Success Strategies in Developmental Math in Small Community Colleges

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Texas Success Center | Talent Strong Texas Pathways

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Introduction

Community colleges in Texas are continually working to provide support for all students to complete their educational goals. In addition to guiding students in exploring post-secondary options, the Talent Strong Texas Pathways strategy highlights the importance of providing supports that help all students succeed in college-level courses upon entry. Supporting academically underprepared students in completing the entry-level math course for their pathway is challenging and has become more so as a result of the pandemic. Two primary factors that affect a student's success are the level of readiness upon entering college and the configuration of supports provided prior to and corequisite with an entry-level course.

In Texas community colleges, support for students deemed not ready for entry-level coursework by Texas Success Initiative (TSI) standards is provided by Adult Education and Literacy (AEL) programs and/or developmental education programs based on a student's readiness level as determined by the TSI Assessment 2.0 (TSIA2.0). While the state sets the standard score for readiness for both developmental education and entry-level courses, community colleges decide placement levels and associated supports within and between these readiness standards.

The type of supports offered can depend in some part on the funding of these programs. In general, the state provides funding to community colleges to provide developmental education and college-level coursework. Funding for students at the adult basic education level (below developmental education) is provided to AEL providers. In Texas, the majority of community colleges are either direct recipients of AEL funding or a part of a consortia with another entity managing the funding. However, there are some community colleges that neither receive AEL funding nor participate in a consortium to provide AEL services despite having students at this level to serve.

Support design is also influenced by the colleges' efforts to redesign the student experience through guided pathways and legislation (Senate Bill (SB) 162, 82nd Texas Legislature; House Bill (HB) 2223, 85th Texas Legislature). Since 2016, Texas community colleges have participated in Texas Pathways and Talent Strong Texas Pathways to organize programs into meta-majors, define math pathways that align coursework with students' end goals, and to provide effective supports for both academic and wellness needs. In addition to this statewide reform effort, SB 162 mandated that colleges offer at least one non-course-based option (NCBO) for students needing college readiness support and HB 2223 mandated the use of corequisite support for students deemed not college-ready, but who are eligible for developmental education. These laws have resulted in the design and implementation of several developmental education, NCBO, and corequisite models at community colleges across Texas.

This mixed-methods study examined the placement and outcomes for Texas community college students who were placed below and into developmental math and how these placement decisions and student supports contributed to the completion of math courses along students' pathways. The study focused on small colleges—those with full-time enrollment (FTE) < 5000—as these schools often do not have AEL programs on their campus or separate developmental education departments, which provided a unique context in which to examine math placement and success.

Methods

Research Questions

Concerning small schools (FTE < 5000) in Texas community colleges:

1. What modalities of developmental math support are being utilized at various college readiness levels?
2. What patterns exist between modalities of developmental math support and placement structures to the success in entry-level math courses or TSI-clearance for Career and Technical Education (CTE) entry?

Data and Study Design

Three Texas community colleges (colleges A, B, and C) participated in the research study by providing course, student, and enrollment data and participating in a qualitative focus group. The math progress of a cohort of students who were first-time in college (FTIC) Fall 2021 and Spring 2022 and not college-ready in math was tracked. A total of 388 student records were analyzed in the study with 86, 109, & 193 students enrolled in colleges A, B, & C, respectively. Each school provided the following:

- Math course inventory in place for Fall 2021
- Placement chart from Fall 2021
- Student demographic data including TSIA2.0 scores, degree-seeking status, race, age, etc.
- Math enrollment and outcomes data from Fall 2021-Fall 2023

Analysis

An analysis of each college's placement practices revealed two primary 'levels' of placement—Level 1 and Level 2—based on the first developmental math course offered at the college. Then, each student was coded with their placement level. The progress of each student was recorded by calculating the following based on math enrollments from Fall 2021 through Fall 2023:

