to the TSIA began with a search of previous studies on the topic. The key terms college readiness and mathematics were used to determine the most relevant research on college readiness in mathematics and the alignment of high school algebra curriculums. The initial list was refined by limiting the peer-reviewed articles to anything from 2018 or more recently. Reviewing this list of articles and starting to read them for relevance to the problem of high school graduates needing to be sufficiently prepared for introductory-level college mathematics courses, the reports that had high relevance were used to reference the source articles those authors used for additional background information. Searching through the other reference articles helps increase the research's breadth and obtain saturation. Additional terms to repeat the process included *assessment*, *curriculum alignment*, *mathematical competencies*, *algebra curriculum*, and *Texas Success Initiative*.

This initial search needed more information provided for a complete literature review; therefore, the headings were adjusted to be a little broader to find literature better aligned with the problem and research question. This process included searching for *math curriculum, math or STEM in high schools in Texas, teacher preparation, placement* *testing, curriculum policy, math content in high schools in Texas, teacher content knowledge*, and *college readiness*. A literature search allowed the categories of *high school algebra curriculum* and *college placement testing in mathematics* to be utilized with a subheading for *college readiness in mathematics*.

Teachers' Content Knowledge (CK) in High School Mathematics

CK is the understanding of concepts, principles, relationships, processes, and applications teachers must know to teach their students the content (Jacob et al., 2020; Dreher et al., 2018). Critical to teaching practice is knowing the difference between content knowledge (CK), which is the ability to do algebra, and pedagogical content knowledge (PCK), which is the knowledge of how to teach the content for student success (Sharpe & Marsh, 2022). Furthermore, it is critical for teaching to understand the content and the knowledge of the subject matter it provides and why the content exists, which requires a deep understanding to share that CK with students (Dreher et al., 2018; Jacob et al., 2020). In mathematics, CK is vital for teachers to effectively teach mathematics with an organized plan and appropriate instructional strategies for student success in learning (Moh'd et al., 2021). Teaching mathematics requires educators to develop mathematical knowledge specialized to teaching mathematics through analyzing student work and assessing the student's understandings and misconceptions (Gess-Newsome et al., 2019; Stevenson, 2020). The ability to not only perform the required mathematics themselves but be able to explain how and why the processes and procedures work within the content and the connections between the current content with other content that will be taught require another dimension of mathematical understanding that teachers must be able to excel at to instruct students in mathematics successfully (Boaler, 2016; Stevenson, 2020). To be able to understand mathematics deeply, there must be an ability to justify mathematical thinking, communicate mathematical explanations to others, understand how and why procedures work, make connections between concepts and practices, and see structures and patterns in mathematics (Gess-Newsome et al., 2019; Stevenson, 2020).

PCK requires the teacher to be competent in delivering the conceptual approach, relational understanding, and adaptive mathematics reasoning to support successful student learning (Jacob et al., 2020). PCK supports mathematics content knowledge with other knowledge of teaching and learning to create a comprehensive learning experience for students (Copur-Gencturk, & Doleck, 2021; Moh'd et al., 2021). Effective mathematics teaching at the secondary level will be improved with the level of mathematics PCK, and enhancing teachers' levels of PCK will improve students' performance in mathematics courses (Moh'd et al., 2021). Teachers cannot only be proficient in secondary mathematics, but they must develop specialized knowledge for teaching mathematics, or PCK, based on six kinds of knowledge: common content knowledge (solving problems, recognizing errors), horizon content knowledge (how mathematics topics fit together), specialized content knowledge (specific to teaching mathematics), knowledge of content and students (how students learn mathematics), knowledge of content and pedagogy (task selection and sequencing), and knowledge of content and curriculum (materials and resources for teaching mathematics) (Arnold et al., 2020). Pedagogical knowledge (PK) involves the strategy that allows a teacher to present information to students in a way that engages students in their learning (Jacob et al., 2020).

Developing educators' PCK incorporates skills and strategies, including lesson planning, student monitoring, and personal reflection, to help improve their craft and their students' mathematical proficiency (Güler & Çelik, 2021 & 2018; Tachie, 2021). Additionally, classroom instructional practices of questioning strategies, student work, discussion monitoring, and metacognitive strategies further supported improving students' mathematical abilities (Tachie, 2021). The significant difference between CK and PCK is the understanding and knowledge of students and the students' pre-knowledge, learning, and misconceptions (Gess-Newsome et al., 2019; Güler & Çelik, 2021 & 2018).

The Connection Between Curriculum and Mathematics Content

At the national level, high expectations through more rigorous college-ready standards have been the policy focus since the 2001 No Child Left Behind Act (Urick et al., 2018). The No Child Left Behind Act was amended under the 2015 Every Student Succeeds Act (ESSA), requiring every state to administer math and reading tests annually in grades 3-8 and at least once in high school (Adler-Greene, 2019; Urick et al., 2018); however, ESSA removed requirements that states had to provide parental notification if their schools needed improvement if their child is being taught by a teacher who is not highly qualified and information on teacher quality to parents (Adler-Greene, 2019; Green et al., 2021). While the curriculum is essential for student success, these changes through ESSA could create opportunities for states to develop standards and assessments with little oversight (Adler-Greene, 2019).

Texas designated TEKS as readiness or supporting standards at the state level to become more competitive in the national and international environments (Barlow et al., 2018). By grade level, the standards were reviewed for what was considered “essential for success” for students to succeed in the next grade level. These standards were categorized as readiness (Barlow et al., 2018; Cheung et al., 2021; Saldivar, 2021). Standards that supported preparation for the next grade level and were not considered essential were classified as supporting standards (Barlow et al., 2018).

In addition to the grade-level standards, the student’s learning progression was critical in preparing a curriculum that would improve student achievement. Instructional materials have several features that support student outcomes through their learning progressions, including the development of terminology, procedures, nature of tasks, and collections of problems (Akiba et al., 2019; Choppin et al., 2022; Duschl, 2019; Perrotta & Selwyn, 2020). Each of these features of instructional materials can be evaluated through the delivery mechanism and thinking device (Choppin et al., 2022). The delivery mechanism focuses on efficiency and developing expert performance through chunking content into small pieces of knowledge that, when delivered and mastered, can show competence in the concept (Cavanagh et al., 2020; Choppin et al., 2022; Taylor et al., 2021). The thinking device approach focuses on developing thinking; concepts represent big ideas connecting multiple topics or concepts (Choppin et al., 2022).

Another factor beyond the grade-level standards is the teacher's understanding of the curriculum as essential to student learning and success. Teacher understanding can be based on experience, systematic and explicit instructional practices, using concrete and pictorial representations, creating opportunities for discussion and feedback, differentiating core instruction, monitoring student responses to teaching, coordinating vocabulary instruction, and creating additional practice opportunities are all strategies teachers should employ to support student content growth (Nelson et al., 2020; Row, 2022; Sotto, 2021). Jean Piaget and Lev Vygotsky developed constructivist theories that support discovery and collaborative learning where the teacher facilitates student learning while scaffolding helps the student process complex and rigid materials (Kayii & Akpomi, 2022; Sotto, 2021).

Making the connection between curriculum and mathematics content can support teacher development for the teacher to be better prepared to help students master grade-level content and be ready for the TSIA, SAT, or ACT to demonstrate college readiness in mathematics (NIET, 2020). The curriculum progression takes you from the what (content and standards) to the why (basic instruction), to the how (pedagogy), to for whom (emerging differentiation), to by whom (student-led learning) (NIET, 2020; Staynezer & Lom, 2019; Trenholm & Peshke, 2020). Being able to provide teachers with specific feedback related to each of these stages of curriculum development will allow for better utilization of curriculum resources to support student growth, understanding, and achievement, preparing the student for successfully demonstrating college readiness in mathematics (Leeds & Mokher, 2020; NEIT, 2020).

Teachers' decisions regarding curriculum resources happen at several process stages (Amador, 2019; Dingman et al., 2021; Siuty et al., 2018). They are essential for evaluating teaching and learning mathematics and the instructional cycle (Dingman et al., 2021; Wæge & Fauskanger, 2021). Analyzing curriculum materials, mapping learning trajectories, considering mathematical meanings, and revising curriculum materials are all points of decision-making that teachers attempt to meet the needs of their students (Dingman et al., 2021). Some of these decisions can lead to implementation gaps in instruction that persist even after adopting rigorous standards (Edgerton & Desimone, 2018). A study found that 82% of educators thought the students lacked the knowledge to succeed in entry-level college mathematics (Er, 2018). Of those educators, 60% thought it would take students less than a semester to a year to attain college readiness, while 21% thought it would take two or more years to achieve college readiness (Er, 2018).

Students utilize several aspects of learning ability, including conceptual, procedural, problem-solving, communication, reasoning, and representation ability, to demonstrate an understanding of the curriculum (Afgani et al., 2019; Dingman et al., 2021). The type of high school a student attends and the choice of courses can positively influence a student's success when they choose a science or STEM-focused pathway (Arias et al., 2021; Zhao & Perez-Felkner, 2022). It has been found that many tasks used in classrooms are closed-ended, lower-level cognitive tasks that tend to emphasize memorization and automated computation, which do not lend themselves to providing students opportunities to develop critical and creative thinking, deep conceptual understanding, or application and modeling skills (Berisha & Bytyqi, 2020). Reviewing curriculum resources should include an analysis of problem-solving and if the materials use an approach to teach problem-solving, to teach problem-solving, or to guide through problem-solving (Bingolbali & Bingolbali, 2019).

For students to build meaningful knowledge, a reflection process should be in place to support student interaction with the curriculum to create engagement and a sense of community for learning (Buitrago-Flórez et al., 2021). Additionally, it is essential to note that calculation skills are not the sole indicator of mathematical knowledge, as the skills of reasoning, reading ability, and calculation are all necessary to perform adequately on assessments of mathematical knowledge (Anselmo et al., 2021; Fyfe et al., 2019; Hornburg et al., 2018). Math is cumulative, and each year builds upon the foundation created in the prior year requiring students to connect concepts in a progression that is interdependent on concepts learned in multiple years of their education (Rose, 2020). This interconnectedness requires spiraling of ideas and questions to reinforce skills that would make learning gaps impossible if not retained. With limited instructional minutes, educators do not always have the time to ensure these learning gaps are not made (Rose, 2020).

Mathematic concepts and topics are based on logical and conceptual connections that students must understand to flexibly apply mathematics to situations and problems (Cogan et al., 2019). A coherent and quality mathematics curriculum that builds on previous concepts and competencies over the years is required for students to develop this understanding (Cogan et al., 2019; Roehrig et al., 2021). Deficiencies in student understanding will result in knowledge gaps for students, making continuing in mathematics pathways more challenging if these connections are not ensured (Bakar & Ismail, 2020; Cogan et al., 2019). The productive struggle within the student's zone of proximal development and student thinking visible to others are critical components to pushing the curriculum to the level that will support creating college-ready students (Schoenfeld, 2020).

Evaluating the alignment of instructional materials, including learning guides, textbooks, and assessments, is an integral part of educational systems (Dhlamini, 2021; González & Quiroz, 2019). Alignment focuses on how educational components relate (Dhlamini, 2021). Misalignment of instructional materials and assessments makes it difficult for teachers to fully prepare students for their next step of education (Dhlamini, 2021; Tang et al., 2020).

From the literature on high school algebra curriculum, my interpretation of the studies shows that there is a disconnect between the curriculum put in place by the state, the resources available for educators to use for instruction, and the outcomes that are desired to be demonstrated by the college math placement tests. There needs to be more connection between the state standards at the secondary level and the desired outcomes of introductory-level mathematics courses, as seen in the challenge K-12 educators have in correctly preparing students for post-secondary studies.

College Placement Testing in Mathematics

Historically, the two dominating placement tests have been the College Board's ACCUPLACER and ACT Inc.'s COMPASS assessment instruments (Sole, 2020; Ngo et al., 2018). ALEKS (Assessment and Learning in Knowledge Spaces) is offered by

McGraw-Hill and is an adaptive system that develops a map of student knowledge based on machine learning and artificial intelligence utilizing Knowledge Space Theory (Ayele et al., 2022; Cosyn et al., 2021; Doble et al., 2019). Texas created its version of a placement test with the TSIA (Texas Success Initiative Overview, 2017). Placement tests tend to place students into developmental courses that are different from the proper placement due to the need for the test's ability to predict non-cognitive characteristics such as a growth mindset and openness to seeking help (Sole, 2020). The placement in developmental education mathematics courses may be an effect because many students are only told they will take a placement test once test until they arrive on campus. They are unprepared for the assessment, unaware of the purpose of the evaluation, and unaware they can retake the examination (Coleman & Smith, 2021). Many students in developmental education courses never complete the developmental courses to complete their degrees (Logue et al., 2016; Logue et al., 2019).

