Design Principles for Corequisite Mathematics: An Exploration of Corequisite Models for Texas Colleges and Universities in Response to State Legislative Change (House Bill 2223)

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Abstract

Prerequisite models of developmental education have failed to produce results. The vast majority of students placed in multi-semester remedial programs do not earn a gateway credit. In response to consistently low persistence and gateway success rates in developmental education, the Texas Legislature passed House Bill 2223 in 2017 requiring a redesign of the prerequisite model to a single-semester corequisite model for most underprepared students at public two- and four-year institutions. Through a synthesis of data collected from interviews, a literature review, and several state and institutional-level surveys, this report offers an analysis of corequisite models to support colleges and universities as they respond to the mandates of House Bill 2223. The report offers a landscape overview of corequisites in higher education and concludes with a discussion of the ongoing implementation considerations associated with corequisite remediation.

I. Introduction and Background

HB2223 and Corequisite Developmental Education

Students deemed underprepared as they enter public institutions of higher education are required to enroll in non-credit-bearing developmental education courses. Traditional remedial programs require a sequence of one to three semesters of prerequisite courses before a student can enroll in a gateway course. Most students who enter multi-semester remedial sequences do not exit with a gateway credit; for every ten students placed into three or more semesters of math developmental education, only one will enroll in and complete a gateway course.[1]

Remedial barriers disproportionately affect students of color. As detailed in **Figure 1**, a significantly higher percentage of black and Hispanic first-time-in-college students enroll in remedial courses compared to white students. On average, black and Hispanic students take more semesters of remediation. At two-year colleges, black students take 3.5 remedial courses and Hispanic students take 4 remedial courses compared to 2.4 courses for white students. The comparatively low progression of students of color through developmental coursework and onto degree completion highlights the system's failure to serve all students effectively. [2]

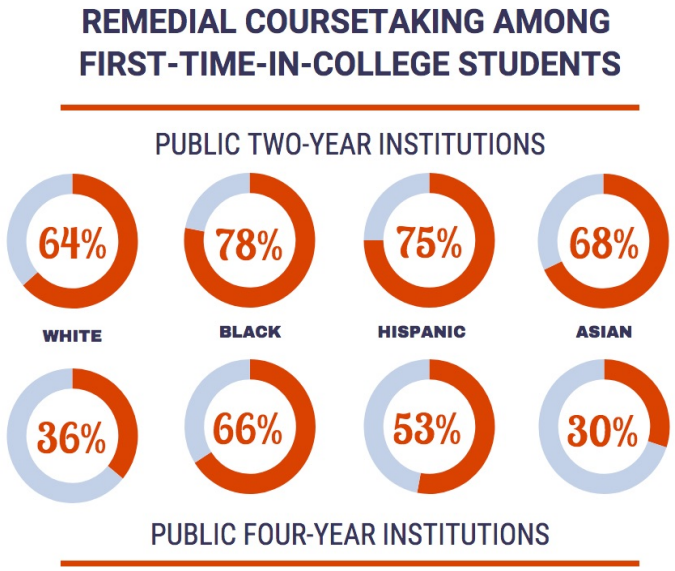

Figure 1- Source: "Remedial Coursetaking at US Public 2-and 4-Year Institutions: Scope, Experiences, and Outcomes. Statistical Analysis Report. NCES 2016-405." *National Center for Education Statistics* (2016). p. 19.

[1]Thomas Bailey, Dong Wook Jeong, and Sung-Woo Cho, "Referral, Enrollment, and Completion in Developmental Education Sequences in Community Colleges." *Economics of Education Review* 29, no. 2 (2010): 260, doi:10.1016/j.econedurev.2009.09.002.

[2] Peter Riley Bahr et al., "Unrealized Potential: Community College Pathways to STEM Baccalaureate Degrees," *The Journal of Higher Education* 88, no. 3 (2016):doi:10.1080/00221546.2016.1257313.

By contrast, corequisite models of remediation place students who fall below a college readiness standard in a college-level, credit-bearing course and deliver additional academic support. In this model, an academically underprepared student can complete a gateway credit in one to two semesters.

