

The Impact of the New CoDE Model of Developmental Mathematics on Student Retention and Graduation Rates

Dr. Kenneth N. Buckey



Abstract

The community college is an institution where constant change is needed to keep up with technology, student needs, and industry standards. The evolution of developmental subjects, especially developmental math, is a needed change within the community college system. This research examined the impact of the new Corequisite and Developmental Education (CoDE) model (formerly Reinforced Instruction for Student Excellence (RISE)) of developmental mathematics on student retention and graduation rates. The study used a mixed methods approach that included course completion rates, grade distribution reports, and instructor surveys from three North Carolina community colleges to address four research questions related to the new CoDE model. Instructor surveys, with a combination of Likert scale and open-ended questions, were used to supplement the quantitative data. The four research areas involved in the CoDE program are 1) student success in terms of completing the MAT 003 course, 2) completion rates for minorities and by gender in developmental math, 3) the gap in services for distant/remote students related to completion rates, and 4) comparison of the CoDE math program to previous Developmental Math (DMA) courses for entry into gateway math courses. The study revealed a significant difference in females' pass rate and a slight difference in the pass rate overall of the DMA mathematics. The positive difference between the three colleges' DMA and MAT 003 was not as significant as expected. The study did reveal a significant difference in the withdrawal rates of those students taking CoDE MAT 003 compared to the DMA mathematics.

Keywords: developmental math, community college, CoDE, RISE, gateway math

The Impact of the New CoDE Model of Developmental Mathematics on Student Retention and Graduation Rates

Many Americans believe getting a job means going to college and receiving a degree in a specific field of study that aligns with the job field chosen (American Association of Community Colleges, 2012). Earning a degree or a credential is not as simple as signing up for and attending classes. Even though college is more accessible and tuition assistance is more readily available than in the past, the ability to pass the entrance tests and placement exams affects many students today and can get in the way of achieving their educational dream. This paper is a summary of a dissertation and provides the results of that research.

CoDE (Corequisite and Developmental Education)

Corequisite and Developmental Education (CoDE) is a new program that was intended to replace the old placement system and developmental series of math and English instruction. CoDE was piloted (initially as Reinforced Instruction for Student Excellence, or RISE) at 16 community colleges in North Carolina and was initially scheduled for full implementation in all 58 community colleges by fall 2020. The full rollout was discontinued, largely due to complications related to the pandemic.

This article is brought to you for free and open access by the North Carolina Community College Faculty Association @NCCCS. It has been accepted for inclusion *North Carolina Community College Journal of Teaching Innovation* by an authorized editor of NCCCFa. For more information, please contact editor@ncccf.org.

At present, many, but not all, North Carolina community colleges have implemented CoDE or a modified version of CoDE. As noted by the North Carolina Community College System (2019), "The two primary factors considered in the ... RISE [CoDE] model are the proper placement of students in gateway math and English courses and academic support for students in the context of their math and English courses" (para 1).

The documents on the CoDE program are extensive. They give the educator a clear understanding of the program as a whole and show the pathways a student can take to meeting the requirements for English and math. According to Newsom (2019), "Community colleges will have redesigned English and math classes for students who have high school GPAs below 2.2 or who aren't yet ready for gateway classes. Students must complete these transitional classes before taking courses that award credit toward a degree or certificate" (para 6).

The Research Problem

Developmental education has been paramount to higher education, with most of the remedial education left to the community colleges. Developmental math, more than English remediation, is seen as one of the key stumbling blocks to students' college success. "Every year, tens of thousands of young people fail to graduate because they can't earn enough math credits" (Gewertz, 2018, p. 1). Earlier, Provasnik and Planty (2008) voiced similar findings, noting that mathematics was the most common remedial course reported by beginning postsecondary students (15%) and by beginning community college students (22%).