Colleges use measures for admissions, including TSIA PSAT, SAT, and ACT, and college-specific admissions assessments (Allensworth & Clark, 2020; Galla et al., 2019; Sole, 2020). A study conducted in 2011 found that over 90% of community colleges used placement tests to assess college readiness (Barnett et al., 2020; Ngo & Melguizo, 2021). A survey completed in 2018 showed that over 50% of community colleges were using multiple measures, indicating that the idea of college readiness has evolved over the years, and how to offer these measures has changed (Ngo & Melguizo, 2021).

The Transition to College Mathematics (TCM) course developed by the Charles A. Dana Center at the University of Texas is one way the Dana Center has worked to remove barriers to mathematics learning and increase the availability of courses that prepare students for high education mathematics (Barnett et al., 2022). Completing this course helps students to be more successful on college placement tests, including the TSIA, and supports their success in introductory-level college mathematics courses (Barnett et al., 2022). Mathematics abilities are one of many barriers to success on college placement tests. Metacognitive reading comprehension monitoring strategies have impacted students' success on college mathematics placement tests (Sand et al., 2020). Math knowledge, multiple approaches to problem-solving, re-reading questions, critical thinking skills, and persistence support student success on mathematics placement tests (Sand et al., 2020; Santangelo et al., 2021).

Mathematics college placement testing has been a tradition many institutions now see may need a better policy or procedure (Cohen & Kelly, 2019; Logue et al., 2019). Many factors play into a student's success in introductory-level mathematics courses that cannot be identified by a placement test alone (Logue et al., 2019). The placement test allows a glimpse of a student's content at a given point and time (Logue et al., 2019; Widana et al., 2018). Still, placement tests are not good indicators of a student's motivation, growth mindset, or willingness to ask for help (Logue et al., 2019).

College Readiness in Mathematics

Students' academic ability and cognitive skills have been the direct measurements of college readiness of students (Alkharusi et al., 2019; Ngo et al., 2018). Most students believe that successful completion of high school education will prepare them for college. Still, the reality is that many students need to prepare and are placed in courses to prepare them for college-level classes (Xu et al., 2022).

Community colleges provide an alternative pathway for students to become college ready in mathematics through their developmental mathematics programs designed to support student preparation for college-level mathematics courses (Peralta et al., 2020). 62% of students that enroll in community colleges take high school Algebra II, and only approximately 18% have taken courses beyond Algebra II that would prepare them for precalculus (Peralta et al., 2020). The effectiveness of developmental education and remedial programs depends on the fidelity of implementation, the targeted interventions utilized, and the criteria used to place students in these programs (Boatman, 2021). Supporting students and allowing engagement with other courses before college-level mathematics could help remove some barriers and support the successful completion of mathematics courses by students more at risk through community, mentoring, and participation (Sansing-Helton et al., 2021). Mathematics readiness is essential for other studies in post-secondary education as other classes require mathematical concepts to support their learning (Woods et al., 2018; Zhan, 2020).

According to the research, college readiness in mathematics can be determined through college placement testing, developmental education coursework, and multiple measures, including high school grade point averages, high school courses completed, and high school class rank (Ganga & Mazzariello, 2019; Leeds & Mokher, 2020). The additional factors help provide a more well-rounded picture of students' potential to succeed in introductory-level mathematics courses (Leeds & Mokher, 2020). The growing body of research on college placement tests indicates that placement tests alone are poor indicators of student success in college (Ganga & Mazzariello, 2019). As more colleges utilize multiple measures, the college placement test will lose its dominant position as the gatekeeper to students admitted to introductory-level mathematics courses (Ganga & Mazzariello, 2019).

Implications

The literature review indicated that the connections between the high school algebra curriculum and college-readiness assessments in mathematics must be critically analyzed to support students and educators in both the K-12 and higher education settings. The implication that the high school algebra curriculum does not adequately prepare students for introductory-level college mathematics, as demonstrated on the TSIA, was shown through the data collection and analysis process. Many variables in the content must be learned for a proficient understanding of mathematics by students. The educators' decisions to implement Algebra I and Algebra II content affected students' abilities to demonstrate their college readiness. That deficiency was exacerbated if the curriculum and assessments were not aligned. Precise alignment between the delivered curriculum and the assessment tools was necessary for students to demonstrate their understanding and ability to meet the demands of introductory-level college mathematics courses. The project resulting from the data analysis helped inform secondary mathematics instructors regarding the gaps in practice and curriculum to help those educators better prepare students for introductory-level college mathematics courses.

Summary

This study aimed to examine the current Algebra I and Algebra II curriculum and the current TSIA in mathematics content and questions to better align the content students need to demonstrate college readiness in mathematics successfully. The research problem was that most students in Texas high schools need to prepare for introductory-level college mathematics courses (TEA TAPR, 2021). The definitions of terms, the significance of the study, and the research question focused on the high school algebra curriculum and the adjustments secondary educators need to make for high school students to be prepared for college introductory-level mathematics courses. The literature review created the basis of the knowledge concerning high school algebra curricula, placement assessments, and college readiness for mathematics. The Texas algebra standards were based on national standards and supported a student's learning progression through mathematical concepts. The TSI assessments were developed as a diagnostic tool to determine if Texas students were college-ready for mathematics. Determining college readiness for mathematics evaluates students' academic behaviors, mindsets, perseverance, learning strategies, and social skills. The implications and chapter summary are the final components that set up the background knowledge for the study.

The following section discusses the methodology, including the research design and approach used to examine the research problem and question. Data were collected and analyzed. Examining the data helped determine the project's needs and helped inform secondary mathematics instructors concerning the gaps in practice and curriculum to help those educators better prepare students for introductory-level college mathematics courses.

Section 2: The Methodology

Research Design and Approach

Research Design

The problem addressed in this study was that most students in high school in Texas need to prepare for introductory-level college mathematics (TEA TAPR, 2021). The research question focused on how the Algebra I and II curriculum content aligned with the TSIA for mathematics. Analyzing the curriculum documents for the Algebra I and Algebra II courses at the local site allowed me to determine the content included in classroom instruction. The further analysis of the sample TSIA problems enabled me to determine the content assessed on the TSIA in mathematics. The study of all documents provided the data to determine if the local site's classroom instruction in Algebra I and II aligned with the content assessed on the TSIA in mathematics. Selecting documents allowed me considered the documents' authenticity, credibility, representativeness, and meaning to the problem of students being unprepared for introductory-level college mathematics (Morgan, 2022).

Qualitative Method

I used a qualitative methodology with a basic design utilizing a data collection method of document analysis to analyze curriculum documents and assessment questions to determine the alignment of the content. Qualitative methods follow a process that allowed analysis to occur realistically and holistically (Cresswell, 2005). Documents as a source of information in qualitative research can be valuable for study (Cresswell, 2005).

Qualitative research is the systematic and subjective approach used to describe and give meaning to the research problem (Ravitch & Carl, 2021).

Qualitative research is an iterative process that allows the researcher to interpret the subject matter by studying information and gaining understanding through deduction and induction processes to understand the outcomes (Aspers & Corte, 2019). Specifically, document analysis is a systemic process of reviewing and evaluating documents to make meaning, create understanding, and increase knowledge of the subject being studied (Bowen, 2009). Document analysis provided meaning to this study by allowing the systematic review of documents to create an efficient process with stability, coverage, exactness, availability, and a lack of obtrusiveness and reactivity (Bowen, 2009). For these reasons, qualitative document analysis provided the most meaning to determining the alignment of Algebra I and Algebra II content with the TSIA mathematics section to determine college readiness for introductory-level mathematics courses.

Basic Qualitative Design

A basic qualitative design provided data that was analyzed to answer the research question and provide document analysis. For the research design, the documents were analyzed to give context to the mathematics curriculum of the local site (Armstrong, 2021; Bowen, 2009; Morgan, 2022). Document analysis was an efficient method of reviewing curriculum when readily available documents are less affected by the research process, reducing reflexivity and benefiting from the stability of the data (Armstrong, 2021; Bowen, 2009; Morgan, 2022). The data in the documents were unaffected by personal bias or influences that may inadvertently be part of interviews or observations (Morgan, 2022).

Determining the alignment of high school Algebra I and Algebra II course content with the mathematics section of the TSIA required a systemic, iterative process. Qualitative document analysis provided the structure for this process through its inherited inductive and deductive reasoning process. Deductive analysis sorted data into categories, organized the data categories to keep alignment with the research question, and applied the conceptual framework to the research (Bigham & Witkowsky, 2022). The inductive analysis made meaning from the documents through in vivo coding, creating categories, developing themes from the categories, and explaining the findings through the conceptual framework (Bigham & Witkowsky, 2022). This systemic process utilized both deductive and inductive analysis, allowing the document analysis to be organized, rigorous, and analytic to create a comprehensive study (Bigham & Witkowsky, 2022).

Qualitative designs could include narrative, phenomenological, grounded theory, ethnographic, action research studies, and case studies (Burkholder et al., 2020; Creswell et al., 2007; Grossoehme, 2014). Narrative qualitative designs utilize interviews and documents to look for themes to create a story to build a persona that incorporates a sequence of events and would not be appropriate for this study (Burkholder et al., 2020; Creswell et al., 2007). Phenomenological qualitative designs describe events or activities and do not adequately address content alignment (Burkholder et al., 2020; Creswell et al., 2007; Grossoehme, 2014). Grounded theory qualitative designs try to find the reason or explanation behind an event or activity and would not address the research question for this study (Burkholder et al., 2020; Creswell et al., 2007; Grossoehme, 2014). Ethnographic research designs colleges and analyzes data concerning cultural groups to develop cultural theories, which is not the purpose of this study (Burkholder et al., 2020; Grossoehme, 2014). Action research qualitative designs seek to improve practice and review the actions that have already been taken; since the current problem needs to look at actions, this type of study is inappropriate for the present study (Creswell et al., 2007). Case study qualitative research designs look at several data sources to gain a deep understanding of an organization, individual, or event and are not the purpose of the current study (Burkholder et al., 2020; Creswell et al., 2007).

Other qualitative methods include survey questionnaires, observations, and interviews (Ravitch & Carl, 2021). Survey questionnaires and interviews would not be appropriate for this study on high school algebra curriculum alignment to the TSI assessment because they would not provide objective data for analysis due to the subjective opinions of teachers regarding their instruction (Ravitch & Carl, 2021). Observations would not be appropriate for this study on curriculum alignment due to the difficulty of evaluating content when observing a student taking an assessment (Ravitch & Carl, 2021). The best option for analyzing Texas high school algebra curriculum and the alignment to placement testing is document analysis due to the availability of written materials for both the curriculum and the assessment components and the ability to provide background information on the high school algebra course content. As a research design, document analysis has fewer ethical issues, is unobtrusive to the local site, and is an efficient method of looking for data (Bowen, 2009; Morgan, 2022).

Data Collection

The data collected for this qualitative document analysis included documents from high school Algebra I and Algebra II courses at the local site, as well as TSI documents. Documents to be analyzed for the Texas high school mathematics curriculum included the following: a) instructional focus documents (IFDs) for Algebra I's 13 units of study, with each IFD about 30 pages in length for a total of 390 pages, b) Algebra II's 12 units of study with each unit IFD about 30 pages for a total of 360 pages, c) each courses PLC agendas for a total of about 30 pages each course, d) high school course descriptions and learning outcomes with a total of 6 pages, e) TSIA overview, description, purpose, blueprint, and format with approximately a total of 70 pages, and f) practice tests for a total of about 60 pages. Combined sources will total approximately 916 pages of collected document data sources.

The analysis of the PLC documents from the local site added authenticity to the research, and I made sure the PLC documents were authentic (Duanne et al., 2016; Mogalakwe, 2009; Morgan, 2022). Authenticity was determined using both primary and secondary sources (Morgan, 2022). Primary sources are original materials that other research is based upon, such as research articles in journals, firsthand observations, interviews, and diaries (Brilliant, 2022). Secondary sources are interpretations or evaluations of primary sources such as review articles, books, biographies, and commentaries (Brilliant, 2022). Tertiary sources compile data on a given subject, including collections of primary and secondary sources like bibliographies, indexes, literature reviews, and databases (Brilliant, 2022).

Credibility was another factor to look at when selecting documents for analysis that focuses on the document's accuracy or the number of errors (Morgan, 2022). The IFDs and TSIA documents were created by curriculum experts to support educators and are intended to be error-free. The analysis of these documents added a layer of credibility to the content within the algebra courses and is to be demonstrated in the assessment. The determination of the sources as reliable supported the conclusion of the documents as a credible source (Flick, 2018).

Representativeness and meaning have to do with how typical a document is and the significance of the document's content (Morgan, 2022). The analysis of the course descriptions, outcomes, TSIA overview, TSIA description, and TSIA blueprints allowed me to determine the representativeness and meaning of the documents as they related to the content alignment analysis for college readiness in mathematics. Representativeness and meaning derived from these documents added to the credibility of the research work (Morgan, 2022).

