

Executive Summary

AT THEIR OWN PACE

**Interim Findings from
an Evaluation of a
Computer-Assisted,
Modular Approach to
Developmental Math**

Alissa Gardenhire
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Overview

Community colleges nationwide are looking for solutions to help students complete developmental (remedial) math — a known barrier to graduation. Some are offering computer-assisted, modular developmental math courses that allow students to earn credits incrementally and move through the curriculum at their own pace.

One of these modularized courses, ModMath, was created at Tarrant County College (TCC) near Fort Worth, Texas. It reorganizes the content of TCC's two semester-long developmental math courses into a set of six modules, each of which is five weeks long. The four primary components of the ModMath intervention are: a *diagnostic assessment* that places students in a starting module; individual registration into three *modules* per course section each semester; *computer-based instruction* delivered online through an instructional software program; and *personalized, on-demand assistance* in class from an instructor and class aide.

MDRC is evaluating ModMath's implementation and its effects on students' academic outcomes using a randomized controlled trial. This report contains implementation findings and some findings on early impacts for the first three semesters of students enrolled in the study:

- ModMath was well implemented and differed from traditional developmental math courses in both the nature of its instruction and its credit-earning structure.
- After one semester in the program, students randomly assigned to ModMath (the program group) were, on average, closer to completing the developmental math sequence than were students randomly assigned to traditional, lecture-based courses (the control group). This relatively greater progress was the result of program group students getting credit for completing one or two modules but not the equivalent of an entire course.
- However, this advantage did not translate into other measures of progress. For example, program group students were not more likely to pass the halfway mark in the developmental math sequence than the control group. More than 70 percent of the students in the study, in either group, were unable to pass this benchmark in the first semester.
- ModMath had a small negative effect on the percentage of students who completed the developmental math sequence during their first semester (0.4 percent of program group students compared with 1.9 percent of the control group).

While this report contains final findings regarding the implementation of ModMath, it contains only preliminary findings on the program's effects. Data were only available for students who enrolled in the first three semesters of what were ultimately four semesters of enrollment, and the report only follows them for one semester. The final report from this study will draw upon additional data and provide additional evidence about the effect ModMath may have on student outcomes.

Preface

Developmental education has been a major target of postsecondary reform in states and community colleges for decades. In recent years, for example, some states have even begun requiring their community colleges to do away with developmental offerings, or have begun allowing students to opt out of developmental courses regardless of their assessment scores. Other colleges are moving toward a model in which remedial students enroll in a college-level course and receive additional support in an extra lab period, never enrolling into a developmental math course.

Despite all this attention to the issue, in 2011 MDRC reviewed the literature on developmental education and found only limited evidence of effective reforms. Since then, MDRC has worked to build a rigorous and reliable body of evidence about effective developmental education reforms. Many of these studies have explored reforms to the instruction of developmental math specifically, as it is widely considered the most significant barrier to college completion for students who are placed in developmental courses. ModMath, at Tarrant County College near Fort Worth, Texas, is one such approach. It offers computer-assisted, modular developmental math instruction that allows students to earn credits incrementally and work through course material at their own pace. Within the classroom it also offers students personalized, on-demand attention that gives them the academic and emotional support they need to learn math.

This is the first of what will be two reports on ModMath. It finds that so far the program has been implemented well and that it is producing experiences for students that are meaningfully different from more traditional, lecture-based math courses. At this early stage the findings on the program's impacts are mixed: After one semester in the program, ModMath students had moved further through the developmental math sequence than non-ModMath students, but they remained far from successfully completing the requirements. After one semester, well under half of the students in both ModMath and traditional, lecture-based courses have made it to the halfway mark in the developmental math sequence — and the halfway mark is the equivalent of passing a single semester's worth of developmental math.

The second and final report from this study is due in 2018. It should reveal whether the incremental progress ModMath students have begun to make does ultimately lead more of them to complete developmental math, and more importantly, whether it leads more of them to complete college-level math and either graduate or move on to a four-year college.

Gordon L. Berlin
President, MDRC

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The Authors

Executive Summary

My name is Theresa and I'm now in Mod 2.¹ I started at the bottom, now I'm here. I've taken many, many remedial [math] classes and haven't gotten anywhere, because after a while I realized that I didn't have the core that I needed to move on. I'm almost finished with my college career here at TCC and the only thing that's holding me back [is] the math requirements.