Developmental Mathematics Pre-CoDE

The North Carolina Community College System (NCCCS) started redesigning developmental mathematics (DMA) courses in 2009. The transition from MAT to DMA was official in 2012, with a comprehensive state implementation beginning in 2013. Classroom instruction methods varied from teacher centered, student centered, and computer centered and were used in the redesigned North Carolina DMA courses (North Carolina Community College System, 2011).

The North Carolina Community College System oversaw and implemented the new developmental

mathematics sequence in 2012. Peeler (2016) stated that the program changed at this time

from a three-course, traditionally taught sequence into a sequence of eight modules and gave each college the ability to choose the structure and instructional methods used to teach these. The goal of this redesign was to support students in need of developmental mathematics to complete their sequence of developmental courses and pass their first college-level mathematics course (called the gateway course). (p. 3)

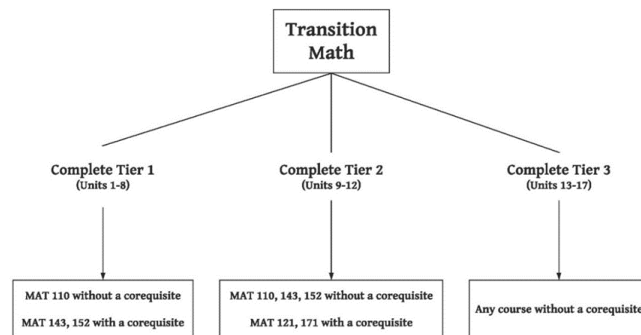
The redesign was intended for a more consistent pathway into gateway mathematics courses and the support of developmental learning; however, it added to the time students had to take developmental mathematics and some never made it into college level mathematics courses.

Impact of CoDE on Colleges

When the community colleges in North Carolina started the CoDE program with pilot institutions, these institutions no longer offered the NC Diagnostic and Placement (DAP) testing. Therefore, students either placed into the tier level they needed or had to take the transition courses. See Figure 1.

Figure 1

Transition Math Tier Levels and Exit Points to Gateway Math Courses (NCCCS, 2019).



Since there were no online transition courses offered at the time of the pilot program, students at some colleges were required to take placement tests or DMAs at other colleges and have them transferred back into their respective institutions. Having to take classes elsewhere placed undue hardship and caused extra classes, financial difficulties, and other issues for the pilot college students. Although the impact was limited into the fall 2019 academic year, a much larger effect was anticipated by the spring of 2020,

when the colleges would have had at least two semesters of students taking placements or courses elsewhere (North Carolina Community College System, 2019). These impacts have been mitigated with the discontinuation of the full CoDE rollout and the pandemic related boost of online learning resources. In our post COVID world, online components are largely available for distant/remote students enrolled at community colleges with CoDE programs.

CoDE Tier System

- The CoDE math test consists of three tiers. Students must achieve a score of at least 80 on each tier to progress to the next tier. Students who score less than 80 on the first tier are placed into a transition math course. Students who score an 80 or higher on the first tier may then choose to take the second tier test for placement into gateway math courses if needed. A corequisite course may be required depending on the gateway course. Students who score an 80 or higher on the second tier may then choose to take the third tier if needed for placement into a higher level gateway course.
- Tier 1 includes whole numbers, fractions and mixed numbers, decimals, ratios, rates, proportions, percentages, measurements, geometry, and real numbers.
- Tier 2 includes concepts in statistics, solving equations and inequalities, exponents and polynomials, and graphing.
- Tier 3 includes factoring, systems of equations and inequalities, rational expressions, radical expressions and quadratic equations, and functions.

Statement of the Problem

Students today are leaving high school underprepared for college. Adult learners are entering college after years away from the academic setting without the basic skills necessary to navigate the rigors of higher education. The need to address this issue brought about the developmental series of instruction. The actual effectiveness of developmental math has been debated for some time, and a new system currently called CoDE was incorporated in 2019 to meet this challenge. The CoDE program is designed to assist all students in achieving their po-

tential and complete their specific gateway math course more effectively and continue to graduation (North Carolina Community College System, 2019).