Studies of system-wide implementations of well-designed corequisite models show significant improvements in gateway course completion. In Tennessee, the Board of Regents established a policy requiring all public community colleges in Tennessee to implement math, reading, and writing corequisite courses at scale. At the same time, community colleges reformed advising practices to support the corequisite implementation. As a result, Tennessee students now receive more robust advising on the differences between science, technology, engineering and math (STEM) pathways and non-STEM pathways, and more students are placed in statistics and quantitative reasoning corequisite models.[3] College algebra, a class that historically acted as a barrier to college completion, no longer exists as Tennessee's default gateway course in mathematics. At full implementation, 51 percent of students enrolled in a corequisite mathematics course in the fall of 2015 earned a gateway credit in one semester, compared to 12.3 percent of students who achieved a gateway credit after one year in the previous prerequisite model. For minority students, the success rate increased from 6.7 percent after one year in the prerequisite model to 42.6 percent in one semester in the corequisite model.[4]

Similar models in Georgia, Indiana, and West Virginia show that corequisite remediation is doubling and tripling gateway success.[5] After switching to corequisite remediation, the University System of Georgia increased success in gateway mathematics from 20 percent over two years to 63 percent over two semesters.[6] Within one year of implementing corequisite remedial mathematics at the West Virginia Community and Technical Colleges, gateway success increased from 14 percent over two years to 62 percent in one year. At Ivy Tech Community College in Indiana, corequisite remediation was implemented alongside pathway reform. Placement into remediation dropped from 77 percent to 34 percent due to differentiated placement for courses, with gateway success rising from 29 percent over two years to 64 percent over one year. [7]

In 2017, the 85th Texas Legislature passed HB 2223 requiring all public IHEs to enroll 25 percent of their developmental education students in a corequisite model in 2018. This proportion of developmental students served by corequisites must increase to 50 percent in 2019 and 75 percent in 2020.

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[3] Clive Belfield, Davis Jenkins, and Hanna Lahr, "Is Corequisite Remediation Cost-Effective? Early Findings From Tennessee," *CCRC Research Brief*, April 2016, p. 8.

[4] Tristan Denley, "Co-requisite Remediation Full Implementation 2015-16," Tennessee Board of Regents Technical Brief No. 3, 2017, p. 1-4. https://www.tbr.edu/sites/tbr.edu/files/media/2016/12/TBR%20CoRequisite%20Study%20-%20Full%20Implementation%202015-2016.pdf

[5] Complete College America. (2016). Corequisite Remediation: Spanning the Completion Divide. Retrieved April 28, 2018, from http://completecollege.org/spanningthedivide/

[6] Complete College America. (2016).

[7] Complete College America. (2016).

Texas's developmental education policy change comes in light of a growing national movement away from lengthy remedial course sequences and towards corequisite models. As a result of the legal mandate, corequisites will become the primary method of developmental education delivery at all Texas IHEs by 2020. Across the state, IHEs are demonstrating different levels of preparedness for HB2223 and its requirements. While some campuses currently deliver developmental education through a combination of traditional and corequisite models, others operate under a strictly prerequisite remedial model. The needs of each IHE in Texas differ substantially regarding support needed to implement HB2223. Assessments of the current climate indicate that IHEs are seeking guidance about corequisite models that deliver developmental education effectively and equitably to all students.

Through key informant interviews, a literature review, and data analysis from several state and institutional-level surveys, this report offers a comprehensive assessment of corequisite models. The driving goal of this research is to identify characteristics of exemplar corequisite models to provide Texas IHEs with a framework for common design principles that lead to successful corequisite implementation. This report details the results of this research and offers high-level recommendations for stakeholders to fulfill the requirements of HB2223 and execute successful corequisite models with fidelity.

Texas Success Center

The Texas Success Center was established at the Texas Association of Community Colleges to support the scaling of student success strategies and policies at all Texas community colleges.[8] The authors of this report partnered with the Texas Success Center to support colleges and universities as they implement corequisite models. Per the Texas Success Center's request, the authors created a usable compilation of exemplar corequisite course designs (see Exemplar Corequisite Course Design Snapshots Document).

II. Current Landscape

Texas IHEs need varying levels of guidance related to HB2223. This section details the data obtained from the THECB's Developmental Education Program Survey (DEPS), eight key informant interviews, and self-assessments from Texas community colleges (referred to as "Visioning Worksheets") for the purpose of identifying needs of schools and exemplar design principles. The report offers additional considerations regarding IHEs' approaches toward equity in college access and success.

Institution-Level Data Analysis

To better understand the current landscape of higher education in relation to corequisites, the authors surveyed multiple IHEs' developmental education models using campus websites and Texas Higher Education Coordinating Board (THECB) data. Through this initial data analysis, the authors sought to uncover the strengths and weaknesses of existing conditions of corequisite models in Texas.