—ModMath student

Community colleges nationwide are looking for solutions to help students like Theresa complete developmental math, because it is a barrier to college completion for large numbers of them. More than half of entering community college students place into developmental math, but many of them fail to complete the developmental sequence and even fewer enroll in and pass a college-level math course, which is often a requirement to get a degree.² In response, many colleges have made changes that tend to fall into one or more of three broad categories:

- Curricular reforms that change the *content* of the curriculum, for example, by eliminating courses to reduce redundancy in the sequence or replacing prealgebra with statistics in order to help students learn the math most relevant to their larger academic goals and careers
- Structural reforms that change *course offerings* or reduce the time spent in the developmental math sequence, for example, by dividing courses into modules or discrete units, compressing 16-week courses into 8 weeks, or pairing developmental courses with college-level ones (a practice known as mainstreaming)
- *Pedagogical or instructional reforms* that change how developmental math content is delivered, for example, by introducing computer-assisted instruction or learning associated with real-world career paths or contexts

One strategy is to offer computerized, modular courses where students can move through the curriculum at their own pace. ModMath — created and implemented by Tarrant County College (TCC) near Fort Worth, Texas — is one such approach that aims to change both pedagogy and course-credit structure. ModMath encompasses four basic components: diagnostic assessment; the division of courses into modules; computer-assisted instruction; and

¹This student's name was changed to protect his or her identity.

²Thomas Bailey, Dong Wook Jeong, and Sung-Woo Cho, "Referral, Enrollment, and Completion in Developmental Education Sequences in Community Colleges," *Economics of Education Review* 29, 2 (2010): 255-270.

on-demand, personalized assistance. At the core of ModMath is a structural change that divides TCC's two semester-long developmental math courses into six five-week modules or "mods." MDRC, a nonprofit, nonpartisan education and social policy research organization, is evaluating ModMath's implementation and its effects on students' academic outcomes using a randomized controlled trial.

This report addresses three primary questions about how ModMath was implemented and three questions about its early impacts on student outcomes.

1. To what degree were ModMath services and activities implemented as planned?
2. How are the services and activities experienced by program group students different from those experienced by control group students?
3. Are students randomly assigned to ModMath (the program group) more engaged in learning math than students randomly assigned to traditional, lecture-based courses (the control group)?
4. What is the effect on students' math placement levels of using *MyMathTest* compared with other placement tests?
5. What is the effect on students' likelihood of completing the developmental math course sequence of being offered the opportunity to enroll in ModMath?³
6. What positive spillover effects or negative side effects on students' credit accumulation are caused by offering them the opportunity to enroll in ModMath?

The implementation research has revealed that the four components of ModMath were implemented well and that they have created a substantially different experience for the program group from that of the control group. The early impact findings are mixed — program group students made more progress in the developmental math sequence than control group students, but were not more likely to pass the halfway mark in the sequence and were slightly less likely to complete all of it. The remainder of this executive summary describes the intervention and provides more details on the findings.

³Note that this is the primary or "confirmatory" research question as described in Peter Z. Schochet, *Technical Methods Report: Statistical Power for Regression Discontinuity Designs in Education Evaluations*, NCEE 2008-4026 (Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education, 2008).

Table ES.1
Content Alignment of ModMath Modules and Lecture-Based
Developmental Math Courses

Module 1	Simple algebraic operations	Math 0361: Developmental Math 1
Module 2	Basic geometric measurements Basic algebraic expressions Graphing	
Module 3	Exponents Polynomials	
Module 4	Rational expressions and equations Functions Variation equations	Math 0362: Intermediate Algebra
Module 5	Linear and absolute value equations Linear and absolute value inequalities Radical expressions	
Module 6	Radical expressions and equations Real and complex numbers Quadratic equations and functions	

SOURCE: ModMath program coordinator, Tarrant County College.

What Is ModMath?

