

FEATURE ARTICLE

Fully Scaling Up Corequisite Models in Math: Challenges and Successes

Laurie A. Sharp, *Academic Affairs, Tarleton State University*

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ABSTRACT

DE programming in higher education should be designed to increase student success, and well-designed corequisite models have shown great potential as an accelerated option for completion of the first college-level course in math. With the support of a Texas Higher Education Coordinating Board grant, Tarleton State University, a member institution of the Texas A&M University System, revamped its developmental education (DE) program to exceed requirements for the Texas Success Initiative by fully scaling up student enrollment in corequisite models to 100%. Along with a multi-pronged approach to help students satisfy any TSI liabilities, Tarleton's revamped DE program includes holistic advising practices that use multiple measures to inform placement decisions, a robust expansion of corequisite models, refinement of assessment protocols, inclusion of peer mentoring services, and two intervention options to address academic underpreparedness and issues with self-efficacy in math. Findings from the first year of implementation were favorable and demonstrated a significant increase in course completion when compared to the previous year. Limitations of this study and areas for future research were also discussed.

Keywords: corequisite models, developmental education, math, student success

Postsecondary institutions and states have continually reformed their developmental education (DE) practices to facilitate higher levels of success among students who are not yet college-ready. In Texas, many DE reformations have been in response to legislative state mandates, such as the Texas Success Initiative (TSI), as well as requirements set forth by the Texas Higher Education Coordinating Board (THECB). Most recently, the passing of House Bill 2223 (2017) into law requires postsecondary institutions to enroll a percentage of students who are not yet college-ready in corequisite models by subject matter (i.e., 25% by Fall 2018 semester, 50% by Fall 2019 semester, 75% by Fall 2020 semester).

From their inception, corequisite models were designed to address financial and time losses experienced by students in traditional prerequisite DE programming, which consisted of multi-semester, non-credit course sequences (Ran & Lin, 2019). Since 2007, corequisite models have been gaining popularity among postsecondary institutions and states and are viewed as a promising accelerated learning program (ALP) for students. With respect to the subject area of math, Boatman (2012) studied corequisite model implementation among students in Tennessee and reported significantly higher levels of fall-to-spring persistence and credit hour completion rates. Similarly, Logue et al. (2016, 2019) studied

corequisite model implementation among students in New York and reported significantly higher course pass rates in math, success in courses beyond math, and increased graduation rates.

Ran and Lin (2019) noted that the way in which corequisite models have been implemented varies among postsecondary institutions. For example, the RAND Corporation, the American Institutes for Research, and the THECB studied corequisite model implementation among Texas community colleges in 2016 and defined five different versions: paired course models, extended instructional time models, ALP models, academic support service models, and technology-mediated support models (Daugherty et al., 2018). Although corequisite model design varies across postsecondary institutions, the overarching goal is the same: to accelerate academic readiness, progress, and success among students (Cullinane, 2012).

To support postsecondary institutions' efforts with helping students fulfill college readiness requirements and complete entry-level,

Corresponding Author

Dr. Laurie A. Sharp, Academic Administration in Academic Affairs
Tarleton State University
Box T-0010 | Stephenville, Texas 76401
Email: lsharp@tarleton.edu

degree-applicable coursework successfully, the THECB offers institutional grant opportunities. One such opportunity, the College Readiness and Success Models (CRSM), awards competitive grants that support scaling of evidence-based DE practices. Tarleton State University (herein referred to as Tarleton) was a recipient in the 2020 CRSM grant award cycle, which supported 100% enrollment of eligible students in improved corequisite models. To achieve the 2020 CRSM grant award requirements, a number of stakeholders at Tarleton worked in collaboration to enhance and expand impactful DE practices. This article describes specific institutional challenges we faced in math, aspects of our DE program redesign, and preliminary outcome data for first college-level course (FCLC) completion in math among first-time-in-college (FTIC) students.

Institutional Challenges in Math

Prior to applying for the 2020 CRSM grant, we reviewed 5 years of outcome data for FCLC completion in math among FTIC students (see Table 1). The data showed that on average less than one third of FTIC students who enter Tarleton not yet college-ready in math completed a FCLC in math with a final grade of an A, B, or C during their first year of enrollment. While this finding was concerning, we also noted an upward trend in FCLC completions in math for the 2018 and 2019 FTIC cohorts (i.e., $n = 150$, 31.7%, $n = 172$, 38.8%, respectively). Consequently, these were the first two years that Tarleton implemented the corequisite enrollment requirements of House Bill 2223 (2017) at 25% and 50%, respectively, among eligible students.