Document analysis is a qualitative method that reduces obstacles, such as time, technology limitations and access, and public health issues, such as during the recent COVID-19 pandemic (Morgan, 2022). A critical part of document analysis is selecting the appropriate documents to analyze and check for authenticity, credibility, representativeness, and meaning to produce a trustworthy study (Morgan, 2022). The documents selected in this study supported these requirements. They provided research on the descriptive level to look for explicit meaning and research the alignment or misalignment of the content in high school algebra courses with the TSIA.

Data Sources

Each document analyzed can be obtained from a public internet search or a public records request. The IFD documents for Algebra I and II are the curriculum documents provided by TEKS Resource System to the local site and are available to teachers, administrators, and parents online. The IFD documents for the algebra courses were found on the Texas Curriculum Management Program Cooperative (TCMPC) website. The TEKS (Texas Essential Knowledge and Skills) were identified through the Texas Education Code, and TEKS Resource System has organized the TEKS into units of study. The PLC agendas for Algebra I and Algebra II and learning outcomes for each course from the local site were requested through a public records request of the local school district. The PLC documents were obtained through the local site and were created by the teachers during their planning and collaboration meetings. The course overviews for each high school mathematics course were obtained from the course guide posted on the local school district's website. The TSIA overview, description, purpose, blueprint, and format were available to teachers, administrators, students, and parents in a digital format from the TSI website. The College Board has practice tests for the TSIA assessment on their website. These documents are used by educators to design instruction for students and to prepare students for the TSIA, making these documents the best sources to determine if the content alignment between the instruction and assessment items is correlated. I evaluated each source of the Algebra I and II curricula for content, skills, processes, and procedures to create a list of those items and compare it with a similar list from the TSIA documents. Comparing these lists helped to support the alignment or misalignment of the content between the Algebra I and II curricula at the local site and the required content to be successful on the TSIA in mathematics to show college readiness for introductory-level college mathematics courses.

Each document was analyzed through the RBT framework for the knowledge and cognitive process dimensions (Anderson et al., 2001). The two dimensions of the RBT framework provided the categories for the analysis of the documents. The knowledge dimension has four categories: factual, conceptual, procedural, and metacognitive (Anderson et al., 2001). The cognitive process dimension has six categories: remember, understand, apply, analyze, evaluate, and create (Anderson et al., 2001). The knowledge dimension and the cognitive process dimension categories have subcategories within the RBT framework, which were utilized to narrow the coding work. A codebook was created to identify the codes and simplify the annotation of the documents for the researcher.

Historical documents from the local site's PLCs were used in the document analysis of this study. The PLC documents provided a primary source of firsthand evidence regarding the work completed by the local site educators (Brillant, 2022). The TSIA documents contained some legal documents from the TEA, a governmental agency. The standards that the high school mathematics courses were based on our state law as part of the Texas Education Code (TEC). These documents represented the best data source for the study because they are primary sources and provide the foundation of the content that should be taught in high school mathematics courses. Determining the alignment or misalignment of these content and skill areas with the TSIA answered the research question of this study.

Data Sufficiency

The sufficiency of the data collected to answer the research question was based on the document's validity, reliability, and usability (Johnson et al., 2020). Triangulation of the data sources supported the study's rigor and minimized researcher error and bias (Johnson et al., 2020). Immediate recording of the researcher's notes improved accuracy and enhanced the rigor of the interpretation of the data sources (Johnson et al., 2020). The research question focused on the alignment or misalignment of the high school algebra classes with the TSIA mathematics section. Utilizing the documents from sources provided sufficient data to analyze and make conclusions concerning the results. A review of the IFD documents for Algebra I and Algebra II courses provided me with the curriculum foundation teachers use to generate instruction for their students. The PLC agendas for each content team at the local site provided insight into the discussions and reasoning for the instructional decisions made to include or exclude different parts of the curriculum at any given time during the school year. The high school course descriptions and the learning outcomes for the courses provided a context for reviewing the IFD and PLC documents within the scope of the local sites' instructional work. The TSIA overview, description, purpose, blueprint, and format documents provided the background for creating the TSIA in mathematics and the assessment's intention, purpose, and context. The practice tests for the TSIA gave the information to determine if the instruction provided to students at the local site aligned with the assessed items and content and allowed me to determine if the local site's curriculum aligned with the assessments provided.

Processes for Data Generation

The data gathered and recorded were all in document form; therefore, qualitative document analysis was an appropriate qualitative research design method for me to employ to determine the alignment of the local site's Algebra I and II curricula with the TSIA in mathematics. The data were stored digitally, with some resources in print. The documents were maintained for the study and either shredded or deleted after the successful completion of the final paper. To maintain objectivity and avoid bias, I used several data sources through the documents to support the interpretation of the different documents. Researcher notes were recorded immediately after analysis to limit discrepancies and strengthen rigor (Johnson et al., 2020).

Systems and Organization

The systems that need to be in place to keep track of the data and emerging understandings follow a sequential process (Armstrong, 2021). I defined the research question for this study to determine the alignment or misalignment of the high school algebra curriculum with the TSIA mathematics sections to determine college readiness for introductory-level college mathematics courses. I collected and prepared the documents for analysis (Armstrong, 2021). The codebook was developed based on the RBT framework. A document was coded to test the codebook and make adjustments for precise, detailed coding of the data and reliability (Kuckartz, 2014). The codebook included a brief definition, an extended definition, criteria for using the code, criteria for when not to use the code, and an example (MacQueen et al., 1998). Coding instructions and rules to keep the analysis consistent were specified to look at sentences as the coding unit (Saldaña, 2021). I completed a few trial runs of coding to determine which codes worked and which did not, as well as to verify that the unit of coding was sufficient, the codebook was comprehensive, and that the coding could be done with reliability (Saldaña, 2021). I revised and modified the code book and coding rules to provide the most accurate coding process (Schreier, 2012). All documents were read once or twice to become comfortable with the documents before focusing on one code at a time to code all documents. After all documents were coded, the code categories were analyzed and compared to create categories. The categories were analyzed and compared to develop themes. The data were interpreted from the categories and themes of the research question and the final results presented (Armstrong, 2021). I kept a journal to record personal reflections during the processes to help avoid bias, a research log to document all steps of the process and any adjustments made through the iterations, and an update of the codebook as needed.

Researcher Role

I am a K-12 mathematics coordinator for the research site's central Texas public school district. In this role as a district mathematics coordinator, there is potential for researcher biases due to the involvement in some of the instructional decisions at the regional, district, and campus levels. During the analysis of the documents, the included content, and the determination of that content in the assessment items, was potential for personal experiences and perspectives to cloud the confirmation of patterns and trends between the local site documents and the assessment documents. I kept a journal recording my reactions to the details of the process and findings to limit personal biases.

Data Analysis

Document analysis involved several iterations, including familiarization, identification, indexing, charting, and interpretation (Goldsmith, 2021). Analysis of the documents for completeness, original purpose, and alignment of the content to develop an understanding of the progression through Texas high school mathematics algebra curriculum to demonstrate readiness on the college-readiness assessment in mathematics on the TSIA determined the answer to the research question (Goldsmith, 2021). Coding data required a systematic and critical reflection on what was being learned from the data (Ravitch & Carl, 2021).

After all, documents were read through twice; the codebook was developed for coding. This codebook was based on the RBT framework using the knowledge and cognitive process dimensions and the dimensions subcategories. Deductive coding was used with the predetermined set of codes from the RBT framework. Coding instructions and rules were defined with words and phrases used as the coding unit to keep consistency between document types. One document was selected to code on a trial run and to fine-tune the codes and units of coding as needed for the analysis. Then the first cycle of coding on all documents using a code list generated from the RBT framework was completed. The document analysis involved coding the TEKS, including the mathematical process standards, the Algebra I IFDs, the Algebra II IFDs, PLC agenda documents, high school algebra course descriptions, TSIA documents, and TSIA practice tests. The second coding cycle with descriptive coding entailed reviewing the "first-cycle codes to assess their commonality and assess them as a pattern code" (Burkholder et al., 2020; Saldaña, 2021). A pattern-matching technique was used to create categories for the coded data (Burkholder et al., 2020; Saldaña, 2021). The third cycle of content analysis coding analyzed and compared the a priori categories from the TSIA framework to look for patterns that create themes from the data analysis. Utilizing several coding methods through the cycles ensured validity through triangulation (Ravitch & Carl, 2021). During the coding process, I began the analysis process while keeping a research log and reflection journal to track the analysis work.

Document analysis followed a prescribed process for this study to ensure reliable results (Ravitch & Carl, 2021). The initial review and reading of the documents determined the ease of access for me and provided an initial list of descriptive codes (Burkholder et al., 2020; Saldaña, 2021). First-cycle coding followed the codes from the RBT framework, while descriptive coding was used as the second-cycle method (Burkholder et al., 2020; Saldaña, 2021). A priori categories collated the documents' excerpts to determine themes from the coding cycles (Burkholder et al., 2020; Saldaña, 2021). The codebook was made with definitions for each code based on the RBT framework. Documents were coded based on the initial code list, and any text that doesn't fit within the code frame had a new code created to describe the text (Burkholder et al., 2020). Evaluation of the data included an initial determination of the alignment and framework to be validated or invalidated, with detailed notes to reflect on the interpretations (Burkholder et al., 2020; Saldaña, 2021). The new codes created were evaluated to see if they fit as subcategories of initial codes. Notes were taken on reflections and their impact on the initial research framework (Saldaña, 2021). A frequency count of the incidents for each code helped evaluate the data from the documents and provided a basis for the analysis findings (Burkholder et al., 2020; Saldaña, 2021).

The secondary review acknowledged potential biases from the documents themselves or myself and addressed those biases, including confirmation bias, question-order bias, wording bias, or halo effects (Burkholder et al., 2020; Saldaña, 2021). The research log and reflection journal helped to provide context for the coded data. Focusing on the research question, organizing the documents to evaluate the alignment between the curriculum and the assessments, and ensuring the documents that address these questions adequately provided initial results for interpretation (Ravitch & Carl, 2021).

A tertiary review utilized directed content analysis and a deductive approach to qualitative research (Burkholder et al., 2020; Saldaña, 2021). Directed content analysis allowed a structured approach based on the existing theory that the curriculum and assessments were aligned (Ravitch & Carl, 2021). The new TSIA2 was first administered in January 2021 and provided four a priori categories: quantitative reasoning, algebraic reasoning, geometric and spatial reasoning, and probabilistic and statistical reasoning (THECB 2021). The third iteration of coding organized the raw data into the a priori categories from the TSIA blueprint. The categories were grouped into clusters to develop themes (Burkholder et al., 2020). Identifying categories and looking for trends to develop themes acted as a labeling and indexing system to look for the patterns of alignment between the high school algebra curriculums and the assessed content on the TSI assessments (Burkholder et al., 2020; Saldaña, 2021).

Evidence of Quality

Quality evidence was assured through the investigation of all documents to determine the document's completeness and valuable, accurate data (Ravitch & Carl, 2021). Potential biases from the documents were thoroughly analyzed and investigated to preserve the credibility of the research (Burkholder et al., 2020; Saldaña, 2021). Document analysis was an efficient and effective way to gather information and data because they are manageable and practical (Ravitch & Carl, 2021). The procedure to analyze documents was to determine the documents to be used, determine an organizational system for the information, make copies for notes to annotate and highlight without damaging original documents, ensure the authenticity of the documents, check for biases, and ask questions to determine the background of documents, evaluate the records, and interpret the findings (Saldaña, 2021).

Discrepant Cases

Discrepant cases were reviewed in the context of the categories and themes to determine the reason for the discrepancy (Burkholder et al., 2020; Saldaña, 2021). Discrepant cases were analyzed to determine if there were alternative meanings the cases represented and provided additional insight into the findings (Ravitch & Carl, 2021). These cases represented contradictions to the developed categories and themes and provided insight into the complexities of the study and how the analysis could better relate to real-world situations (Hendren et al., 2022; Ravitch & Carl, 2021).

Data Analysis Results

Data Preparation

The data for this study were derived from existing documents at the research site obtained through a formal public records request and documents available from a general internet search. Algebra I and II IFD documents, PLC agendas, lesson plan documents, TSI documents, and TSI assessment practice problems were obtained from the research site's public records request. Additional TSI documents and TEKS documents were obtained from a general internet search. The documents were then organized by content and type and labeled with the document name, source, source number, and the number of pages to track all the documents on a sheet of a Microsoft Excel workbook. Content analysis coding allows the analysis of the presence, meaning, and relationships of certain words or terms, categories, and themes (Ravitch & Carl, 2021). The original documents collected had a total of 1,947 pages. During the entire process, I kept a journal to record personal reactions, process details, and initial thoughts concerning categories and themes of the data.