TCC, a community college serving about 50,000 students in the Fort Worth area, created ModMath in 2006 to address the needs of students who need remediation in math. ModMath divides TCC’s two semester-long developmental math courses (Math 0361: Developmental Math 1 and Math 0362: Intermediate Algebra) into six five-week modules or “mods,” covering the entire developmental math course sequence.⁴ The mods align with the college’s traditional, lecture-based developmental math courses in structure and content as indicated in Table ES.1.

The four primary components of the ModMath intervention are diagnostic assessment; the division of courses into modules; computer-based instruction; and personalized, on-demand assistance.

⁴For clarity, this report refers to the six ModMath modules as Mods 1, 2, 3, 4, 5, and 6. The official course numbers designated by Tarrant County College are Math 0114, Math 0115, Math 0116, Math 0117, Math 0118, and Math 0119, respectively.

Diagnostic Assessment

TCC determines remediation needs primarily using the Texas Success Initiative (TSI) Assessment, a test used by colleges across Texas to assess students' college readiness in math, reading, and writing.⁵ In addition to the TSI Assessment, students who are interested in enrolling in ModMath are given a special placement exam using Pearson Education's *MyMathTest* software, which places them in their starting modules. TCC faculty members used the Pearson software to develop a ModMath placement exam aligned with TCC's developmental math curriculum and ModMath's six modules. At TCC, this placement exam was also called *MyMathTest*.⁶ *MyMathTest* is intended to be more precise than TCC's standard placement exam, and to place students in modules that closely match their demonstrated math knowledge. Students can start in any of the six mods, depending on their placement scores on *MyMathTest*.

Modular Courses

ModMath students typically register for three mods each semester, and earn one non-degree-applicable developmental math credit for each mod they pass. Discrete mods provide students the opportunity to earn one credit at a time, so that they can make incremental progress throughout the semester (unlike the all-or-nothing approach of a traditional semester-long class, in which students fail to earn any credits if they fail a course, even if they master one-third or more of the material). Students who fail a mod are allowed to repeat it immediately in the next five-week session, without waiting for the next semester. For ease of scheduling, all six mods are offered during each class section.

Computer-Assisted Instruction

ModMath's course content is delivered using an instructional software program called *MyMathLab*. Students work at their own pace through the course content using instructional videos, PowerPoint presentations, or an online or hard-copy version of the textbook. Students can access all of these means of instruction anywhere they can access the Internet — at home, in the library, at the campus math lab, etc. Since instruction is self-paced, students who work quickly and efficiently have the opportunity to accelerate and complete the course work for more than three modules (the equivalent of one course) in a single semester.

⁵Not all students take the TSI Assessment — some students may have the test waived or be exempt from it on the basis of other test scores, or on the basis of other factors, such as their status as veterans. In some instances, students may also be placed in developmental math using alternative placement test scores.

⁶Unless otherwise specified, in this report *MyMathTest* refers not to the Pearson software platform but to the specific math placement test developed by the TCC faculty to place students in ModMath modules.

On-Demand, Personalized Assistance

Each ModMath class is led by an instructor who is assisted by an instructional aide. The instructor and aide walk around the room providing one-on-one help to students who need or request it. This personalized assistance is intended to allow the instructional staff to provide individual academic and emotional support to students.

Study Design

The evaluation study discussed in this report employs a randomized controlled trial research design to estimate the effect of offering students the opportunity to enroll in ModMath, compared with a “business-as-usual” control condition that generally means the offer of a traditional, lecture-based course.⁷ Students who were eligible for and interested in participating in ModMath were randomly assigned either to a program group, who could enroll in ModMath, or a control group, who could enroll in the college’s regular developmental math courses, primarily traditional, lecture-based courses.⁸ TCC and MDRC recruited 1,403 students to participate in the evaluation during the spring 2014, fall 2014, spring 2015, and fall 2015 semesters.

Data Sources

Multiple quantitative data sources were used to characterize study participants and to measure the early effects of ModMath, including student baseline questionnaires, math placement records, student transcript records, and student and instructor surveys. Researchers also conducted field research activities during the spring 2014 and fall 2014 semesters to complement the findings emerging from the quantitative data. Field research was used to explore the development and implementation of ModMath and to gauge students’ and instructors’ experiences with ModMath and other developmental math classes at TCC. Field research activities included student focus groups, instructor focus groups, a focus group with academic advisers, interviews with TCC staff members, and observations of ModMath and non-ModMath classrooms.