[8] "The Texas Success Center," accessed April 22, 2018.

The data displayed in **Figures 2 and 3** show the current landscape of corequisite models in Texas. **Figure 2** shows the percentage of Texas IHEs that report offering corequisite models in 2011, 2016, and 2017. **Figure 3** shows the percentage of developmental students in Texas community colleges enrolled in corequisite models in Fall 2017 according to the THECB's Developmental Education Program Survey (DEPS).

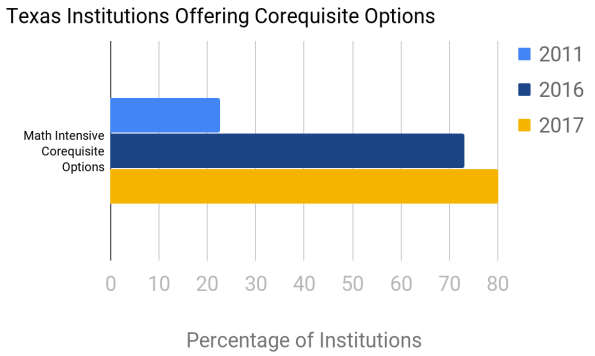

Figure 2- Source: THECB, "Overview: Developmental Education," Accessed Feb. 13, 2018.

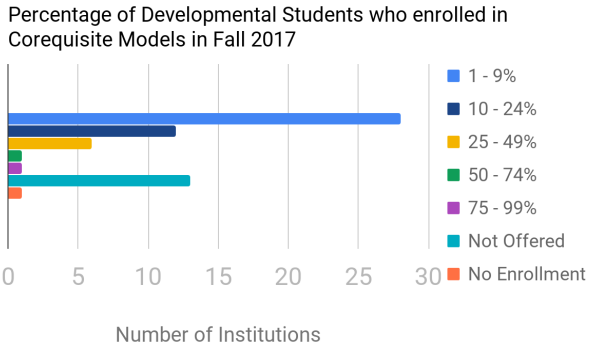

Figure 3- Source: THECB, "DEPS Survey," Fall 2017

We can see from these figures that there is a sizeable discrepancy between the proportion of institutions offering corequisites and the number of students enrolling in these models. For example, the 2016 report shows that the percentage of institutions offering corequisite options increased from 23 percent in 2011 to 73 percent in 2016. However, the Fall 2017 DEPS data shows that 44 percent of colleges report having less than ten percent of developmental students enrolled in the corequisite coursework. Of the 64 schools surveyed, only ten reached the 25 percent corequisite benchmark mandated by HB2223 for Fall 2017. We find that most IHEs are faced with the task of developing corequisite models from the ground up with little to no experience serving the majority of developmental students with these models.

The DEPS results also provided a snapshot of IHEs' perceptions of HB2223, corequisites, and the challenges of implementing the statute successfully. Survey results indicate that many Texas IHEs find implementation of corequisite developmental education challenging. The percentages displayed in **Figure 4** represent the sum of respondents who report factors related to corequisite implementation as "slightly challenging," "moderately challenging," or "challenging." These five factors represent the areas in which IHEs feel least confident.

Figure 4- Source: THECB, "DEPS Survey," Fall 2017

The results of the institution-level data analysis revealed important characteristics of the corequisite landscape. Most Texas IHEs require system-level reforms to implement HB2223 at scale, and many institutions report that the task will be challenging, especially with regards to designing effective courses and aligning curriculum.

Key Informant Interviews

Interviews were conducted with personnel from both two- and four-year IHEs and higher education service provides that currently offer corequisite models for developmental education in mathematics. Representatives from two- and four-year colleges in Texas, a community college in California, a community college in Tennessee, a college system in New York, a college system in Indiana, and a four-year public university in Nevada were interviewed and asked for their perspectives on themes such as corequisite challenges, the culture of developmental education, and program designs. Interviewers selected key informants based on recommendations from the Texas Success Center and the Charles A. Dana Center of exemplar models of developmental education reform. The motivation behind these interviews was to gain a deeper understanding of IHEs who demonstrated success in scaling mathematics reforms. Interviewees were asked the following questions:

> **1.** *How would you describe the purpose of developmental education in today's system of higher education?*
> **2.** *How does your institution frame developmental learning and co-requisite remediation for the faculty and for students?*
> **3.** *How have you identified the strengths of your student body? In what way have these strengths influenced the development of your co-requisite program?*
> **4.** *How do discussions about the equity implications of developmental education reform play out in your institution?*
> **5.** *In addition to course structure and curriculum development, what are key features of a successful co-requisite program?*
> ***6.*** *What challenges do you see for widespread implementation of effective co-requisite courses?*
> ***7.*** *In what ways could corequisite redesign shape the future of higher education?*