The following results are a compilation of the three community colleges involved in this study and depict the overall course counts for each developmental math course (DMA/MAT 003), as well as the gender and grade pass rate between the DMA and MAT 003 course of developmental instruction. See Tables 1 and 2.

Table 1

Colleges A, B, C – Course Name and Grade Crosstabulation

Grade	Course	F	P	Total
Course Name	DMA	412	517	929
Frequency		44%	56%	100%
Total		412	517	929

Note: Table 1 shows the breakdown of DMA mathematics for all colleges and compares the grades of passing (P) and failing (F) along with the percentage of the DMA mathematics course. It is depicted that 517 students out of 929 or 56% passed DMA mathematics. A simple *t*-test was used to determine the significance of college A, B, and C's DMA course of instruction with the results listed below in Table 2.

Table 2

Colleges A, B, C – Course Name and Grade Statistics

Grade	Missing #	Value
N	Valid	929
	Missing	0
Mean		.56
Std Deviation		.497

Note: The results from the *t*-test ($M = .56, SD = .497, t(34) = .016, p < .05$). Course and grade statistics indicate a significant difference in passing rate.

The researcher examined the MAT 003 course and grades. The relation between these variables was significant; students taking the mathematics course MAT 003 had a high fail rate (45.8%). See Table 3.

Table 3

Colleges A, B, C – Course Name and Grade Crosstabulation MAT 003

Grade	Course	F	P	Total
Course name	MAT 003	384	325	709
%		54%	46%	100%
Total		384	325	709

Note: Table 3 shows the breakdown of the MAT 003 mathematics for all colleges and compares the grades of passing (P) and failing (F) along with the percentage of

the MAT 003 mathematics course. It is depicted that 323 students out of 709 or 46% passed MAT 003 mathematics.

DMA and MAT 003 Combined Analysis

A Chi-square test of independence was performed to examine the relationship between the DMA and the MAT 003 course for ethnicity and grades. The relation between these variables was significant: $X^2(5) = 81.688, p = .000$. African Americans had a significantly higher pass rate as well as a significantly higher failure rate than all other races. See Tables 4 and 5 and Figure 2.

Table 4

Colleges A, B, C – Ethnicity Grade/Course Crosstabulation

	Race	Count	Grade		Total
			F	P	
X Ethnicity Race	AN	Count	60	109	169
		Expected Count	91	78	169
		% within X Ethnicity Race	35.50%	64.50%	100.00%
	AS	Count	4	7	11
		Expected Count	5.9	5.1	11
		% within X Ethnicity Race	36.40%	63.60%	100.00%
	BL	Count	423	221	644
		Expected Count	346.7	297.3	644
		% within X Ethnicity Race	65.70%	34.30%	100.00%
	HIS	Count	72	82	154
		Expected Count	82.9	71.1	154
		% within X Ethnicity Race	46.80%	53.20%	100.00%
	MULTI	Count	55	41	96
		Expected Count	51.7	44.3	96
		% within X Ethnicity Race	57.30%	42.70%	100.00%

	Race	Count	Grade		Total
			F	P	
X Ethnicity Race	WH	Count	122	171	293
		Expected Count	157.8	135.2	293
		% within X Ethnicity Race	41.60%	58.40%	100.00%
Total		Count	736	631	1367
		Expected Count	736	631	1367
		% within X Ethnicity Race	53.80%	46.20%	100.00%

Note: Abbreviations for race/ethnicity: AS=Asian, AN=Native American, BL=Black, HIS= Hispanic, MULTI=Multiple races, WH=White.