Table 1
Outcomes for FTIC Students Who Were Not Yet College-Ready in Math

FTIC Cohort	Number of FTIC students	FTIC students not college-ready in math	FCLC in math
FTIC 2015	1,955	449 (23.0%)	162 (36.1%)
FTIC 2016	2,169	585 (27.0%)	160 (27.4%)
FTIC 2017	1,899	439 (23.1%)	109 (24.8%)
FTIC 2018	2,162	473 (21.9%)	150 (31.7%)
FTIC 2019	2,079	443 (21.3%)	172 (38.8%)

The use of multiple measures and holistic assessment during the initial advising session prompts some students to defer their enrollment in a corequisite model in math for one semester.

We also examined Tarleton’s DE practices and identified two specific institutional challenges in the subject area of math in relation to students who were not yet college-ready. First, students had only two corequisite model options (i.e., College Algebra, Elementary Statistics). Since Tarleton offered four different FCLC options in math, it was problematic to limit enrollment in the other two options (i.e., Contemporary Math, Business Math) to students whose degree programs do not require College Algebra or Elementary Statistics. Second, corequisite models in math were implemented using a comingled approach, meaning the credit-bearing course sections contained students who were college-ready and not yet college-ready. Although corequisite models may be implemented using a cohorted or comingled approach, Visher et al. (2012) asserted that similar to learning communities, students experience greater levels of comfort, support, and trust with peers and instructors in cohorted approaches.

Revamped DE Program Design

Once Tarleton received official notification that our 2020 CRSM grant project was funded, we immediately made infrastructure changes to centralize the DE program within University College. University College was established in July 2019 as a non-academic unit within the Division of Academic Affairs and housed Tarleton’s student support services (e.g., academic advising, career services, peer mentoring, tutoring, supplemental instruction). Centralizing student support services in University College simplified oversight of the DE program and facilitated communication about students, promoted resource sharing, and advanced consistency with best practices and operational procedures. We also worked collectively with colleagues across departments during this restructuring move to improve and streamline workflow processes for students.

In our revamped DE program, we developed specialized academic advising services to promote success among students. Upon admission to Tarleton, students are assigned to a TSI advisor. During the initial advising session, TSI advisors implement a holistic advising approach (Bailey et al., 2016) that determines DE placement using multiple measures (Ganga & Mazzariello, 2019; Ngo & Kwan, 2015). Multiple measures taken into consideration include TSI Assessment (TSIA) scores with accompanying diagnostic student profiles, high school

class rank, high school grade point average (GPA), and grades earned from high school coursework. TSI advisors also work with their advisees to create a personalized academic plan that takes several factors into consideration for academic advising purposes, such as the student's work experiences, non-cognitive factors (e.g., attitudes, behaviors, mindset, motivation), and family-life issues (e.g., childcare, financial aid, transportation, tutoring). Furthermore, TSI advisors enter comprehensive documentation for each academic advising session and any advisor-advisee interactions into Tarleton's enterprise-level, web-based technology systems that are accessible to both the student and institutional stakeholders who have legitimate educational interests.

To improve Tarleton's corequisite models in math, we took steps to address Tarleton's institutional challenges in collaborating with our colleagues in the Department of Mathematics. We developed corequisite models for Contemporary Math and Business Math to ensure FTIC students had access to all of the FCLCs in math. For all corequisite models, we opted to retain the paired course corequisite model approach (i.e., FCLC paired with a DE course) and strengthen the DE course. The head of the Department of Mathematics selected faculty member liaisons to coordinate a planning team of subject matter experts (e.g., full-time faculty members or adjunct instructors, graduate students, practicing and retired high school teachers) to compile and create repositories of supportive materials for course concepts within each corequisite model in math. Supportive materials were populated into separate course shells in Canvas, Tarleton's learning management system, and included a wide range of technology-mediated learning supports (e.g., Quizlet vocabulary flashcards, brief instructional videos, links to online games).

Lastly, we scaled up peer mentoring services in our revamped DE program. The Coordinator of Academic Coaching and Peer Mentoring developed and launched a peer mentor program with 25 undergraduate student workers who served as the inaugural peer mentors. Each student was assigned a peer mentor who performed weekly check-ins and provided academic and non-academic support.

DE Interventions in Math

In addition to the improved corequisite models, we developed two DE interventions in our revamped DE program. We developed these DE interventions to accommodate students who were either at an Adult Basic Education (ABE) level in math or opted to defer enrollment in a corequisite model for one semester to refresh their foundational math skills. In each DE intervention, instructors held periodic check-in conferences with their students to mutually discuss concerns, feed-

back, and goals. Each DE intervention also incorporated strategies to increase student self-efficacy in math.