The interviews identified common reform principles. For example, while some reforms were mandated from the top-down through administrative policy and others developed from the bottom-up through faculty innovation, in each case, initiatives came forth after examining institutional and national data on developmental persistence and success. Armed with the knowledge that there was a serious problem with prerequisite developmental mathematics, the leaders in these institutions researched options and took actions that suited the needs of their institution. While some of the informants indicated that they were initially uncertain about the outcome of the reforms, they knew that any change would improve upon the previous multi-semester, algebra-based developmental math system.

The institutions' results showed that the reforms made a significant impact on student success. For example, an open-enrollment Hispanic-serving four-year institution in Texas saw substantial improvements after the introduction of corequisite sections for developmental students. Rather than taking developmental coursework prior to gateway coursework, all students who fall below

the college readiness standard enroll in a single-semester corequisite gateway course. The six-hour course provides just-in-time remediation aligned with the traditional gateway content. Following this reform, the respondent reported that 65 percent of students enrolled in college algebra, finite mathematics, and contemporary mathematics corequisite sections earned a gateway credit in the Fall of 2017. The success rate for students enrolled in finite mathematics and contemporary mathematics was 73 percent. A community college in Texas also experienced growth in student success after introducing a one-semester college algebra corequisite course. The respondent reported that 74 percent of all corequisite college algebra students earned a gateway credit in the spring of 2016. They also report closing the performance gap between Hispanic and white students enrolled in the corequisite programs.

Many leaders identified major philosophical shifts in institutional views of developmental education and in perceptions of "developmental students." The previous model of developmental education was described as a "bridge to nowhere" or a "pipeline of doom," with very few developmental students ever completing a college-level mathematics class. Interviewees reported a shift in the faculty and staffs' beliefs in student capacity to do college-level work. Rather than focusing on students not being college-ready, reformers designed corequisite models to make their programs student-ready. The new models included streamlined content, academic support, and appropriate advising. These changes, in turn, also redefined the students' perception of remediation. By being engaged in credit-bearing coursework with a cohort or in comingled classrooms, students displayed higher degrees of engagement with the learning process. Many leaders reported a reduction in the stigma that students experienced with remediation.

The key informants indicated that the need to foster buy-in was wide ranging and constant. Schools enlisted the most experience faculty to teach the corequisite sections and to inform other faculty of the positive outcomes in the classroom. In one school that employs a two-instructor model, new instructors are introduced to the course through an apprenticeship model, in which an experienced professor takes the lead role for the first semester. This model introduces the new faculty member to the change in pedagogy and cultural norms in the classroom. Leaders acknowledged that faculty resistance to reform stemmed from fear that the changes would hurt students or reduce rigor. While these feelings persist, leaders are hopeful that seeing positive outcomes will increase faculty buy-in.

In addition to fostering faculty buy-in, a common best practice that emerged from the interviews was thoughtful planned communication with all institutional stakeholders. A working relationship with student service and advising departments assisted faculty developers in understanding how course sequence changes might affect students in non-academic ways, such as scheduling and financial aid. Communication with faculty allowed student services to gain important knowledge about the course expectations as students made registration choices. Communication with other departments that have math prerequisites helped foster an institution-wide system of information.

Corequisite reforms did not come without challenges. As referenced earlier, buy-in was and remains a challenge among faculty, students, and institutional services. Effective communication strategies are both a challenge and a solution to fostering buy-in and increasing awareness. While all the key informants considered the corequisite model to be an improvement over the prerequisite model, challenges with algebra proficiency and subsequent course performance in the path to

calculus were reported by multiple interviewees. For example, at a four-year public university in Texas, the success rate for students in finite mathematics and quantitative reasoning was more than ten percentage points higher than the success rate for college algebra. At a community college in Texas, leaders are collecting data on subsequent course performance to make adjustments to support sustained student success. Leaders were honest about these challenges and approached them with more innovative ideas. These ideas included increased focus on better placement strategies, improved guidance on course selection and advising, continual redesign of algebraic content, and varied pedagogical approaches to learning. In addition, IHEs may consider redesigning the post-gateway calculus sequence to include the successful design and support principles employed in corequisite gateway models.