Table 5

Colleges A, B, C – Chi-square Tests Gender/Grades, Course

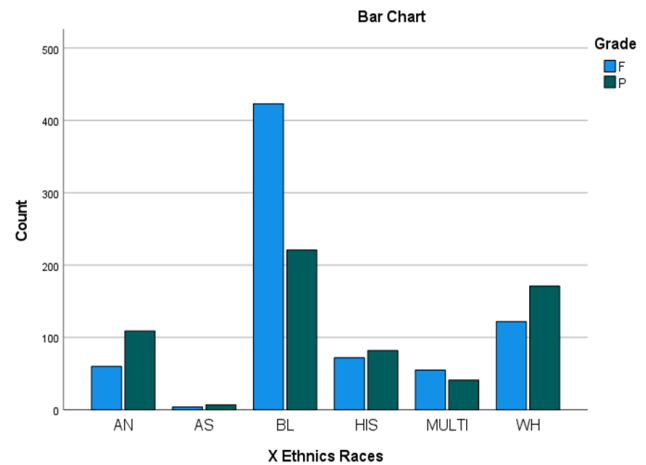
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-square	81.688 ^a	5	.000
Likelihood Ratio	82.543	5	.000
N of Valid Cases	1367		

Note: a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.08.

The Chi-square analysis in Table 3 indicates several associations. Course success was significantly associated with both females and African Americans. These two associations indicate that student demographic characteristics and gender have an effect on course success. However, both characteristics also appear to be associated with course failure rates as well.

Figure 2

Colleges A, B, C – Chi-square Tests Bar Chart Ethnicity and Grades



A Chi-square test of independence was performed to examine the relationship between the DMA and the MAT 003 course and grades. The relation between these variables was significant, $X^2(2) = 31.748, p < .05$. DMA had a significantly higher pass rate than MAT 003; DMA also had a higher repeat rate overall. The withdrawal rate, however, was higher in MAT 003 compared to the DMA course. See Table 6.

Table 6*Colleges A, B, C – DMA/MAT Crosstabulation*

Grade	Course	F	P	Total
Course name	DMA	452	553	1005
%		45%	55%	100%
	MAT 003	337	325	662
%		51%	49%	100%
Total		789	887	1667

Note: Table 6 shows the breakdown of DMA and MAT 003 mathematics for all colleges and compares the grades of passing (P) and failing (F) along with the percentage of the DMA/MAT 003 mathematics courses. It is depicted that 553 students out of 1005 or 55% passed DMA mathematics. It is depicted that 325 students out of 662 or 49% passed MAT 003 mathematics.

The Chi-square analysis in Table 4 indicates several associations. Course success was significantly associated with the DMA series of developmental mathematics. These two associations indicate that pre CoDE and CoDE programs of instruction have an effect on course success. What is also noteworthy is that there is only a slight difference between the passing and failure rate of the MAT 003 course; the pass rate was 49% and the failure rate was 51%.

Summary

Research Question 1 is the primary question of this study: Are developmental math (CoDE) students achieving success in completing the MAT 003 course? Success is a broad term and depends on the student's needed gateway math course, and on how many levels they obtain in MAT 003. Students completing at least tier 1 of MAT 003 and proceeding into their gateway math with the corequisite course would mean success for a student only needing the gateway MAT 143.

Hypothesis 1 is: There is a significant difference in the success of pre CoDE and CoDE students in achieving success in completing the MAT 003 course. The review of the data revealed several im-

portant findings related to the developmental mathematics and CoDE program effectiveness. A Chi-square test was conducted for each of the research questions to determine any significant differences in the population demographics and gender and the pass rate. The relationship between the previous developmental mathematics (DMA) and the new CoDE MAT 003 course was also analyzed to determine which course had a higher passing rate.

Because the number of students varied at each participating college, a final combined tally of all institutions participating was conducted to develop a bigger picture of the state's new CoDE program and its effectiveness. Although there was no research question or hypothesis for students' withdrawal rate in either program, the results did determine a high withdrawal rate in MAT 003 compared to the pre CoDE program of instruction.

The study found a significant difference in pass rates between the pre CoDE mathematics compared to the CoDE program of instruction. This study did indicate that females had a significantly higher pass rate than males for both education programs. Furthermore, the study results showed a significant increase in withdrawals with the CoDE program compared to the pre CoDE DMAs. Results from the survey indicated that instructors were very confident that distant students had as much opportunity to succeed in an online or hybrid course as those taking the course face-to-face. The instructors further indicated that the success rate was just as high.