- Total developmental, credit, all math, corequisite, NCBO, and stand-alone semester credit hours (SCHs) accumulated
- Total semesters spent in credit, developmental, and all math courses
- Exit TSI Status
    - TSI Clear refers to college-ready, TSI Not Clear refers to not college-ready
- Success in the first developmental math course
- Credits awarded in each math pathway:
    - College Algebra, Statistics, Business Math, & Contemporary Math

Descriptive statistics were calculated to compare the following by college, placement level, and demographic information (age, gender, ethnicity, Pell-status):

- Completion of academic goals: TSI clearance (college readiness), credit level non-algebra and algebra entry-level course completion
- Average semesters and contact hours for completion of academic goals
- Types of supports (corequisite, stand-alone, NCBO, etc.) provided

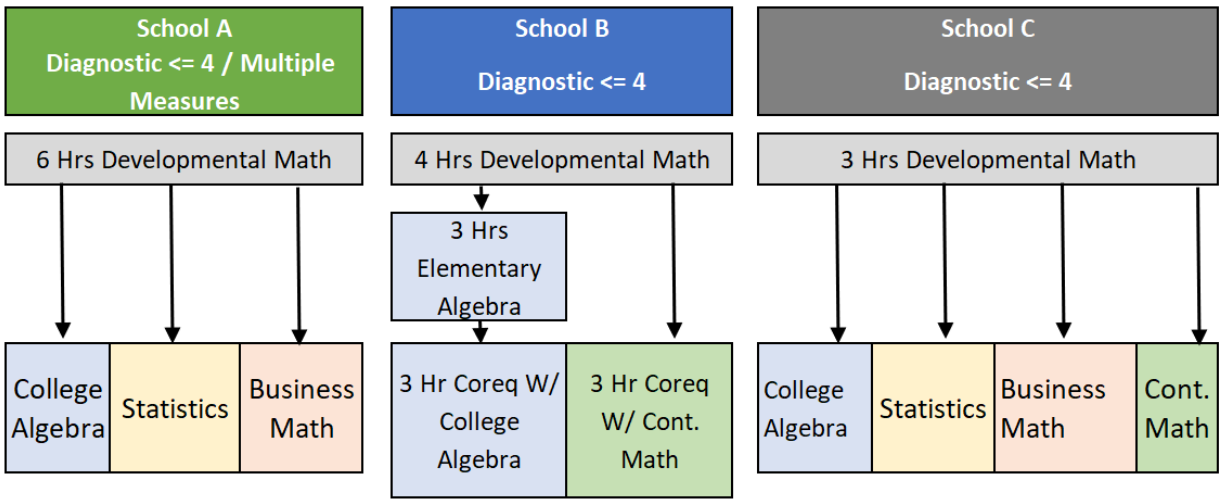
Tracking of student persistence through the developmental math pathway was completed by school for the Level 1 placement cohort only since this represented 77% of the study participants. Individual schools received detailed progress reports for individual students at their college.

Findings

Modalities of Developmental Math Support

Placement Level 1. At the lowest placement level, students started in a stand-alone developmental math course ranging from three to six SCH (Figure 1). All three colleges designated this level of remediation using either TSIA2.0 Diagnostic ≤ 4 or multiple measures.

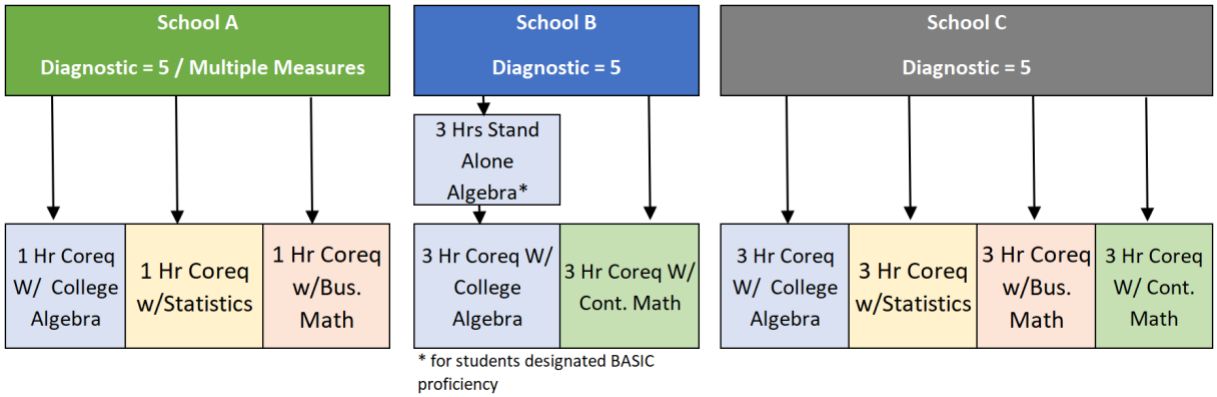
Figure 1
Math Pathways for Placement Level 1