Algebra I Coding

The Microsoft Excel codebook contained the RBT framework for first-cycle coding to analyze the documents. The RBT framework was coded for each subsection of the RBT knowledge dimension and the RBT cognitive process dimension, including examples, definitions, criteria for using or not using the code, and notes on actions required for the framework. This organization helped the coding process be more efficient and precise. The coding was completed on one document to work through the logistics of the coding process, streamline the instructions and rules for coding, and create an organization of the work to be able to analyze. Critical parts of the documents were added to another page of the Microsoft Excel workbook. This organization helped analyze the documents' essential components to develop themes from the RBT categories. It examined the Algebra I curriculum, Algebra II curriculum, and TSIA sample questions in relation to the research question.

The first cycle deductive coding process analyzed the documents using RBT's knowledge and cognitive dimensions, which is the conceptual framework the study is based upon. Using the RBT framework as the basis of the first coding cycle embedded the RBT framework into the results. The analysis of the Algebra I documents showed that while most of the content may have required conceptual or procedural knowledge, the content focused on the application dimension. Utilizing the RBT framework, the data showed no curriculum content for remembering, understanding, analyzing, evaluating, or creating. The application dimension was 100% of the Algebra I curriculum content. The skill of recalling basic concepts (remembering), explaining ideas (understanding), drawing connections among ideas (analyzing), justifying a decision (evaluating), and producing new or original work (creating) is not explicitly addressed in the Algebra I curriculum content (Anderson et al., 2001). Table 2 shows examples of the Algebra I curriculum standards and coding cycle 1 utilizing the RBT framework.

Table 2

RBT Coding for Algebra I, Cycle 1, Example

Codes	Raw Data
Applying	A.1A: Apply mathematics to problems arising in everyday life, society, and the workplace.
Applying	A.1B: Use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution.
Applying	A.1C: Select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems.
Applying	A.1D: Communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language, as appropriate.
Applying	A.1E: Create and use representations to organize, record, and communicate mathematical ideas.

For the second cycle, coding, familiarization, identification, indexing, and charting of the documents for analysis occurred through the organizational process of labeling the documents, creating the source numbers, recording page numbers, and reading through the documents initially. The process helped me to systematically reflect critically on the content of the documents and code the mathematical content. The initial coding was completed as a deductive coding process, starting with a predetermined set of codes and assigning these codes to the data (Ravitch & Carl, 2021). The second cycle of coding for Algebra I was completed with descriptive coding to determine patterns by topic (Saldaña, 2021; Burkholder et al., 2020). The second cycle coding process was a descriptive analysis of the Algebra I curriculum to find the mathematics content in Algebra I curriculum documents. The Algebra I curriculum standards were coded upon reviewing the complexity of the Algebra I curriculum content. Table 3 lists the descriptive codes and how the raw data were encoded for cycle 2.

Table 3

Descriptive Codes for Algebra I, Cycle 2

Codes	Examples of Raw Data
Exponential equations	Graph exponential functions that model growth and decay and identify critical features, including y-intercept and asymptote, in mathematical and real-world problems.
Linear equations	Write linear equations in two variables given a table of values, a graph, and a verbal description.
Mathematical arguments	Display, explain, and justify mathematical ideas and arguments in written or oral communication using precise mathematical language.
Mathematical expressions	Simplify numeric and algebraic expressions using the laws of exponents, including integral and rational exponents.
Mathematical language	Create and use representations to organize, record, and communicate mathematical ideas.
Mathematical sequences	Write a formula for the nth term of arithmetic and geometric sequences, given the value of several of their terms.
Polynomials	Multiply polynomials of degree one and degree two.
Problem-solving	Apply mathematics to problems arising in everyday life, society, and the workplace.
Quadratic equations	Describe the relationship between the linear factors of quadratic expressions and the zeros of their associated quadratic functions.

Algebra II Coding

The exact process was utilized for Algebra II curriculum document coding as Algebra I. The first cycle deductive coding process was used to analyze the documents using RBT's knowledge and cognitive dimensions. Using the RBT framework as the basis of the first coding cycle, I was able to embed the RBT framework into the results. The analysis of the Algebra II curriculum documents for the knowledge dimension showed that most of the content required conceptual or procedural knowledge while being focused on the application level of the cognitive dimension. Analysis of the coding for the cycle utilizing the RBT framework showed that there were no curriculum standards in remembering, understanding, analyzing, evaluating, or creating dimensions.

The applying dimension was 100% of the Algebra II curriculum standards. A sample of the Algebra II curriculum standards and coding cycle one is shown in Table 4.

Table 4

RBT Coding for Algebra II, Cycle 1, Example

Codes	Raw Data
Applying	Graph the functions $f(x)=\sqrt{x}$, $f(x)=1/x$, $f(x)=x^3$, $f(x)=\sqrt[3]{x}$, $f(x)=b^x$, $f(x)=\|x\|$, and $f(x)=\log_b(x)$ where b is 2, 10, and e, and, when applicable, analyze the key attributes such as domain, range, intercepts, symmetries, asymptotic behavior, and maximum and minimum given an interval.
Applying	Graph and write the inverse of a function using notation such as $f^{-1}(x)$.
Applying	Describe and analyze the relationship between a function and its inverse (quadratic and square root, logarithmic and exponential), including the restriction(s) on the domain, which will restrict its range.
Applying	Use the composition of two functions, including the necessary restrictions on the domain, to determine if the functions are inverses of each other.

The second cycle coding process was a descriptive analysis of the Algebra II curriculum standards codes. These codes were developed from the curriculum to find the mathematics content in Algebra II curriculum documents. The second cycle coding process was a descriptive analysis of the Algebra II curriculum to find the mathematics content in Algebra II curriculum documents instead of the deductive coding process of cycle 1. The Algebra II curriculum standards were coded upon reviewing the complexity of the Algebra II curriculum content. Table 5 shows a sample of the raw data with the coding cycle two codes for the Algebra II curriculum documents.

Table 5

Descriptive Codes for Algebra II, Cycle 2

Codes	Examples of Raw Data
Absolute value equations	Solve absolute value linear equations.
Complex numbers	Add, subtract, and multiply complex numbers.
Cubic equations	Analyze the effect on the graphs of $f(x) = x^3$ and $f(x)=\sqrt[3]{x}$, when f(x) is replaced by a (x), f(bx), f(x - c), and f(x) + d for specific positive and negative real values of a, b, c, and d.
Cube root equations	Solve cube root equations that have real roots.
Exponential equations	Rewrite exponential equations as their corresponding logarithmic equations and logarithmic equations as their corresponding exponential equations.
Linear equations	Solve systems of three linear equations in three variables using Gaussian elimination, technology with matrices, and substitution.
Linear inequalities	Formulate systems of at least two linear inequalities in two variables.
Logarithmic equations	Determine the reasonableness of a solution to a logarithmic equation.
Mathematical arguments	Display, explain, or justify mathematical ideas and arguments using precise mathematical language in written or oral communication.
Mathematical equations	Solve equations involving rational exponents.
Mathematical expressions	Determine the sum, difference, product, and quotient of rational expressions with integral exponents of degree one and of degree two.
Mathematical notation	Write the domain and range of a function in interval notation, inequalities, and set notation.
Mathematical language	Communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate.
Mathematical modeling	Analyze data to select the appropriate model from among linear, quadratic, and exponential models.
Polynomials	Add, subtract, and multiply polynomials.
Polynomial equations	Determine the linear factors of a polynomial function of degree three and of degree four using algebraic methods.
Problem-solving	Use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution.
Quadratic equations	Write the quadratic function given three specified points in the plane.
Quadratic inequalities	Solve quadratic inequalities.
Rational equations	Determine the reasonableness of a solution to a rational equation.
Square root equations	Identify extraneous solutions of square root equations.

TSIA Coding

The first cycle deductive coding process analyzed the documents compared to RBT's knowledge and cognitive dimensions, which is the conceptual framework on which the study is based. Using the RBT framework as the basis of the first coding cycle embeds the RBT conceptual framework into the analysis and results. The analysis of the TSIA sample mathematics questions for the knowledge dimension showed that the majority of the content required conceptual or procedural knowledge while being focused on the application level of the cognitive dimension. Analysis of the coding for the cycle utilizing the RBT framework showed that there needed to be curriculum standards in the remembering, understanding, or creating dimensions. The applying dimension was found in 100% of the TSIA sample mathematics questions. The recall of facts and basic concepts (remembering) and explanation of ideas or concepts (understanding) is not explicitly stated. Still, these dimensions are not expressly addressed in the TSIA sample mathematics questions. Table 6 shows a sample of the TSIA sample mathematics questions and coding cycle one deductive codes utilizing the RBT framework.

Table 6

RBT Coding for TSIA, Cycle 1, Example

RBT Skills	Raw Data
Applying	Last year, a bakery sold w loaves of bread. This year, the bakery sold three more than twice the number of loaves of bread sold last year. If next year the bakery plans on selling twice the number of loaves of bread sold this year, how many loaves of bread does the bakery expect to sell next year? A. 2w B. 2w + 3 C. 4w + 3 D. 4w + 6
Applying	Which of the following is NOT equivalent to (3x − 12)(x + 4)? A. 3(x2 – 8x + 16) B. 3(x2 – 16) C. 3x2 – 48 D. 3x(x + 4) – 12(x + 4)
Applying	Under ideal conditions, the population of a certain species doubles every nine years. If the population started with 100 individuals, which of the following expressions gives the population of the species t years after the population started, assuming that the population has been living under ideal conditions? A. 2 × 100^(9t) B. 2 × 100^(t/9) C. 100 × 2^(9t) D. 100× 2^(t/9)
Applying	The formula for the volume of the right circular cylinder is V = πr2 h. If r = 2b and h = 5b + 3, what is the volume of the cylinder in terms of b? A. 10π(b^2) + 6πb B. 20π(b^3) + 12π(b^2) C. 20(π^2)(b^3) + 12(π^2)(b^2) D. 50π(b^3) + 20π(b^2) + 90πb
Applying	A bag contains 9 red marbles, 2 blue marbles, and 5 green marbles. What is the probability of choosing a blue marble? A. 5/16 B. 1/8 C. 9/16 D. 2/11

The second cycle coding process was a descriptive analysis of the TSIA sample mathematics question codes. These codes were developed from the sample questions provided to find the mathematics content that is in the TSIA sample mathematics questions. This simultaneous coding process (Saldaña, 2021) grew organically from the document review. It allowed me to begin categorizing patterns and trends and develop an analysis of the TSIA sample mathematics questions. The TSIA sample mathematics questions were coded depending on the complexity of the TSIA sample mathematics questions. Table 7 shows a sample of the raw data with the coding cycle two descriptive codes utilized to analyze the content of the TSIA sample questions.

Table 7

Descriptive Codes for TSIA, Cycle 2

Codes	Examples of Raw Data
Exponential equations	Which of the following is NOT equivalent to (3x − 12)(x + 4)?
Geometric reasoning	A triangular-shaped lake-front lot has a perimeter of 1800 feet. One side is 100 feet longer than the shortest side, while the third side is 200 feet longer than the shortest side. Find the length of all three sides.
Mathematical equations	If the cost of carpeting a floor is $2.50 per square foot, how much will it cost to carpet a rectangular floor that is 10 feet by 12 feet?
Mathematical expressions	Under ideal conditions, the population of a certain species doubles every nine years. If the population started with 100 individuals, which of the following expressions gives the population of the species t years after the population started, assuming that the population has been living under ideal conditions?
Mathematical probability	A bag contains 9 red marbles, 2 blue marbles, and 5 green marbles. What is the probability of choosing a blue marble?
Linear equations	The variables x and y are directly proportional, and y = 4 when x = 9. What is the value of y when x = 18?
Proportional reasoning	If there are 2.2 pounds in 1 kilogram, how many pounds are there in x kilograms?
Quadratic equations	If an object is propelled upward from a height of 144 feet at an initial velocity of 128 feet per second, then its height after t seconds is given by the equation $y(t) = -16t^2 + 128t + 144$. After how many seconds does the object hit the ground?
Square root equations	r which of the following values of x is the function $f(x) = \sqrt{4 - x^2}$ NOT defined as a real number?

Alignment of Codes

Several areas (logarithmic equations, mathematical arguments, mathematical notation, and mathematical sequences) are included in the Algebra I and Algebra II curriculum documents that need to be included in the assessed content of the TSIA. The exclusion of applying right triangle trigonometry, computing probability, converting measurement units, describing measures of center, describing spread of data, interpreting probability, performing geometric transformations, and solving geometric problems is a surprising finding. The missing content creates a misalignment of the Algebra I and II curricula materials with the TSIA sample assessment items.