ABE Intervention

Each fall, Tarleton admits approximately 25 students who placed into ABE Levels 1–4 on the TSIA ABE Diagnostic in math. A score within this range indicates a math skill level of Grade 8 or below. To serve these students effectively, we developed an ABE intervention course, which was taught by a skilled DE instructor. The ABE intervention instructor offered personalized, technology-infused instruction that reviewed basic math concepts needed to succeed in a FCLC. Similar to corequisite models, each FTIC student enrolled in the ABE intervention was assigned a peer mentor who maintained regular contact to provide academic and non-academic support.

Non-Course-Based Option (NCBO) Intervention

The use of multiple measures and holistic assessment during the initial advising session prompts some students to defer their enrollment in a corequisite model in math for one semester. To provide these students with an opportunity to refresh on foundational math skills, we created a NCBO intervention. The NCBO intervention leveraged aspects of the emporium-style model (e.g., self-paced learning, technology-centered instruction) and a web-based program that uses artificial intelligence to create personalized learning modules for students. Similar to corequisite models, each student enrolled in the NCBO intervention was assigned a peer mentor who maintained regular contact to provide academic and non-academic support.

Outcomes from Scaling Up Corequisite Models in Math

We implemented the DE interventions in the Fall 2020 semester and the improved corequisite models in the Spring 2021 semester, at which time we had achieved fully scaled up corequisite enrollment in math. During each semester, we held frequent planning meetings and monitored student progress in the DE program closely. In our review of preliminary outcome data, we were pleased to see encouraging results, as well as opportunities to further strengthen the DE program. Below is a summary of results, which were deemed exempt from review by Tarleton's Institutional Review Board.

ABE Intervention

In the Fall 2020 semester, 29 students were enrolled in the ABE intervention, of which 27 students (93.1%) completed it successfully (see Table 2). Of these students, 24 students (82.8%) persisted to the end of the Spring 2021 semester, and 19 students (65.5%) were retained in the Fall 2021 semester.

Table 2
ABE Intervention Student Demographics

Demographic characteristics	Number of students
Gender	
Female	21
Male	8
First-Generation status	
First-Generation	20
Continuing generation	9
Pell eligibility	
Pell eligible	13
Not Pell eligible	16
Race/Ethnicity ^a	
Non-White	12
White	16

^a One student did not self-report their race/ethnicity.

Students in the ABE intervention had an average end-of-term GPA of 1.94 and average credit completion rate of 71.6%. Closer inspection of these data showed students attempted an average of 13.24 semester credit hours and earned an average of 9.48 semester credit hours.

NCBO Intervention

In the Fall 2020 semester, 387 students were enrolled in the NCBO intervention, of which 333 students (86%) completed it successfully (see Table 3). Of these students, 320 students (82.7%) persisted to the end of the Spring 2021 semester and 243 students (62.9%) were retained in the Fall 2021 semester.

Table 3
NCBO Intervention Student Demographics

Demographic characteristics	Number of students
Gender	
Female	273
Male	114
First-Generation status	
First-Generation	224
Continuing generation	163
Pell eligibility	
Pell eligible	199
Not Pell eligible	188
Race/Ethnicity ^a	
Non-White	135
White	226

^a 26 students did not self-report their race/ethnicity.

Students in the NCBO intervention had an average end-of-term GPA of 2.23 and average credit completion rate of 76.8%. Closer inspection of these data showed students attempted an average of 13.64 semester credit hours and earned an average of 10.43 semester credit hours.

Corequisite Models

Students who completed the ABE or NCBO DE intervention during the Fall 2020 semester enrolled in a corequisite model in math during the Spring 2021 semester. To understand outcome data more fully, we conducted percentage point gap analyses that compared passing rates between students who were college-ready and not college-ready (see Table 4). Findings revealed gaps in student performance, particularly in the Business Math course.