Colleges differed greatly in the amount of developmental support offered to students after the successful completion of an initial stand-alone course. In Colleges A & C, students progressed directly to a credit-level math course. College B required an additional Elementary Algebra course for students on an Algebra pathway and 3 SCH developmental corequisites for College Algebra and Contemporary Math.

Placement Level 2. At Level 2, students started in a credit-level math course with a corequisite developmental math course (Figure 2). Placement into this level was mostly based on a TSIA2.0 Diagnostic of 5.

Figure 2
Math Pathways for Placement Level 2



For Level 2 placements, College A offered a 1-SCH developmental corequisite while Colleges B and C required 3-SCH developmental corequisites. College B required a stand-alone Elementary Algebra course for certain students on an Algebra pathway and only offered College Algebra and Contemporary Math pathways.

Modalities of Developmental Math Support and Placement Structures and Success

All students in this study were assigned a placement level based on their first developmental course. There was a large difference in the percentage of students placed at Level 1 (77%) compared to those who began their math course in corequisites at Level 2 (23%). In comparing the progress of students by placement level, there were similar percentages of students designated college-ready (TSI Clear) based on developmental coursework but a large difference in percentages of students earning college math credits. Level 1 students had higher averages in the number of math contact hours and semesters enrolled in math (Table 1).

Table 1
Comparison of Student Progress by Placement Level (N=388)

	Level 1	***Level 2***
Number of Students	297 (77%)	91 (23%)
Designated College Ready	177 (60%)	57 (63%)
Earned College Math Credit	75 (25%)	56 (62%)
Average Math Contact Hours	6.6	5.9
Average Semesters	1.7	1.3

There was a minimal difference (1%) in the percentages of Level 2 students earning college math credits when comparing students designated as degree or non-degree seeking. There was a 7% difference in the percentages of Level 1 students earning college math credits in comparing the degree and non-degree seeking students (Table 2).

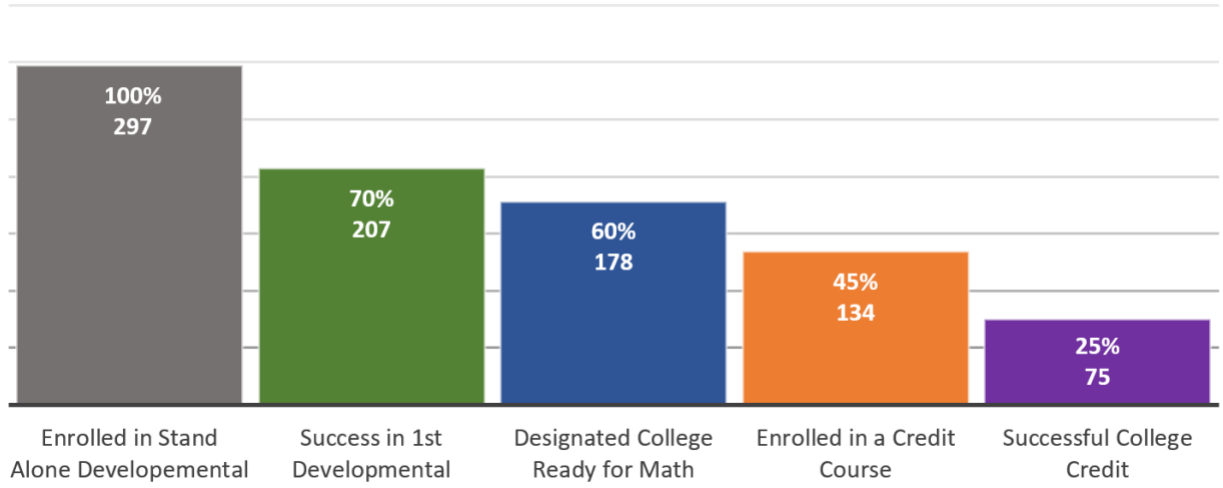
Table 2
Comparison of College Math Credits Earned by Level and Degree Seeking Status (N=388)