Table 8

Alignment of Descriptive Codes

Algebra Content	Algebra Not Aligned with TSIA	TSIA Aligned with Algebra	TSIA Not Aligned with Algebra
Absolute value equations	Logarithmic equations	Absolute value equations	Geometric reasoning
Absolute value inequalities	Mathematical arguments	Absolute value inequalities	Mathematical probability
Complex numbers	Mathematical notation	Complex numbers	Proportional reasoning
Cube root equations	Mathematical sequences	Cube root equations	
Cubic equations		Cubic equations	
Exponential equations		Exponential equations	
Linear equations		Linear equations	
Linear inequalities		Linear inequalities	
Logarithmic equations		Mathematical equations	
Mathematical arguments		Mathematical expressions	
Mathematical equations		Mathematical language	
Mathematical expressions		Mathematical modeling	
Mathematical language		Polynomials	
Mathematical modeling		Polynomial equations	
Mathematical notation		Problem-solving	
Mathematical sequences		Quadratic equations	
Polynomials		Quadratic inequalities	
Polynomial equations		Rational equations	
Problem-solving		Square root equations	
Quadratic equations			
Quadratic inequalities			
Rational equations			
Square root equations			

Table 8 shows the alignment of the descriptive codes. The Algebra I and II curriculum documents produced the twenty-three codes shown in the table's first column. The Algebra I and II documents coding found the twenty-three content areas described by these codes: linear, quadratic, square root, exponential, logarithmic, absolute value, cubic, cube root, polynomial, and rational equations. The second column of the table shows the four descriptive codes found in the algebra curriculum documents but not in the sample questions from the TSIA. Logarithmic equations, mathematical arguments, mathematical notation, and mathematical sequences were all content areas found in the Algebra I and II curriculum documents that were not content found in the TSIA sample questions. The third column of the table shows the descriptive codes found in the Algebra I and II curriculum documents and the TSIA sample questions. These nineteen codes describe content areas included in the Algebra I and II curriculum documents and were found in the TSIA sample questions and codes the content that overlaps both document sources and is both intended curricula to be delivered to students and assessed to determine introductory-level college mathematics course readiness. The fourth column shows three codes in the TSIA sample questions but not in the Algebra I and II curriculum documents. These content areas are assessed on the college readiness assessment but were not found to be included in the Algebra I and II curricula documents.

Alignment of Categories

The third coding cycle was completed utilizing content analysis coding for a priori categories. Quantitative reasoning, algebraic, geometric, spatial, and probabilistic, and statistical reasoning were the a priori categories. The third iteration of coding organized the second cycle codes into the a priori categories from the TSIA blueprint. These categories were algebraic, geometric, probabilistic, quantitative, spatial, and statistical reasoning. The Algebra I curriculum documents revealed that the curriculum is based on quantitative and algebraic reasoning categories. The representation of the categories is shown in Table 9 for Algebra I, Algebra II, and TSIA.

Table 9

Alignment of Categories

Categories	Algebra I	Algebra II	TSIA
Algebraic Reasoning	X	X	X
Geometric Reasoning	NA	NA	X
Probabilistic Reasoning	NA	NA	X
Quantitative Reasoning	X	X	X
Spatial Reasoning	NA	NA	X
Statistical Reasoning	NA	X	X

The categories of geometric and spatial reasoning and probabilistic and statistical reasoning are not components of the Algebra I curriculum. The Algebra II curriculum documents revealed that the curriculum is based on quantitative, algebraic, and statistical reasoning categories; however, there needed to be evidence of geometric reasoning or probabilistic reasoning in the Algebra II curriculum or PLC documents for perfect alignment to TSIA. The TSIA sample mathematics questions revealed that the assessment is based on quantitative, algebraic, geometric, spatial, probabilistic, and statistical reasoning categories. The mathematics content focused on quantitative and algebraic reasoning in the Algebra I and Algebra II curriculum documents. These were the critical components of the curriculum documents. Reviewing the TSIA sample mathematics questions, it became apparent that the mathematics content based on geometric and spatial reasoning and probabilistic reasoning needed to be coded in the Algebra I and Algebra II curriculum documents for complete content alignment.

The Algebra I curriculum that is part of the Texas Education Code supports the content that are needed for the algebraic reasoning section of the TSIA mathematics section which is about 39% of the assessed material as indicated by the TSIA blueprint and the quantitative reasoning section of the TSIA mathematics section is about 29% of the assessed material according to the TSIA blueprint (College Board, 2021). The Algebra I curriculum covers only the quantitative and algebraic reasoning portions of the TSIA exam. The categories of geometric, spatial, probabilistic, and statistical reasoning should be covered in the Algebra I curriculum for complete content alignment.

Content analysis of the Algebra II documents indicates the portion of the Algebra II curriculum that is part of the Texas Education Code supports the content that is needed for the algebraic reasoning section of the TSIA mathematics section which is about 39% of the assessment material, as stated in the TSIA blueprint, the quantitative reasoning section of the TSIA mathematics section which is approximately 29% of the assessment material according to the TSIA blueprint, and the probabilistic and statistical reasoning section of the TSIA mathematics section which is about 18% of the assessment according to the TSIA blueprint (College Board, 2021). The Algebra II curriculum covers only the quantitative and algebraic reasoning portions of the TSIA exam. Geometric and spatial reasoning and probabilistic reasoning are not covered in the Algebra II curriculum. The Algebra I and II curriculum did not cover the content needed for geometric and spatial reasoning portion of the TSIA, which is approximately 15% of the TSIA per the blueprint, or the probabilistic reasoning portion of the TSIA assessment, which is about 18% of the TSIA as stated in the blueprint (College Board, 2021). During the analysis and development of categories, it was noted that mathematics content based on geometric, spatial, and probability reasoning concepts needed to be coded in the Algebra I and Algebra II curriculum documents for complete content alignment.

Discrepant Cases

Discrepant cases were analyzed to determine if alternative meanings may represent or provide additional insight into the findings. A review of the content areas as coding through the descriptive coding process shows that all Algebra I content codes except mathematical sequences are covered in the Algebra II curriculum documents. While mathematical sequences are essential to understand mathematical relationships fully, they are outside the assessed curriculum on the TSIA, which diminishes their value for the student working to demonstrate college readiness for introductory-level college mathematics courses.

Table 10

Algebra I and Algebra II overlap

	Algebra I	Algebra II
Absolute value equations		X
Absolute value inequalities		X
Complex numbers		X
Cube root equations		X
Cubic equations		X
Exponential equations	X	X
Linear equations	X	X
Linear inequalities	X	X
Logarithmic equations		X
Mathematical arguments	X	X
Mathematical equations	X	X
Mathematical expressions	X	X
Mathematical language	X	X
Mathematical modeling		X
Mathematical notation		X
Mathematical sequences	X	
Polynomials	X	X
Polynomial equations		X
Problem-solving	X	X
Quadratic equations	X	X
Quadratic inequalities		X
Rational equations		X
Square root equations		X

Table 10 shows the overlap, or lack of overlap, of the Algebra I and II curriculum documents. Linear equations and inequalities, exponential equations, polynomials, quadratic equations, mathematical arguments, mathematical language, mathematical equations, mathematical expressions, and problem-solving are content areas covered in both courses. These areas are essential portions of the TSIA assessment according to the TSIA blueprint but are not an exhaustive list of content areas. This shows that both courses are critical to preparing students for the TSIA and demonstrating their readiness for introductory-level college mathematics courses. It indicates that mathematical sequences are the only area that Algebra I curriculum documents contain that needs to be covered by content in Algebra II. There are numerous content areas that Algebra II curriculum documents have that need to be included in the Algebra I curriculum documents. While both courses are essential for success on the TSIA, the Algebra II curriculum documents and the content areas found through the descriptive coding process are a more significant portion of the assessed curriculum.

Themes

The themes were derived from the document analysis process of identifying codes and categories, looking for trends, and labeling to look for the patterns of alignment between the Algebra I and Algebra II curriculums and the assessed content on the TSIA (see Burkholder et al., 2020; Saldaña, 2021). The themes are relevant to the research question and based on the results of the coding cycles. Three themes were developed from the document analysis. The first theme was major misalignment occurring when most content taught in Algebra I and Algebra II needed to be tested on TSIA. The second theme was minor misalignment when some content tested on TSIA needed to be taught in Algebra I and Algebra II. The third theme was that minor alignment occurs when some content tested on TSIA is taught in Algebra I and Algebra II.

Theme 1

The document analysis results addressed show several themes to be developed from the findings. Major misalignment occurred when most content taught in Algebra I and II needs to be tested on TSIA. This major misalignment may have created a disconnect for students from their instruction on content areas and how they are asked to demonstrate introductory-level college mathematics course readiness. Misalignment of the content between the curriculum and the assessment creates gaps in understanding for students and their abilities to display achievement. The effects of misalignment between curriculum and assessments include gaps in students' understanding and knowledge of mathematics, reduced motivation and engagement of students in the mathematics content, provided potentially unreliable assessment results, made inefficient use of instructional time and resources, and contributed to inadequate preparation of students for future academic or career pursuits (Lopest et al., 2019).

Theme 2

Minor misalignment occurs when some content tested on TSIA needs to be taught in Algebra I and II. Content not taught in Algebra I and II but assessed on the TSIA shows that students are not ready for introductory-level college mathematics courses when they have yet to receive instruction on the content. The minor misalignment potentially added to the gaps in understanding of students and their abilities to demonstrate college readiness for introductory-level college mathematics courses. The misalignment between classroom instruction and future assessments can cause students to struggle to make connections between the concepts and push students to experience gaps in understanding (Lauermann & ten Hagen, 2021).

Theme 3

Minor alignment occurred when little content tested on TSIA was taught in Algebra I and Algebra II. Content taught to students and then assessed on TSIA helps students demonstrate mathematical understanding and content connections. A student's performance on the TSIA can indicate their readiness for introductory-level college mathematics courses. A student's performance will demonstrate understanding when the assessed curriculum is aligned with the instructed curriculum. Learning outcomes help teachers focus on what the student should be able to do, while assessment criteria focus on how well learners can perform with the mathematics content (Jaiswal, 2019).

Discussion of Research Question

The problem addressed in this study is that according to the Texas Success Initiative Assessment (TSIA) data for the 2018-2019 academic year, most students in a local high school in Central Texas must prepare for introductory-level college mathematics (TEA TAPR, 2021). The gap in practice examined in this study is that the content required to perform well in the mathematics TSIA section are assumed to be provided in the curriculum of the study site's Algebra I and Algebra II courses. This basic qualitative study aims to examine the Algebra I and Algebra II mathematics course curriculum documents at the local high school to determine alignment to the mathematics section of the TSIA and identify content necessary for students to demonstrate college readiness in mathematics on the TSIA. The research question is: how does the content in the Algebra I and Algebra II curriculum documents of a central Texas high school and the TSIA for mathematics align?

The document analysis of the Algebra I and Algebra II content with the TSIA sample questions shows that there is a major misalignment of the Algebra I and II content with the TSIA sample questions due to the amount of content that is taught in Algebra I and II curriculum and not tested on TSIA. There needs to be more alignment when content tested on TSIA is not taught in Algebra I and II, and there is minor alignment when content tested on TSIA is taught in Algebra. The results of this qualitative study show that the Algebra I and II curricula need to be aligned with the TSIA mathematics section because the curriculum documents contain only some of the content assessed in the TSIA mathematics section.

Discussion of the Literature

To be a systems thinker, one is concerned with the whole rather than the components, the process over content, and the patterns over results (Ollhoff & Walcheski, 2006). By looking at the algebra curriculum and its components with the view of a systems thinker, one looks to understand the connections and relationships and be able to manage the complexity of information. Thinking in systems helps students to use problem-solving and process in novel and unique ways as they encounter new situations to apply their understandings. Conceptual understanding helps one justify results and is learned through thoughtful and reflective mental activity. Understanding concepts and their relationship to each other allows the student to successfully use the known ideas in new problem situations (transfer of knowledge).

Teachers' content knowledge (CK) of high school mathematics and introductory college-level mathematics may play a role in the misalignment of the written and intended curriculum versus the enacted curriculum. It is critical to teaching and learning to understand the content and the knowledge of the subject matter it provides and why the content exists, which requires a deep understanding to share that CK with students

(Dreher et al., 2018; Jacob et al., 2020). PCK (pedagogical content knowledge) requires the teacher to be competent in delivering the conceptual approach, relational understanding, and adaptive mathematics reasoning to support successful student learning (Jacob et al., 2020). When a weakness in CK and PCK exists, it can unintentionally cause gaps in learning for students.

Making the connection between curriculum and mathematics content can support teacher development for the teacher to be better prepared to help students master grade-level content and be ready for the TSIA, SAT, or ACT to demonstrate college readiness in mathematics (NIET, 2020). Instructional materials have several features that support student outcomes through their learning progressions, including the development of terminology, procedures, nature of tasks, and collections of problems (Akiba et al., 2019; Choppin et al., 2022; Duschl, 2019; Perrotta & Selwyn, 2020).