Recommendations

This study was relatively small and only included three community colleges out of the 58 colleges in the North Carolina Community College System. A better understanding of the program effectiveness could come from expanding research to include all colleges in the system. A statewide survey of those mathematics instructors teaching CoDE could be sent from the system office to get a bigger picture across the 58 colleges in the state.

Additionally, the use of the application for developmental mathematics, EdReady™, was an area of concern for some instructors. Instructors felt it aided the students in only passing through the application but not the course as a whole. The application allows a student to take the test multiple times without watching the instructional videos; this means a

student could master the test but not the material. There should be a system in place that ensures the students must take the instructional material before taking a practice test. This ensures the students are prepared for the finals and their gateway mathematics course.

Conclusion

This study explored the differences and pass rates of the new CoDE model developmental mathematics and the pre CoDE model of DMA mathematics and the efficacy between the courses, method of delivery, and demographics of the students. The study further explored the differences of three different size colleges in the North Carolina Community College system.

The study revealed a significant difference in females' pass rate and a slight difference in the pass rate overall of the DMA mathematics. Still, the positive difference between the three colleges' DMA and MAT 003 was not as significant as expected. The study did reveal a significant difference in the withdrawal rates of those students taking CoDE MAT 003 compared to the DMA mathematics.

This study is beneficial to the research on developmental mathematics, specifically the CoDE model, since no research was found on the subject. The results are similar to previous studies on developmental mathematics and revealed that transitioning from one program to another produced similar results in student retention and pass rates. Although the findings presented in this dissertation research study were significant in relationship to student success in DMA versus MAT 003, this study raised the question of the high withdrawal and repeat rates of both programs of developmental mathematics. This research study's findings extend the academic conversation regarding student success in CoDE mathematics and inform policies at institutions and state system offices.

Gewertz, C. (2018, May 22). Retooled courses help students avoid a remedial-math roadblock to college. *Education Week*. <https://www.edweek.org/ew/articles/2018/05/23/retooled-courses-help-students-avoid-a-remedial-math.html>

Newsom, J. (2019, January 24). RISE up: N.C. community colleges try a new approach for placing new students. *Winston-Salem Journal*. https://journalnow.com/news/state/rise-up-n-c-community-colleges-try-a-new-approach-for-placing-new-students/article_61d20866-5235-53e8-9d2f-14a600e1d10f.html

North Carolina Community College System. (2011). *Developmental math modular curriculum*. <http://ncmatyc.matyc.org/wp-content/uploads/file/BetaVersionDevelopmental%20Math%20Modules%20-%20NCCCS%5B1%5D.pdf>

North Carolina Community College System. (2019). *2019 RISE pilot colleges*. <https://drive.google.com/drive/folders/1KQRf35ytmgVL537qomnS57cvkubyXmoL>

North Carolina Community College System. (2019, August 19). *Accelerating student readiness (RISE)*. <https://www.nccommunitycolleges.edu/it-resources-and-services/it-projects/accelerating-student-readiness-rise>

Peeler, M. A. (2016). *Comparison of developmental mathematics sequences* [Doctoral dissertation, University of North Carolina at Charlotte].

Provasnik, S., & Planty, M. (2008). Community colleges: Special supplement to the condition of education 2008 (No. NCES 2008-033). *The Condition of Education 2008*. National Center for Education Statistics. <http://nces.ed.gov/programs/coe/2008/analysis/index.asp>

References

American Association of Community Colleges. (2012). *Reclaiming the American dream: Community colleges and the nation's future*. <http://www.aacc21stcenturycenter.org/wp-content/uploads/2014/03/21stCenturyReport.pdf>

Author's Note

The authors have no known conflicts of interest to disclose. Correspondence concerning this paper should be addressed to Kenneth N Buckey, Fayetteville Technical Community College, NC 28303 Contact: buckeyk@faytechcc.edu.