The major takeaways from these interviews is in the significant impact corequisite reform will have on the future of higher education. One respondent said "this could be huge!" Another believes "more students will realize education's promise!" A faculty member claims that "just-in-time remediation will change the future!" The informants shared the common belief that as more students complete their gateway credit, the future of higher education will be framed by a more diverse set of students now entering into viable pathways to a degree.

Visioning Worksheets

The support materials created for the Texas Success Center were informed by data from "Corequisite Visioning Worksheets." The Texas Success Center administered the Visioning Worksheets (VWs) to all Texas community colleges to identify their strengths and the support they need to scale corequisites.[9] An example of part I of the VW is displayed in **Figure 5.**

COREQUISITE VISIONING WORKSHEET Part I – Identifying Capacities and Potential Challenges		
What have we learned from our previous efforts to improve underprepared students' time to successful college course completion?		
	We are great at:	*We might have issues with:*
1. Changing DE course delivery/structure and curriculum	We have changed the structure of DE courses, especially in the math areas. Algebraic vs non-algebraic pathways have been created.	We will begin implementation in the fall 2018. Since De sequences have been minimized, we predict the college needs to provide strong and effective support programs.
2. Changing advising and scheduling practices	We have developed DE sequences with the recommendations from the Student Success Center. We also will be training all educational program leads as well as the leads for the services areas.	We hope to minimize misadvising but pathways are clear. The courses in the schedules have been linked to TSI scores and majors so we are hoping that students are placed in the right DE courses.

Figure 5- Source: "Corequisite Visioning Worksheet," *Texas Success Center.*

[9] "Corequisite Visioning Worksheet," *Texas Success Center.*

Thirty-nine institutions completed and submitted VWs. All responses were compiled into a master spreadsheet that will allow the Texas Success Center to view data from each institution. For Part I of the VWs, the responses were assigned codes using an iterative inductive method. A total of 13 codes emerged, with 14 subcodes. Due to time constraints, Part II was not coded, but some of the responses were collapsed into quantitative data. In a second spreadsheet, the colleges' responses were grouped by codes and subcodes to allow for further analysis.

The VW data identifies areas in which many colleges need support. For example, only one institution's response was coded as a strength under "staffing," while 18 colleges listed concerns in that area. Some of these patterns correspond to what was learned from the interviews. For example, twenty institutions expressed concerns about buy-in, which speaks to what interviewees shared about faculty resistance. The VW data also provides a qualitative supplement to the quantitative data from the THECB DEPS, as many of the VW codes align with themes from DEPS. For example, on the DEPS, 31 percent of respondents stated that they had insufficient professional development on aspects of corequisite models. The analysis of the VWs provides a deeper understanding of this concern: five institutions stated concerns about training for faculty, while seven expressed a need for educating advisors. A summary of the themes that emerged from the codes and their connection to the DEPS will be provided to the Texas Success Center.

The coded data will also allow the Texas Success Center to connect colleges that identified themselves as strong in an area with those that identified challenges in that area. For example, four institutions listed placement as a strength, while twelve listed it as a concern. These institutions could be brought together during a conference or virtually through a webinar so that strong institutions can share best practices and struggling colleges can ask questions. In cases where one college's strength matched closely with another college's concern, the Texas Success Center could invite those institutions to communicate directly (see the example in **Figure 6**). These actions can facilitate statewide collaboration during the implementation years as schools share best practices and lessons learned.

	"We are great at..."	***"We might have issues with..."***
Code: Alignment	**College A**: Knowledge of aligning curriculum to meet co-requisite objectives	**College B**: Alignment of math curriculum between developmental and credit-level corequisites
Code: Design	**College C**: Retaining rigor of courses in transition	**College D**: Creating the right amount of scaffolding to ensure that the rigor of gateway course remains strong, without losing the more vulnerable students

Figure 6- Source: Visioning Worksheet Analysis

III. Challenges and Recommendations

This final section discusses anticipated challenges and recommendations to two-year higher education institutions in Texas as they move forward with corequisite implementation. Through an examination of the developmental education landscape, with special attention paid towards exemplar corequisite models, this report identifies four main challenges and corresponding recommendations.

Challenge: Fostering buy-in
A common challenge addressed by the institutions analyzed in this report was faculty motivation and institutional buy-in. As Texas IHEs implement corequisite models, we anticipate similar challenges will arise.