	Level 1		***Level 2***	
	Degree Seeking	***Non-Degree Seeking***	***Degree Seeking***	***Non-Degree Seeking***
Number of Students	187	110	58	33
Earned College Math Credit	52 (28%)	23 (21%)	36 (62%)	20 (61%)

Further analysis was performed on the Level 1 students that revealed gaps in persistence and completion (Figure 3). While 70% of Level 1 students passed their first developmental course, only 45% persisted in enrolling in a college-level course. Considering approximately half of the students who enrolled in the credit course were successful, additional supports may be needed to support these students. These findings suggest there is room for continuous improvement efforts in developmental math support at these colleges.

Figure 3

Overall Progress of Level 1 Students (N=297)



In addition to success rates, it is extremely beneficial to consider persistence through the pathway for cohorts of students. To further understand factors that may contribute to the success of the Level 1 students, progress was determined for each college in the study (Figure 4).

Figure 4

Level 1 Persistence Rates by School (N=297)

	School A			School B		School C			
1st Math Success	6 Hr Developmental 22 of 56 (39%)			4 Hr Developmental 69 of 94 (73%)		3 Hr Developmental 116 of 147 (79%)			
Persist->Credit	16 of 22 (73%)			48 of 69, (70%)		67 of 116 (58%)			
				3 Hr Elem					
Credit Enrollment	College Algebra	Statistics	Business Math	College Algebra w/Coreq	Cont. Math w/ Coreq	College Algebra	Statistics	Business Math	Cont. Math
Success	7 of 10 (70%)	5 of 7 (71%)	< 5 (100%)	8 of 13 (62%)	24 of 38 (63%)	8 of 24 (33%)	15 of 32 (47%)	< 5 40%	6 of 13 (46%)
Credits Earned									
All Students	13 of 56 (23.2%)			31 of 94 (33.0%)		31 of 147 (21.0%)			
Degree Seeking Only	9 of 39 (23.1%)			29 of 87 (33.3%)		14 of 61 (23.0%)			
Averages	9 Hrs, 2.1 Semesters			11.5 Hrs, 2.5 Semesters		6.6 Hrs, 2.1 Semesters			

In School A, only 39% of Level 1 students were successful in the first developmental math course, but 73% of these students enrolled in a credit course with a high rate of success. School B had a higher overall percentage of Level 1 students who earned a college credit compared to their peers, with a 60-70% persistence from the first developmental math course to completion of a credit math course. School C had a high percentage (79%) of students who passed the first developmental math course, but much lower percentages persisted to credit and passed the credit math courses.

There was a minimal difference in the percentages of students earning credit courses between all students and those designated as degree-seeking. A higher average of contact hours and semesters accumulated for the 33.3% of students who earned a college credit for School B compared to the 23% who earned a college credit for Schools A and C.