Discussion of the Conceptual Framework

The conceptual framework for this study is RBT, a two-dimensional framework, including knowledge and cognitive process, that analyze curriculum documents and educational objectives in more detail than could be achieved from a one-dimensional framework (Anderson et al., 2001; Radmehr & Drake, 2019). Utilizing RBT organized the coding of the curriculum documents to explain the findings purposefully. The key variables and relationships between those variables could be studied in an organized way to analyze the data clearly and concisely. This study's key variables include the Algebra I and Algebra II curricula concepts. These concepts are the basis of the instructional focus that educators use to help students gain an understanding of mathematics. The alignment of the concepts included in the Algebra I and Algebra II curricular materials and the concepts assessed on the TSIA college placement test indicate the level of success that students can demonstrate to show readiness for introductory-level college mathematics. The content is solely in the applying dimension, indicating a challenge with the lack of all other levels of RBT not represented. This could contribute to students' difficulties in showing proficiency in their mathematics content on the TSIA college placement assessment.

Evidence of Quality

Evidence of the quality of this study is found through the triangulation of the source documents. The IFDs are documents from TCMPC (Texas Curriculum Management Program Cooperative), an organization dedicated to providing scope and sequence aligned with the TEKS (Texas Essential Knowledge and Skills) standards to deliver the required content by the Texas Education Code. The 2020-2021 and 2021-2022 lesson plans from the local site show how the educators decided to deliver the state curriculum. The PLC agendas are documents showing the discussions of the educator team with the direction of instructional coaches and administrators to attempt better to align the curriculum to the needs of students. The analysis of these documents from three different perspectives allows for the mathematical content's convergence, or divergence, to be analyzed for overlap, accuracy, or misalignment between the three data sets. The results from the three rounds of coding, deductive, descriptive, and content analysis, allow an in-depth picture of the research to be built by each method, informing the other and creating complementarity or interdependency and coherence. Triangulating the data sets from both the source of the documents and the type of coding increases the accuracy of the final analysis. The study followed the outlined procedures for gathering, organizing, and analyzing data to summarize the findings and develop the project deliverable accurately.

Summary

Cycle 1 coding embedded the RBT framework into the analysis. Cycle 2 coding combined the RBT framework with descriptive conceptual codes. Cycle 3 coding organized the data into a priori categories based on the TSIA framework, and cycle four coding developed the themes for the document analysis findings. The first and second cycles worked to break the documents into smaller, more manageable pieces for reorganizing the data into categories. In summary, the written curriculum, as analyzed, is aligned with the algebraic methods and functions but needs to be aligned with geometric and spatial reasoning and probabilistic and statistical reasoning.

Additionally, the enacted curriculum by the local site educators needs to be aligned with the assessed curriculum, as evidenced by comparing the curriculum standards versus the PLC documents. It, therefore, leaves gaps in student learning due to needing to have delivered instruction on all the content required of the curriculum that students need to perform successfully on the college placement assessment in mathematics. These findings resulted in several themes being developed, including significant misalignment occurring when most content taught in Algebra I and II is not tested on TSIA, minor misalignment occurring when some content tested on TSIA is not taught in Algebra I and II, and minor alignment occurring when little content tested on TSIA is taught in Algebra I and II.

The project for the local site would be a white paper with a three-step policy recommendation. The first step would be to implement processes and procedures to ensure that all state curriculum and local instructional materials are utilized and delivered to students during instruction in Algebra I, Geometry, and Algebra II courses. The missing content found during the analysis of the PLC documents from the local site shows that students were not exposed to all the content that were needed for successful performance on the TSIA mathematics section, as well as the need for strong instruction in Geometry for the geometric and spatial reasoning section of the TSIA mathematics section. The second step would be to provide teachers with professional development to support their content knowledge, understanding of the curriculum materials, and understanding of the TSIA mathematics section to help support students' academic achievement and ensure all content is delivered through instruction. The third step would be to review the processes, procedures, and professional development at least once per semester to maintain alignment with the TSIA content and make adjustments for the local site's needs.

Section 3: The Project

Introduction

The study problem was that according to the TSIA data for the 2018-2019 academic year, most students in a local high school in Central Texas were not prepared for introductory-level college mathematics courses (TEA TAPR, 2021). Across Texas, more than half of the students (52.1%) needed to demonstrate college readiness in mathematics. In comparison, 70.9% of the students at the local site needed to to demonstrate college readiness in mathematics (TEA TAPR, 2021). The gap in practice examined in this study is that the content required to perform well in the mathematics section of the TSIA is assumed to be provided in the curriculum of the study site's Algebra I and Algebra II courses. From the analysis results, I provided information regarding a white paper with a three-step policy recommendation for the local site. This section presents the project rationale, literature review, introductory description, project evaluation plan, and implications. Appendix A includes the Project Study.

Rationale

A white paper was selected for this study as it will provide the local site with evidence-informed guidance on bridging the gap between the Algebra I and Algebra II curriculum and the assessed content on the TSIA mathematics section to help more students demonstrate introductory-level college mathematics readiness. A white paper on policy allows in-depth research focusing on the recommendations for policy and program changes to have a tangible impact on the local site, students, families, and the local community. The existing course-taking policy was reviewed in light of the data analysis findings of this study, evidence from the literature was provided to support the policy update, and recommendations based on the literature and current policy were outlined.

The results from the data analysis of this study indicate a misalignment of the curriculum in the Algebra I and Algebra II courses and the content in the TSIA mathematics section. This misalignment needs to be evaluated and improved course-taking policies implemented. A three-step policy recommendation for the local site will include the following: a) improving algebra curriculum alignment to TSIA, b) teacher collaboration to contribute to the curriculum alignment process, and c) review algebra curriculum alignment at least once per semester to maintain alignment with TSIA.

The problem that initiated this study focused on the alignment of the curriculum delivered in Algebra I and Algebra II courses. In comparison to the TSIA mathematics sample questions, the results showed that the Algebra I and Algebra II curricula need to be realigned to match the assessed content of TSIA and include part of the geometry curriculum to cover all of the assessed content. Therefore, a white paper on policy for the local site could help fill the gap in curriculum and student success on the TSIA by improving the alignment of the Algebra I and Algebra II course curriculum with the TSIA.

Review of the Literature

A literature search was conducted through Walden's library research database and digital libraries, as well as Google Scholar, to understand the project study further. The themes for the literature review were best practices for developing policy recommendations, mathematics course-taking practices, and mathematics educator professional development practices. The keywords that I used in my search included the following: *white papers, policy papers, organizational change, institutional change, organizational communication, institutional communication, institutional policy, organizational stakeholders, mathematics course-taking, course-taking patterns, mathematics educator professional development, education professional development practices,* and *best practices in mathematics education.*

Best Practices for Policy Recommendations

Policy leading to practice changes has yet to be a focus of much research; however, policy research has focused on how policies are shaped, enacted, and interpreted (Cheeseman et al., 2019). Cheeseman et al. (2019) noted that local policymakers need to be included throughout the policy updating process to collaboratively address gaps in practice and move beyond the primary identification of barriers. Further, teacher education programs must focus on capacity building and integrating curriculum to impact teacher skills to deliver content in the classroom. This should be reflected in educational policy (Cheeseman et al., 2019).

The evidence-based policy uses high-quality information to inform policy decisions (Beerkens, 2018; Pellegrini & Vivanet, 2021). According to Beerkens (2018), the evidence-informed policy is more inclusive, as it is made through a similar process, but practical knowledge and intervention experiences can add to the policy enriched by but not limited to previous research. Organizations working on updating their policies should base their work on research and evidence (Beerkens, 2018).

Organizational and communication support must be highly effective to positively impact educational decision-making in educational settings (Verdenhofa, 2022). Technology systems that support databases, data banks, and information resources need to be improved, internal organizational and communications need to be developed, and external and internal information exchanges must continue to be enhanced to support effective decision-making processes in education organizations (Verdenhofa, 2022).

Organizations must be ready for change and have the capacity for change to occur (Mladenova, 2022; Vlachopoulos, 2021). Change can happen in terms of control, scope, frequency, or stride (Koutsopoulos et al., 2020; Mladenova, 2022). Mladenova (2022) stated that readiness for change is a mindset, including beliefs, attitudes, and intentions, that must be observed before a change's implementation or influenced during the change for changes to be successful. The organizational capacity for change can be seen as an antecedent to readiness for change and included elements such as climate, experience with past changes, learning, transformational leadership, and structure (Mladenova, 2022). Change management can be improved with leadership support and strategic planning (Busari et al., 2020; Vlachopoulos, 2021). Policy papers based on data-driven, analyzed, and tangible results can drive administrative change and positively impact student learning and teacher effectiveness (Dodman et al., 2019; Rivera Baiocchi, 2019). Clear communication of results and implications is crucial for building support and buy-in for the proposed changes (Banerjee & Lowalekar, 2021; Fixsen et al., 2020). Policy papers grounded in evidence and effectively communicated are more likely to lead to meaningful and lasting education reforms than those lacking clarity or credibility (Hubers, 2020; Reinholz & Andrews, 2020).

Data analysis communicates the need for policy recommendations and improvements (Christensen et al., 2020; Steiner-Khamsi et al., 2020). Identifying trends, patterns, and relationships in data can inform policy recommendations and improvements (Christensen et al., 2020; Teasley, 2019). Providing evidence-based insights from the data support decision-making and can help ensure that policies are practical and efficient (Pellegrini & Vivanet, 2021; Steiner-Khamsi et al., 2020).

Data from policy papers can help point to best practices, but that only sometimes moves an organization to a solution, as there are more effective ways of using data in addition to research (Gorard et al., 2020; Lester et al., 2020). Raw data and research findings must be translated into actionable recommendations and presented in relevant, accessible, and compelling ways to the intended audience (Benoit et al., 2019; Malin & Rind, 2022). According to Evans et al. (2019), effective communication and collaboration with stakeholders, including educators, administrators, and policymakers, are critical to ensure the findings are understood and translated into real-world solutions.

Mathematics Course-taking Practices

Algebra II appears more important in college attendance and has a more substantial probability of passing introductory-level college mathematics courses than Algebra I (Woods et al., 2018). Utilizing multiple measures for college placement, including high school GPA, state graduation tests, SAT or ACT scores, and high school transcript information, is more predictive than college placement tests alone to determine college readiness (Ganga & Mazzariello, 2019). Charles A. Dana Center (2020) and The Launch Years Initiative provided a call to action to remove outdated, irrelevant gatekeeper requirements to college access, create mathematics courses that prepare students for programs and careers, and monitor student enrollment patterns to measure equity.

In their research, Ngo and Velasquez (2020) stated that math mobility between high school and college needed improvement. The typical course sequence in high school is Algebra I, Geometry, and Algebra II (Ngo & Velasquez, 2020). In a study sample, approximately 14% of students placed in elementary Algebra in college had taken Algebra I twice in high school, which is evidence of chronic math tracking (Ngo & Velasquez, 2020). Many students drop from the accelerated track to the standard math track with the transition to high school (Irizarry, 2021). Math repetition from the study showed that only 8% of students did not repeat any math courses between high school and college (Ngo & Velasquez, 2020). All students should be prepared for introductory-level college mathematics courses that align with their chosen future goals when they leave high school (Charles A. Dana Center, 2020).

Calculus is an essential course for students in mathematics for STEM majors and careers, but only 20% of high school students can take calculus (Bressoud, 2021; Edosomwan et al., 2022). According to Edosomwan et al. (2022), high school calculus increases the probability of students completing a STEM degree and succeeding in a STEM career by increasing college readiness. The course sequence that prepares high school students for calculus fails to serve most students (Charles A. Dana Center, 2020).

Misalignment of mathematics through students' courses can affect their abilities to demonstrate college readiness on the TSIA (Johansson et al., 2022). According to Brower et al. (2021) and Ngo & Melguizo (2021), misalignment may show a disconnect between high school and college standards, creating disjointed systems and additional barriers that students must overcome to demonstrate introductory-level college mathematics readiness. The alignment or misalignment of mathematics content at the secondary and post-secondary levels may affect students' ability to demonstrate their readiness for introductory-level college mathematics courses (Johansson et al., 2022; Ngo & Melguizo, 2021). Additionally, preparing students for success in introductory-level college mathematics courses can be hindered by the school curriculum and course-taking patterns (Bicak et al., 2022; Tyson & Roksa, 2016).