Recommendation: Empower a leadership team
Successful and effective corequisite implementation should employ collaboration among the faculty, staff, department leaders, administrators, advisors, student support staff, and students. IHEs should organize and empower a leadership team with representatives from each of these key areas. The role of the leadership team should be to research corequisite models that suit the individual needs of the institution, communicate regarding implementation factors that would affect various aspects of the student experience, and to consistently evaluate and adjust models. The institution should ensure that appropriate resources are allocated to the leadership team's work. Additionally, IHEs should identify in-house reform advocates to lead open dialogue with all members of the institution to foster institution-wide buy-in.

Challenge: Choosing the best model for individual institutions
The landscape of IHEs in Texas is diverse. Each institution will have the challenge of choosing the correct model to suit the needs of their student bodies.

Recommendation: Regularly examine institutional data for continuous improvement
Exemplar models identified in this analysis used in-house data to identify institutional resources, strengths, and areas for improvement. This research provided information to make the best choice for their student population. Considerations for the ratio of part-time to full-time students, student demographics, and instructor availability informed corequisite model design. This data was utilized to determine the type of review support (just-in-time, integrated, sequenced), course design (cohort, comingle), class structure (size, days per week, hours), and instructor model (same instructor, different instructors, instructor and teaching assistant). We collected these design factors and present them in our exemplar snapshot deliverable to the Texas Success Center.

IHE leadership teams should regularly look at in-house data to identify resources, strengths and areas of improvement pertaining to corequisite redesign. Leadership teams should utilize the exemplar snapshots for easy access to possible design models that match the unique characteristics of individual institutions. Representatives from the leadership teams at the IHEs should collaborate with one another to share ideas and spread innovations, which can be facilitated through the VW analyses that provide institutions with access to colleagues with identifiable strengths in

corequisite implementation. Data on implementation should be evaluated often in order to make appropriate adjustments to course design and offerings.

Challenge: Developing corequisite models aligned with pathways
At the exemplar institutions, math pathway models and corequisite models developed simultaneously to place students in appropriate coursework with support for their degree goals and career needs. Course structure and outcomes varied for different gateway corequisite models at the exemplar schools and we anticipate similar variance in corequisite designs and outcomes in Texas IHEs.

Recommendation: Be mindful of pathways during all phases of implementation
It is recommended that IHEs continue to implement math pathway options to eliminate college algebra as a default placement for academically underprepared students. IHEs are encouraged to offer appropriate advising to allow students to enter into the appropriate corequisite model aligned with their degree goal and career needs. Currently, 82 percent of Texas IHEs offer college algebra corequisite models, 41 percent offer statistics, 45 percent offer quantitative reasoning, and 28 percent offer finite mathematics.[10] IHEs should expand multiple mathematics pathways offerings for students by increasing the prevalence of statistics and quantitative reasoning corequisite courses during the initial implementation phases of HB2223.

Effective corequisite redesign is systemic and acculturative. Texas higher education must ask how the effective changes in the student experience at the gateway level can be implemented in the path to calculus to ensure continued success in subsequent course work. IHEs may find that subsequent course sequences will need to adjust to meet the changing needs of the successful completers from gateway courses.

Challenge: Innovation breeds new challenges
Institutions of higher education in Texas should anticipate that the success of one policy, such as corequisite remediation reform, may create new challenges and issues.

Recommendation: **Anticipate future challenges and react in real-time**
More gateway course completers mean that more students will be knocking on college program doors**.** With more students successfully transitioning out of gateway courses, IHEs must begin planning for the increased number of eligible students about to enter college-level programs. IHEs must develop a strategy for expansion to accept this new crop of gateway completers.

College-level programs should start thinking now about entry requirements to ensure that barriers for students, especially historically underrepresented minorities and students of low socioeconomic backgrounds, are not reintroduced at later points in the educational journey. Artificial barriers at every level should be eliminated if Texas higher education hopes to create the most diverse group of college graduates to move the state forward.

[10] Texas Higher Education Coordinating Board. (2017). Developmental Education Program Survey. Retrieved from http://www.txhighereddata.org/interactive/DEPS.cfm

Corequisite remediation is showing promising results for improved gateway completion in two- and four-year institutions. However, corequisite remediation may not effectively serve all students in Texas IHEs. IHE leadership teams must continue to take a critical look at remediation coursework. Even with course completion rates in the 60-percent range reported by most corequisite reforms, thirty to forty percent of students do not complete a gateway credit in corequisite remediation models. Additional research is necessary to identify the factors and develop supports that all underprepared students require for gateway success.[11]

[11]"Core Principle 4," Strong Start to Finish. (2017). Retrieved from https://strongstart.org/learn/core-principles/principle4

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