Implications

Challenges with Placement and Support for Math Students

Designing accurate placement policies and supports for math students is top-of-mind for community college practitioners. Yet, qualitative analysis of the practitioner interviews found that math department chairs and advising directors did not systematically review student placement, in fact, all were surprised at the high percentage of students placed at Level 1 and the progress of these students through the available math pathways. Further analysis provided information on why these challenges may exist at the colleges. Those challenges included:

- Retaining underprepared students who often have additional needs including remediation requirements in reading/writing, basic needs insecurities, etc. that make persistence a challenge.
- Designing effective advising strategies for low-level students who are not successful in their first developmental math course
- Addressing language barriers that impact comprehension of math content
- Increasing communication between faculty and advisors to help students make informed choices along their pathway
- Maintaining consistency in placement and course design with staff turnover
- Collecting and analyzing student transfer data, especially for student-athletes, and how transfer impacts persistence data
- Collecting and analyzing student math course requirements and data for students enrolled in Level 2 certificates, Associate degrees, and Applied Associate degrees, and how differing program requirements impact math course persistence data

Shifting Placement Structures

This retrospective study examined placement structures, developmental math support designs, and outcomes for programs and students in Fall 2021, when the TSIA2.0 was first launched. It is noteworthy that each college in the study reported changing placements and developmental supports since Fall 2021 in response to their own institutional analysis. Additional research is necessary to understand the impact of the changes on student outcomes.

The following changes were reported since Fall 2021:

- College A
  - Reduced the initial stand-alone developmental course to 4 SCH.
  - Reduced the required student success course to 1 SCH from the original 3-SCH.
- College B
  - Adjusted placement for the stand-alone developmental course to only TSIA2.0 Diagnostic 2-3 with consideration of the TSIA2.0 base score.
  - Updated the curriculum for the initial stand-alone developmental math course and Elementary Algebra course.
- College C
  - Changed advising practices to highly encourage students to not opt into the stand-alone developmental math course to avoid corequisite math course
  - Adjusted placement for stand-alone developmental math to only TSIA2.0 Diagnostic 2-3 with consideration of the TSIA2.0 base score.
  - Added multiple measures placement to the test-based placement policy.

Recommendations

Participating Colleges

Based on the quantitative analysis, the participating colleges may consider the following recommendations:

- In the short term, all colleges may increase student success by addressing the gap in persistence after the first developmental math course with proactive/intrusive advising during the semester, during the registration period, and during the intersession.
- In the long term, considering assessment scores, completion rates, and the associated curriculum in each math course and in successive math courses may be helpful to adjust teaching and learning practices in each course.
- College A had a low percentage of students passing the first developmental math course. The college should consider curriculum adjustments or additional supports in stand-alone developmental math courses to increase success.

- College B offered the longest math pathway. The college should consider shortening the path to College Algebra by eliminating the stand-alone Elementary Algebra course, ensuring that relevant content is offered in the corequisite support course.
- College C had a low passing rate in entry-level math courses. The college should consider diversifying the stand-alone developmental course to align with math pathways or offering additional support with credit courses after the initial stand-alone developmental math course.

All Texas Community Colleges

All community colleges in Texas support students who are underprepared for entry-level math courses. It is the college's responsibility to measure student readiness using multiple measures to ensure the most accurate understanding of initial ability. It is also the college's responsibility to design developmental and corequisite math supports that allow students to progress regardless of their starting point.

To meet these responsibilities, colleges should focus on understanding students' progress by their first math course to identify areas for improvement, rather than relying on TSIA2.0 scores as cut-offs for understanding student success. First math course analysis has the following benefits:

- TSIA2.0 scores are difficult and unreliable for tracking student progress. This study found that there is not a 1-1 relationship between placement, outcomes, and their TSIA2.0 score. For example, student enrollment in their first developmental math course did not align with placements reported by colleges in Fall 2021 based on TSIA2.0 scores reported on CBM 002. Students also retake the TSIA2.0 multiple times with different outcomes within small timeframes, which makes analysis of initial readiness by test score challenging.
- The analysis of student progress through pathways based on the first math course provides a framework that will persist through updates to college readiness standards, curriculum updates, and advising practices. It also allows for analysis of students starting in college-level courses and across different programs (other than math).
- Tracking student progress by first math course reveals gaps in performance/persistence that are missed in evaluating success in individual courses.