Mathematics Educator Professional Development Practices

Teachers' involvement in curriculum development is an integral part of the process. The teacher is essential to the curriculum implementation process (Sancar et al., 2021; Svendsen, 2020). The knowledge, experiences, and competencies they bring to the process are central to curriculum development and alignment efforts (Roehrig et al., 2021). According to Oke & Fernandes (2020), improved learning is supported by improved teaching, which is enhanced by the teacher utilizing the curriculum they are provided, trying to understand it, and delivering it in the classroom to students. Therefore, teachers should be involved in curriculum development, and their ideas should be incorporated. The curriculum development team must consider the teacher as part of the environment that affects the curriculum (Bovill & Woolmer, 2019).

Teaching styles need to change as we are no longer in a traditional setting with one-to-one communication but are facing global settings that need high-level thinking with 21st-century skills (collaboration, digital literacy, critical thinking, and problem-solving) that come from teaching strategies that are practical, meaningful, and varied (Penprase, 2020; Rahman et al., 2021). Teachers' collaboration skills support student development by working in groups and respecting the abilities of their peers (Rahman et al., 2021). Teachers must think, understand, conceptualize, apply, analyze, and synthesize information to develop students' critical thinking (Alkhatib, 2020; Rahman et al., 2021). As noted by Rahmen et al. (2021), teachers need to be strong problem-solvers in order to guide students through the problem-solving process of defining the problem, making a plan, solving, and justifying solutions.

Teachers who have experienced professional development to increase their understanding of the design and implementation of inquiry-based pedagogical approaches see improved student engagement, thus influencing students' ability to transfer prior learning to new contexts (Attard et al., 2021; Hews et al., 2022). Mathematics specialists control and sustain professional development to support classroom instruction through planning support and resources while implementing district- or campus-wide initiatives (Hjalmarson & Baker, 2020). Common characteristics of mathematics professional development that positively impacts classroom instruction includes addressing problems of practice through interaction, engagement, and reflective cycles (Biswas et al., 2022; Hjalmarson & Baker, 2020).

Cognitive demand is associated with the types of thought students perform to engage with a mathematical task (Ramos Rodríguez et al., 2022; Van den Bogaart-Agterberg et al., 2022; Walkington et al., 2022). The level of cognitive demand that students demonstrate in a mathematical task can be affected by the professional development level of their teacher and the type of professional development program the teacher has participated in (Ramos Rodríguez et al., 2022; Van den Bogaart-Agterberg et al., 2022; Walkington et al., 2022). Ramos Rodríguez et al. (2022) defined eight principles for effective programs for mathematics teachers: teaching for learning, focusing on knowledge, inquiry, and reflection, external links, time, communities of practice, classroom data collection, and provision of experts.

Project Description

The project is a white paper recommending a three-step policy recommendation to improve the curriculum. The recommendations expand the curriculum's focus to include Algebra I, Algebra II, and geometry courses to have all the content assessed on TSIA in the mathematics section. Professional development would be created to support teachers with their content knowledge, understanding of curriculum materials for their courses, and understanding of the TSIA mathematics section to be able to focus their instruction on supporting the content needed for students to be successful in demonstrating college readiness for introductory-level college mathematics courses. The last recommendation would include a periodic review of the curriculum, professional development, and needs of the district and campus to align with the current needs of the teachers and students to meet the goal of students demonstrating college readiness in the mathematics section of the TSIA.

The problem addressed is that according to the TSIA data for the 2018-2019 academic year, most students in a local high school in Central Texas are not prepared for introductory-level college mathematics courses (TEA TAPR, 2021). The gap in practice examined in this study is that the content required to perform well in the mathematics section of the TSIA is assumed to be provided in the curriculum of the study site's Algebra I and Algebra II courses. The analysis of the results showed that there was misalignment due to the missing categories of geometric, spatial, and probabilistic reasoning. These mathematical content areas are addressed in the curriculum of the local site's geometry course, which requires that course to be a focus for students to demonstrate introductory-level mathematics course readiness on the TSIA mathematics section. Supporting teachers with professional development to reach the goal of increased student readiness, as shown on the TSIA, helps to meet the goal along with a periodic review of curriculum, policy, and practices to support the district and campus needs.

Policy Recommendations

Recommendation #1: Improve Algebra Curriculum Alignment to TSIA. The results of this study showed that there needed to be more alignment between the Algebra I and Algebra II curriculums and the assessment items on the TSIA for mathematics. The descriptive codes of logarithmic equations, mathematical arguments, mathematical notation, and mathematical sequences did not appear in the sample TSIA questions analyzed. From the document analysis results, these content areas should be removed from the Algebra I and Algebra II curriculums.

The analysis of the results showed that there needed to be more alignment due to the missing categories of geometric, spatial, and probabilistic reasoning. The local site's geometry course curriculum addresses these mathematical content areas. The findings, therefore, require that the geometry course be a focus of instruction for students to demonstrate introductory-level mathematics course readiness on the TSIA mathematics section.

The scaffolding between Algebra I, Algebra II, and geometry curriculum needs to improve as was discovered due to the discrepant case. Improved scaffolding helps students retain new information by connecting foundational knowledge to new concepts (Hammemess & Kennedy, 2019; Ruiz-Martin & Bybee, 2022). Scaffolding can help engage students with their learning, providing them more independence and autonomy in the classroom (Goodall, 2020; Oates, 2019).

Recommendation #2: Teachers Contribute to Curriculum Alignment Through Collaboration. The study results show the need for the Algebra I and Algebra II curriculums to better align with the TSIA in mathematics. Teachers from the local site could contribute to this work through collaboration to adjust the curriculum currently taught with the content areas that need to be eliminated and the content areas that need to be added. This will help the local site meet the goal of improved student performance to demonstrate college readiness on the mathematics section of the TSIA.

Teachers' collaboration skills support student development by working in groups and respecting the abilities of their peers (Rahman et al., 2021). Teachers must think, understand, conceptualize, apply, analyze, and synthesize information to develop students' critical thinking (Alkhatib, 2020; Rahman et al., 2021). According to Rahmen et al. (2021), teachers need to be strong problem-solvers to guide students through the problem-solving process of defining the problem, making a plan, solving, and justifying solutions. Teachers who have experienced professional development to increase their understanding of the design of inquiry-based pedagogical approaches improved student engagement, influencing students' ability to transfer prior learning to new contexts (Attard et al., 2021; Hews et al., 2022).

Recommendation #3: Periodic Review of Algebra Curriculum. A periodic review of course curriculum for Algebra I, Algebra II, and Geometry courses should occur at least once per semester to maintain alignment with TSIA sample questions and course content. This review should be a collaboration between the teachers, campus administration, and district administration. The periodic review will help to support the continued alignment of the curriculum taught in the classroom with the TSIA mathematics section.

Needed Resources and Existing Supports

The local site district and campus administration have the resources to implement the policy recommendations. No additional staff will be required to put the policy recommendations into action. The district math coordinator has the curriculum resources, and the district and campus administration teams can support teachers, review instructional decisions, and provide professional development.

Potential Barriers and Solutions to Barriers

Barnes & Cross (2020) noted that positive education changes do not occur without growing pains. Teacher preparation for the content they teach in the classroom and quality are constantly under attack by the general public and will keep teachers from being open to new processes and procedures (Barnes & Cross, 2020; Rapanta et al., 2021). Teaching experiences can allow integration of the tools and methods of instruction for a more engaged, flexible, and meaningful learning environment for students, allowing them to demonstrate their college readiness for TSIA better (Rapanta et al., 2021).

Proposal Implementation and Timeline

The local site has committees that review the curriculum. Those committees and administrative teams would review the policy recommendations presented in the white paper and discuss the proposal to make any necessary modifications for the district. Acceptance of the recommendations will begin aligning the classroom curriculum with the mathematics section of the TSIA for the local site. The process could take up to two months to complete, dependent upon the agendas of the standing committee meetings.

Roles and Responsibilities

Group effort is required for adjusting the course curriculum and through teacher professional development for mathematics courses at the local site. The course curriculum materials and content must be reviewed to ensure it meets the standards assessed in the TSIA sample questions. The local site campus and district administration teams will need to adjust professional development plans to accommodate the needs of the curriculum adjustments and the current teaching staff to successfully implement the curriculum for students to demonstrate success in the mathematics section of the TSIA.

All stakeholders, students, teachers, and administrators must work together to successfully implement the curriculum for student achievement. Successfully strict mathematics coordinator will be a crucial component of keeping the work on track and communicating with all stakeholders to implement the policy recommendations successfully. The standing committees will provide district leaders with periodic updates on successes and challenges for the systematic reviews to make necessary adjustments regularly.

Project Evaluation Plan

The project evaluation will be outcomes-based. The white paper policy recommendations include improving the alignment of the Algebra curriculum to the TSIA, collaborating with teachers to improve the algebra curriculum alignment, and periodic review of the Algebra curriculum alignment. The project's goal is to increase the number of students demonstrating that they are college ready for introductory-level college mathematics courses. Therefore, the successful implementation of this project would show the improved outcomes of students demonstrating college readiness in mathematics on the TSIA.

Project Goals

The white paper has three primary stages. Through the project, I will communicate the following to the district and campus administrative teams:

1. Need to better align Algebra I, Algebra II, and Geometry course curricula as the focus for improved student success in the TSIA mathematics section.
2. Creating a collaborative team of teachers to understand better their course content, course curriculum materials, and the mathematics section of the TSIA and align the content areas to be taught with the TSIA.
3. Need for periodic curriculum review to adjust for current district curriculums with TSIA mathematics assessment items.

The results of the research question showed that the curriculum needed more alignment due to the missing components of geometric, spatial, and probabilistic reasoning in the Algebra I and Algebra II curriculums. I recommend including Geometry in courses focused on improving students' ability to demonstrate college readiness in mathematics, as this course contains the missing curricular content components.

Evaluation Goals and Key Stakeholders

The evaluation goal of this project is to increase the number of students that demonstrate college readiness in mathematics as measured by the mathematics section of the TSIA. The critical stakeholders for the project are the classroom teachers, campus and district administrators, and the students. The teachers must embrace the focus of the content assessed on TSIA, the administrators must be dedicated to supporting the needs of teachers and students with curricular materials and professional development, and the students must be engaged in their learning and understanding.

Project Implications

Implications at the Local Site

The local site is dedicated to supporting teachers becoming better teachers and students becoming better learners to build a community with citizens to support their families through continued education and participation in the workforce. This white paper is one way to support improving the local site's teaching and learning. This ultimately benefits the students and helps them become productive community members.

Implications in the Larger Context

Students who demonstrate college readiness in mathematics can attend post-secondary institutions to further their education more quickly. The lifetime earning power of individuals with post-secondary education is more significant than those with only a high school diploma (U.S. Bureau of Labor Statistics, 2020). The impact on society of a population that is more educated is notable. Higher education levels correspond to lower unemployment, poverty, incarceration rates, and civic participation, such as voting (Ma et al., 2019).

Summary

In this section, I provided a detailed description of the project study. A white paper with policy recommendations is the most appropriate deliverable for the project. The literature review supported the white paper and offered insight into working with multiple levels of stakeholders, looking at mathematics course-taking practices and mathematics educator professional development practices. The local site has resources to provide action to the policy recommendations. There may be some resistance from some stakeholder groups. This should be viewed as an opportunity to revise teaching and learning practices to benefit students and their understanding and achievement.

In section 4, I will discuss the project's strengths and limitations and recommend alternative approaches. The project's development research and processes will be discussed and reflected upon for my growth as a researcher, scholar, practitioner, and project developer. The overall importance of the work, implications for social change, and recommendations for future research will be addressed.

Section 4: Reflections and Conclusions

Project Strengths and Limitations

The problem I addressed was that according to the TSIA data for the 2018-2019 academic year, most students in a local high school in Central Texas were unprepared for introductory-level college mathematics courses (TEA TAPR, 2021). Across Texas, more than half of the students (52.1%) needed to demonstrate college readiness in mathematics. In comparison, 70.9% of the students at the local site needed to demonstrate college readiness in mathematics (TEA TAPR, 2021). The gap in practice examined in this study is that the content required to perform well in the mathematics section of the TSIA is assumed to be provided in the curriculum of the study site's Algebra I and Algebra II courses. A white paper was selected for this study as it gave the local site evidence-informed guidance on bridging the gap between the Algebra I and Algebra II curriculum and the assessed content on the TSIA mathematics section; the ultimate goal was to help more students demonstrate introductory-level college mathematics readiness. A white paper on policy allows in-depth research focusing on the recommendations for policy and program changes to have a tangible impact on the local site, students, families, and the local community. The results from the data analysis of this study indicate a misalignment of the curriculum in the Algebra I and Algebra II courses and the content in the TSIA mathematics section.

The white paper, with its policy recommendations has strengths and limitations. A strength of the white paper is that teachers would be involved in developing curriculum for the Algebra I, Algebra II, and Geometry courses. Another strength is that the professional development recommended for the teachers would help them with their content knowledge, understanding of curriculum materials for their courses, and understanding of the TSIA mathematics section. This would equip them to focus their instruction on supporting the content needed for students to demonstrate college readiness for introductory-level college mathematics courses successfully.