Table 4
Corequisite Enrollment and Outcome Data for FTIC Students Who Completed DE Interventions

Corequisite model & student group	Students	Passed (A, C, B)	Did not pass (D, F, W)	Percentage gap
College Algebra				
College-Ready (Fall 2020)	508	355 (69.88%)	153 (30.12%)	-16.73
Not college-ready (Spring 2021)	143	76 (53.15%)	67 (46.85%)	
Elementary Statistics				-25.72
College-Ready (Fall 2020)	70	36 (51.43%)	34 (48.57%)	
Not college-ready (Spring 2021)	105	27 (25.71%)	78 (74.29%)	
Business Math				-40.03
College-Ready (Fall 2020)	234	163 (69.66%)	71 (30.34%)	
Not college-ready (Spring 2021)	27	8 (29.63%)	19 (70.37%)	
Contemporary Math				-15.34
College-Ready (Fall 2020)	16	9 (56.25%)	7 (43.75%)	
Not college-ready (Spring 2021)	22	9 (40.91%)	13 (59.09%)	

To further examine any impact associated with the ABE and NCBO interventions, we compared passing rates between students from the 2020 FTIC Cohort and 2019 FTIC Cohort. Students in the 2020 FTIC Cohort completed a DE intervention in the Fall 2020 semester followed by a corequisite model in the Spring 2021 semester, whereas students in the 2019 FTIC Cohort enrolled in the College Algebra corequisite model during their entry semester (see Table 5). We limited our analysis to College Algebra because that was the only corequisite model in math offered during both time periods. According to these data, performance rates for students who completed one of the DE interventions were 13.48 percentage points higher.

Table 5
Comparison of Fall 2019 and Fall 2020 Student Groups for College Algebra

Group	Passed (A, B, C)	Did not pass (D, F, W)	Percentage gap
2019 FTIC	48 (39.67%)	73 (60.33%)	+13.48
2020 FTIC	76 (53.15%)	67 (46.85%)	

Discussion

DE programming in higher education should be designed to increase student success in a FCLC for which students have been deemed not yet college-ready (Schak et al., 2017). Within recent years, much literature has advocated that well-designed corequisite models have great potential to facilitate student success in their FCLC in math (e.g., Atkins & Beggs, 2017; Boatman, 2021; Booth et al., 2014; Jaynes et al., 2020). With state legislation in Texas mandating a minimum of 75% corequisite enrollment among eligible students each academic year, it is important for postsecondary institutions to ensure their corequisite models deliver effective and equitable instruction and support. Through the 2020 CRSM grant, Tarleton was supported in revamping our DE program, which enabled us to achieve 100% enrollment of eligible students in improved corequisite models beginning in the Spring 2021 semester.

In addition to addressing our institutional challenges, we believe our revamped DE program has three particular strengths. One strength is the provision of specialized academic advising services. Our TSI advisors are trained to implement enhanced advising methods (Bailey et al., 2016) and use multiple measures to determine the most appropriate placement for each FTIC students (Ganga & Mazzariello, 2019; Ngo & Kwan, 2015). Our TSI advisors also help each FTIC student develop a personalized academic plan that is mindful of influences beyond school (i.e., work experiences, non-cognitive factors, family-life issues). These holistic advising approaches help FTIC students feel well supported in their academic journey.

Another strength of our revamped DE program is the quality of curriculum supports. The ABE intervention accommodates students who are at an ABE level in math, and the NCBO intervention assists students with refreshing their knowledge of foundational math skills. Instructors in both DE interventions perform periodic check-in conferences with their students and use strategies to enhance student self-efficacy in math. In

addition, students have access to corequisite models in all FCLC options in math that include a wide range of technology-mediated learning supports. Results from our first year of implementation have shown favorable results, as the ABE and NCBO interventions reflected high levels of satisfactory completion and the corequisite model for College Algebra demonstrated higher pass rates among students who completed a DE intervention.

A final strength of our revamped DE program is the presence of peer support among FTIC students. We instituted a structured peer mentoring program that pairs every FTIC student with a knowledgeable and skilled upperclassman who attends to their academic and non-academic needs. Including peer mentoring as a component of DE programming has been recognized as an effective and low-cost strategy to support students who are not yet college-ready in math (Deshler et al., 2019).

Concluding Thoughts

Although we have seen favorable results with our revamped DE program, there is still work to be done. For Tarleton's DE program to be successful and sustainable, it is absolutely essential to have continued organization-wide support. Support must include the allocation of dedicated fiscal, human, and technology resources, and more importantly, an institutional mindset that promotes academic success for all students. Furthermore, we must continually assess the effectiveness of our DE programming regularly. By doing so, we will ensure evidence-based practices are being implemented with fidelity in ways that promote success

among every students who are not yet college-ready.

Disclosure Statement

No potential conflict of interest was reported by the author.

About the Authors

Laurie A. Sharp, EdD, currently serves as the assistant vice president for Strategic Academic Initiatives at Tarleton State University in Stephenville, Texas. She also is an associate professor in the College of Education and Human Development and has taught courses in the areas of educational leadership, literacy, and research methods. She has contributed over 100 publications to the field of P-16 education, with a focus on instructional effectiveness and student success.

 <https://orcid.org/0000-0002-2221-1920>

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