To analyze student progress, colleges should classify each student by their 'first developmental math course' to create cohorts of students for analysis. To begin, colleges should start with a baseline assessment of progress by first math course. Then, the analysis should be repeated, particularly after placement, curriculum, or advising changes. This longitudinal study of student progress will provide the necessary framework for institutional conversations that can focus on increasing student success across courses, programs, and pathways.

Conclusion

Community colleges in Texas continue to improve developmental math programs to meet the unique needs of their student population. In this study of math supports and placements, the three colleges were similar in offering two basic levels of support. Level 1 support placed students into an initial stand-alone developmental math course followed by various configurations of developmental corequisite courses alongside credit-level math courses. The second level of support placed students primarily into corequisite developmental courses allowing students to enroll in a credit-level math course in their first semester. While there wasn't a clear pattern predicting a specific combination of developmental math support and placement to overall success, analysis of student progress by entry-level provided a unique understanding of opportunities for improvement for all three colleges. Monitoring the success of developmental math programs through the analysis of student progress by entry-level provides colleges with a necessary framework for improvement. Understanding student progress at each level of entry will provide institutions with key insights into opportunities for helping all students reach their academic goals.

Appendix A.
Placement Chart 1

Mathematics TSIA2 Placement Scores	
MATH TSIA2 Score	**College-Level Mathematics Placement**
1) 950 - 990 ***or*** 2) < 950 and DT = 6	Entry-level college math course appropriate for meta-major: MATH 1314, MATH 1324, MATH 1332, MATH 1342
1) < 950 and DT = 5 ***and*** 2) *HS GPA ≥ 3.0 *Note: If HS transcript > 3 years old, EDUC 1300 required unless exempted by criteria below.	MATH 1314 and 0114 (Concurrently) ***or*** MATH 1324 and 0124 (Concurrently) ***or*** MATH 1332 and 0132 (Concurrently) ***or*** MATH 1342 and 0142 (Concurrently)
< 950 and DT = 5 ***and*** HS GPA < 3.0	MATH 1314 and 0114 and *EDUC 1300 (Concurrently) ***or*** MATH 1324 and 0124 and *EDUC 1300 (Concurrently) ***or*** MATH 1332 and 0132 and *EDUC 1300 (Concurrently) ***or*** MATH 1342 and 0142 and *EDUC 1300 (Concurrently) *Note: Exemption for EDUC 1300 ***if*** 1) Veteran ***or*** **2)** Age ≥ 25 years ***or*** **3)** College credits ≥ 15 semester credit hrs with ≥ 2.5 gpa **(Approval by supervisor required)**
1) < 950 and DT = 4 ***and*** 2) HS Pre-Cal ***or*** AP/CTE Statistics ***or*** *HS GPA ≥ 3.0 *Note: HS Transcript ≤ 3 years old **(Approval by supervisor required)**	MATH 1314 and 0114 and EDUC 1300 (Concurrently) ***or*** MATH 1324 and 0124 and EDUC 1300 (Concurrently) ***or*** MATH 1332 and 0132 and EDUC 1300 (Concurrently) ***or*** MATH 1342 and 0142 and EDUC 1300 (Concurrently)
< 950 and DT ≤ 4	MATH 0404 and *MATH 0200 and EDUC 1300 (Concurrently) *Note: Exemption for MATH 0200 ***if*** 1) Veteran ***or*** **2)** Age ≥ 25 years ***or*** **3)** College credits ≥ 15 semester credit hrs with ≥ 2.5 gpa **(Approval by supervisor required)**