A limitation of the recommendations in the white paper was the time commitment required from the teachers. The professional development would be ongoing throughout each academic year to improve classroom practices for each cohort of students. While the prescribed time involved for teachers is extensive, it is suggested outside the planning responsibilities they already have to meet, making this limitation challenging but manageable.

Recommendations for Alternative Approaches

The issue of students' lack of college readiness in mathematics, as shown on the TSIA, could have been addressed through a professional development training curriculum and materials that included goals, learning outcomes, activities, trainer notes, an implementation plan, and evaluation plan. The local site would still have to approve the professional development plan. Someone with the knowledge and skill would need to implement it to support the mathematics teachers. Additionally, a lengthy professional development plan may not be feasible to implement with the existing responsibilities of the staff and educators at the local site. A challenge for the professional development option is showing mathematics teachers the relevance of the training to their classroom instruction.

Another project could have been creating a curriculum plan for a specified period. Local educators need input into their curriculum, the pacing of lessons, and the planning of activities. In that case, they would need more time to implement that plan successfully. Teachers need input into their lessons to deliver the classes in the classroom more effectively for students.

Scholarship, Project Development and Evaluation, and Leadership and Change

Scholarship

After 15 years in the education world, I have been involved in many initiatives presented by stakeholders. Looking at college readiness in mathematics, as demonstrated on the TSIA for the local site, allowed me to adjust my perspective and see many of the projects and outcomes from a different lens. This experience has been valuable to my professional growth through my interactions with classmates and colleagues, which have helped me deepen my desire to make a difference as an educator. Walden’s online Doctor of Education program with the P-20 self-designed option has allowed me to continue my professional learning as a K-12 educator and start to see the connections to higher education.

Project Development and Evaluation

The development of this project had me reflect on the professional development I have attended previously, policy and initiative changes that I have experienced, and educational outcomes that I want for students. Mathematics has been a significant focus of my professional life as an educator, and I wanted to look at ways to impact students’ future mathematic education. Professional development only sometimes makes a lasting impact on educators, and the curriculum handed to educators is only sometimes implemented effectively. Therefore, I decided to create the white paper with policy recommendations to gain the trust of the local site via their Board of Trustees, Superintendent, District and Campus Administrators, and mathematics teachers to make lasting change through policy that would become a part of the organization. The policy recommendations include a periodic review and evaluation of the work the local site completes to ensure it remains in alignment with its intended student outcomes.

Leadership and Change

This research experience and reflection as a scholar-practitioner have helped me continue developing my leadership skills. I do not anticipate a change in position. Still, this process has helped me learn how to support my opinions and beliefs and put into place opportunities to make a lasting impact on my colleagues and students. Having the courage to start the change process can set into motion some of the components necessary to make a lasting change for the organization.

Reflection on the Importance of the Work

The ability to take a deep look at the Algebra I and Algebra II curriculum documents and the TSIA sample questions improved my understanding of the connection between curriculum, instruction, and assessment. The opportunity to code the documents utilizing RBT and descriptive content codes, categorize using a priori categories from the TSIA mathematics section blueprint, and develop the resulting themes from the document analysis findings gave me a new perspective on my work in mathematics education. The knowledge gained from this process will help improve the understanding of other mathematics educators as I use the knowledge to positively impact the local and regional community of mathematics educators.

Implications, Applications, and Directions for Future Research

Implications

The white paper policy recommendations are put forth to support the local site in creating a system to shift the way mathematics teachers implement their curriculum in the Algebra I, Algebra II, and Geometry courses, with the ultimate goal of helping students demonstrate college readiness for introductory-level college mathematics courses on the TSIA. Students who engage in activities supported by the policy changes with increased teacher understanding of curriculum, instruction, and assessment can demonstrate their achievements more easily on the TSIA. Further, the improved percentage of students demonstrating college readiness in mathematics will help the local site continue to improve student outcomes.

Applications

The local site will be able to institutionalize its systemic changes in curriculum, instruction, and assessment and share these adjustments with other regional districts. The collaboration of the local site with neighboring districts will help the administrators and mathematics educators continue to grow and adjust as the needs of students change over the years. Expanding the network of educators engaged in this work will benefit students across the region and state.

Directions for Future Research

I looked explicitly at the alignment of the Algebra I and Algebra II curriculums with the mathematics section of the TSIA. A more in-depth study could look at the geometry course curriculum. Another study could look at a similar process with the reading and writing sections of the TSIA to help students demonstrate college readiness in mathematics, reading, and writing.

Conclusion

Every cohort of students will have its own set of advantages and challenges to overcome in obtaining the best education they can for their future success in college, career, or life. High school students may need help understanding the impact their current education and devotion to learning may have on their lives. Educators take on that challenge to help students know where they are and how they can move forward as prepared as possible to make lasting changes for the good of their communities. This study provides recommendations for the local site. It has changed me as the knowledge of completing professional research and being a scholar-practitioner will impact my work and future colleagues and students.

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Appendix: The Project

Improving Student Demonstration of College Readiness in TSIA Mathematics Section

Prepared by Kathryn Kober, M.B.A., Doctoral Candidate February 2023

Executive Summary

Defining the Problem

The problem that initiated this study focused on the curriculum delivered in Algebra I and Algebra II courses. The analysis of the Algebra I and Algebra II course curriculum's content compared to the TSIA mathematics sample questions showed that Geometry courses were needed to cover all of the assessed content. The local site does not focus on the geometry course curriculum, therefore, a white paper on policy updates for the local site will help fill the gap in curriculum and student success on the TSIA by improving the course-taking policy and updating educator professional development plans.

Data and Evidence

The document analysis of the Algebra I and Algebra II content with the TSIA sample questions shows that there is a major misalignment of the Algebra I and II content with the TSIA sample questions due to the amount of content that is taught in Algebra I and II curriculum and not tested on TSIA. There is minor misalignment when content tested on TSIA is not taught in Algebra I and II, and there is minor alignment when content tested on TSIA is taught in Algebra. The results of this qualitative study show that the Algebra I and II curricula need to be aligned with the TSIA mathematics section because the curriculum documents contain only some of the content assessed in the TSIA mathematics section.

Recommendations

The white paper has three primary goals. The project will communicate the following to the district and campus administrative teams:

1. Need to improve alignment of Algebra curricula to the TSIA mathematics section.
2. Teachers contribute to improved curriculum alignment through collaboration.
3. Need for periodic review of the algebra curriculum alignment.

The results of the research question showed that the curriculum needed more alignment due to the missing components of geometric, spatial, and probabilistic reasoning in the Algebra I and Algebra II curriculums. I recommend including Geometry in courses focused on improving students' ability to demonstrate college readiness in mathematics, as this course contains the missing curricular content components.

Call to Action

This policy will strengthen teaching and learning at the local site if used in its entirety. Students will better understand quantitative, algebraic, geometric, spatial, probabilistic, and statistical reasoning to demonstrate college readiness in the mathematics section of the TSIA. Students who successfully demonstrate college readiness in mathematics will eliminate the need for developmental mathematics courses, thus saving them money. Students will be better prepared to be exceptional citizens and benefit the community when they enter the workforce.

Introduction

The study problem was that according to the TSIA data for the 2018-2019 academic year, most students in a local high school in Central Texas are not prepared for introductory-level college mathematics courses (TEA TAPR, 2021). Across Texas, more than half of the students (52.1%) needed to demonstrate college readiness in mathematics. In comparison, 70.9% of the students at the local site needed to demonstrate college readiness in mathematics (TEA TAPR, 2021). The gap in practice examined in this study is that the content required to perform well in the mathematics section of the TSIA is assumed to be provided in the curriculum of the study site's Algebra I and Algebra II courses.

The Problem

The problem addressed in this study was that according to the Texas Success Initiative Assessment (TSIA) data for the 2018-2019 academic year, most students needed to prepare for introductory-level college mathematics (TEA TAPR, 2021). The gap in practice examined in this study is that the content required to perform well in the mathematics TSIA section is assumed to be provided in the curriculum of the Algebra I and Algebra II courses.

The Purpose

This qualitative study aimed to examine the Algebra I and Algebra II mathematics course curriculum documents at the local high school to determine alignment to the mathematics section of the TSIA and identify content necessary for students to demonstrate college readiness in mathematics on the TSIA. The Texas College and

Career Readiness Standards (TxCCRS) provide a framework for what students should know and be able to do to succeed in entry-level college courses after graduation from high school (THECB, 2021). These standards were written in response to a need to try to help high school graduates be better prepared for college-level courses by improving the alignment between secondary and post-secondary curricula and that high school graduates complete Algebra II and a mathematics course after Algebra II to be better prepared for entry-level college mathematics courses (THECB, 2021).

Analysis for **Findings**

The written curriculum, as analyzed, is aligned with the algebraic methods and functions but needs to be aligned with geometric and spatial reasoning and probabilistic and statistical reasoning. Additionally, the enacted curriculum by the local site educators needs to be aligned with the assessed curriculum, as evidenced by comparing the curriculum standards versus the PLC documents. It leaves gaps in student learning due to needing to have delivered instruction on all the content required of the curriculum that students need to perform successfully on the college placement assessment in mathematics. These findings resulted in several themes being developed, including significant misalignment occurring when most content taught in Algebra I and II is not tested on TSIA, minor misalignment occurring when some content tested on TSIA is not taught in Algebra I and II, and minor alignment occurring when some content tested on TSIA is introduced in Algebra I and II.

Project Recommendations

Recommendation #1: Improve Algebra Curriculum Alignment to TSIA

This study's results showed a misalignment between the Algebra I and Algebra II curriculums and the assessment items on the TSIA for mathematics. The descriptive codes of logarithmic equations, mathematical arguments, mathematical notation, and mathematical sequences did not appear in the sample TSIA questions analyzed. The document analysis results suggest these content areas should be removed from the Algebra I and Algebra II curriculums.

The analysis of the results showed that there needed to be more alignment due to the missing categories of geometric, spatial, and probabilistic reasoning. The local site's geometry course curriculum addresses these mathematical content areas. The findings, therefore, require that the geometry course be a focus of instruction for students to demonstrate introductory-level mathematics course readiness on the TSIA mathematics section.

The scaffolding between Algebra I, Algebra II, and geometry curriculum needs to improve as was discovered as a result of the discrepant case. Improved scaffolding helps students retain new information by connecting foundational knowledge to new concepts (Hammemess & Kennedy, 2019; Ruiz-Martin & Bybee, 2022). Scaffolding can help engage students with their learning, providing them more independence and autonomy in the classroom (Goodall, 2020; Oates, 2019).

Recommendation #2: Teachers Contribute to Curriculum Alignment Through Collaboration

The study results show the need for the Algebra I and Algebra II curriculums to better align with the TSIA in mathematics. Teachers from the local site could contribute to this work through collaboration to adjust the curriculum currently taught with the content areas that need to be eliminated and the content areas that need to be added. This will help the local site meet the goal of improved student performance to demonstrate college readiness on the mathematics section of the TSIA.

Teachers' collaboration skills support student development by working in groups and respecting the abilities of their peers (Rahman et al., 2021). Teachers must think, understand, conceptualize, apply, analyze, and synthesize information to develop students' critical thinking (Alkhatib, 2020; Rahman et al., 2021). Teachers need to be strong problem-solvers to guide students through defining the problem, making a plan, solving, and justifying solutions (Rahmen et al., 2021). Teachers who have experienced professional development to increase their understanding of the design of inquiry-based pedagogical approaches improved student engagement, influencing students' ability to transfer prior learning to new contexts (Attard et al., 2021; Hews et al., 2022).

Recommendation #3: Periodic Review of the Algebra Curriculum

A periodic review of course curriculum for Algebra I, Algebra II, and Geometry courses should occur at least once per semester to maintain alignment with TSIA sample questions and course content. This review should be a collaboration between the teachers, campus administration, and district administration. The periodic review will help to support the continued alignment of the curriculum taught in the classroom with the TSIA mathematics section.

Next Steps Following Policy Acceptance

The recommendations in the white paper must be presented, discussed, and approved according to the district's guidelines for policy acceptance. This could be a collaborative effort between district and campus administration and teacher leaders. If board approval is needed, the appropriate administrator will initiate the process to have the district Board of Trustees review for acceptance.

Conclusion

The local site can benefit from reviewing current research in the literature and evidence collected through document analysis to guide policies and procedures. The policy recommendations target improving the success rate of students demonstrating college readiness in the TSIA mathematics section for introductory-level college mathematics courses. These recommendations will enhance the alignment of the course content and curriculum to the TSIA sample questions, provide educators with professional development to support their efforts in the classroom, and create a reflection process to review the district's needs over time.

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