Appendix B.
Placement Chart 2

<table>
<tr><th>TSI</th><th>TSI2</th><th colspan="3">Algebra Path</th><th>Non Algebra Path</th></tr>
<tr><td>ABE/TSI</td><td>Diagnostic /CRC</td><td>Business/Accounting
Pre Med/ Pre Vet,etc
Some BSN</td><td>Teaching and Education</td><td>Science, Technology, Engineering & Math</td><td>Social Science and Social Services
Liberal Arts, Fine Arts and Humanities
Some BSN (MSU)
Associate of Applied Sciences</td></tr>
<tr><td colspan="2">1-3</td><td colspan="4">Math ABE
Alternative – Math 0400+0000</td></tr>
<tr><td>4
(300-334)</td><td>4</td><td colspan="4">Math 0400 (Foundations of Math)
Add Math 0000 (Foundations of Math Skills Lab) for subsequent attempts</td></tr>
<tr><td>5
(335-344)</td><td>5
Algebra BASIC</td><td colspan="3">Math 0313 (Developing Algebra Skills I)
Add Math 0013 (Develop Algebra Skills Lab) for subsequent attempts</td><td rowspan="2">Math 0332 (Developing Contemporary) &
Math 1332 (Contemporary Math)

TSI Clear for Non Algebra upon passing EITHER
(Statistics is Non Algebra)</td></tr>
<tr><td>6
(345-349)</td><td>5
Algebra
Proficient /Advanced</td><td colspan="3">Math 0314 (Developing Algebra Skills II) &
Math 1314 (College Algebra)
TSI Clear Algebra upon passing EITHER</td></tr>
<tr><td rowspan="3">350 or more
TSI Math</td><td rowspan="3">6 or 950</td><td>College Algebra</td><td>College Algebra</td><td>College Algebra</td><td rowspan="3">Contemporary Math and/or
Statistics</td></tr>
<tr><td>Statistics – check degree requirements</td><td>Math for Teachers I</td><td>Trigonometry</td></tr>
<tr><td></td><td>Math for Teachers II</td><td>Calculus I, etc.</td></tr>
</table>

Appendix C.
Placement Chart 3

SECTION	TSI SCORES	COURSE PLACEMENT
MATH	900-949 + Level 4 and below	MATH 0300 + BMAT 0101
	900-949 + Level 5	MATH 0314 + MATH 1314 or MATH 0314 + MATH 1324 or MATH 0332 + MATH 1332 or MATH 0342 + MATH 1342
	950 or 900-949 *and* Level 6	College-level

ENGLISH LANGUAGE ARTS	900-944 + Level 3 and below	INRW 0302 + BIRW 0201
	900-944 + Level 4 + Essay 4	ENGL 0300 + ENGL 1301
	945 + Essay at least 5 ***or*** 900-944 + Levels 5/6 + Essay at least 5	College-level

NCBO's	Previously unsuccessful in ENGL 0300	NCBI 0101
	Previously unsuccessful in MATH 0314	NCBM 0101
	Previously unsuccessful in MATH 0332 or MATH 0342	NCBM 0102

******All Preparatory coursework requires a minimum grade of C to advance.******		
ELA	Did not complete INRW 0302	INRW 0302 + BIRW 0201
ELA	Did not complete ENGL 0300	ENGL 0300 + ENGL 1301
MATH	Did not complete MATH 0300	MATH 0300 + BMAT 0101
MATH	Did not complete MATH 0314	NCBM 0101 + MATH 1314/1324
MATH	Did not complete MATH 0332/0342	NCBM 0102 + MATH 1332/1342
NCBO	Did not complete NCBI or NCBM	NCBI 0101 or NCBM 0101/0102

Appendix D.
Interview Protocol

Online meetings were conducted with the Math Department Chair and the Director of Advising for each college in the study. Overall results of the research study were presented followed by individual college data disaggregated by race, age, Pell-status, and gender.

The following questions were used for the interview:

- How do you advise students who are unsuccessful in their 1st developmental course?
- How do you advise students who are unsuccessful in their credit course?
- What changes have you made/planned?
- What details can you add?
- What surprised you about the data?
- What areas do you see where you could benefit from support?
- Have you done any student surveys/focus groups?
- Are you interested in conducting student surveys, if so, which areas?

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Texas Success Center

The Texas Success Center supports the Texas Association of Community Colleges members' efforts to improve student success and directs Talent Strong Texas Pathways – a statewide strategy focused on building capacity for community colleges to design and implement structured academic and career pathways at scale, for all students. For more information, visit tacc.org/tsc.