Study Findings

The implementation research revealed that the four components of ModMath were implemented well, with fidelity to the model. Moreover the classroom experiences of the program group were

⁷For ease of reading, this report will refer to “the effects of ModMath” rather than “the effects of the opportunity to enroll in ModMath.”

⁸The majority of students assigned to the control group enrolled in TCC’s traditional, lecture-based developmental math courses — Math 0361: Developmental Math 1 and Math 0362: Developmental Math 2. However, students in the control group may also have enrolled in other types of developmental math course offerings at TCC, including computer-assisted lecture courses and Math Emporium.

substantially different from those of the control group. The impact study showed that, at least for the first three of the four cohorts in the study,⁹ the short-term effects of ModMath were mixed:

- On the positive side, program group students were 10 percentage points closer to completing the developmental math sequence than control group students — 25 percent of the way through it compared with 15 percent. Program group students also registered at higher rates for math courses and passed math courses at higher rates, as shown in Table ES.2. These differences are statistically significant.
- However, these advantages did not translate into other measures of progress. For example, program group students were not more likely to pass the half-way mark in the developmental math sequence than the control group. More than 70 percent of students in the study, in either group, were unable to pass this benchmark in the first semester.
- ModMath had a very small but statistically significant and negative impact on the percentage of students who completed the entire developmental math sequence during their first semester, 0.4 percent for the program group compared with 1.9 percent for the control group.

Implications of These Early Findings

For some interventions, a lack of impacts can sometimes be attributed to weak or poor implementation of the program or to a lack of contrast between the program and control conditions. This study rules out these factors as explanations for the mixed findings on ModMath's early impacts. Interviews with and survey data from students, instructors, and administrators, as well as classroom observations, confirm that all of the components of ModMath were delivered and that program group students had a very different experience from the control group. Further, most ModMath students reported that they liked this computer-assisted, modular approach to learning math, and said that they felt a sense of accomplishment as they passed each mod.

At this stage, it is still too early to conclude whether or not ModMath will make a difference in the percentage of students who make it through the developmental sequence, the speed at which they do so, or the rate at which they succeed in college-level math. While the study shows that ModMath had a positive effect on the average amount of the developmental math sequence a student completed in the first semester, this effect appears to reflect the many students who succeeded in passing one or two mods, an opportunity that was not available to

⁹A "cohort" is the group of students who joined the program in the same semester.

Table ES.2
Early Math Enrollment and Progress
Tarrant County College
Spring 2014, Fall 2014, Spring 2015

First-Semester Outcome	Program Group	Control Group	Difference	Standard Error
Average percentage of the developmental math sequence completed	25.1	15.0	10.0 ***	1.6
Enrolled in math class shown or higher math (%)				
Any math class (course or mod)	87.9	80.8	7.1 ***	2.4
Second half of the developmental sequence	6.5	5.8	0.7	1.7
College-level math	0.4	0.0	0.4	0.3
Passed math class shown or higher math (%)				
Any math class (course or mod)	71.2	28.3	42.9 ***	3.1
First half of the developmental sequence	24.5	28.0	-3.5	3.0
Second half of the developmental sequence	0.4	1.9	-1.6 **	0.7
College-level math	0.0	0.0	0.0	0.0
Sample size (total = 869)	504	365		

SOURCE: MDRC calculations using transcript data from TCC.

NOTES: Rounding may cause slight discrepancies in sums and differences.

Estimates are adjusted by cohort.

A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent.

their counterparts in traditional 16-week math courses. In other words, students in the ModMath group were able to make more incremental progress, but it remains to be seen whether these “small wins” will get them across the finish line more often or more quickly than the control group.

There are at least two additional reasons why the results from longer-term follow-up with the full sample will be important. First, most of the students in the study placed at the beginning of the developmental math sequence. These students’ odds of passing each course — let alone the entire sequence and a college-level math course — are not good. Because many students may withdraw from or fail courses, requiring multiple attempts to pass, the process of completing the math sequence can take many semesters to play out. Outcomes in the first semester may say little about what lies ahead.

Second, ModMath was explicitly designed by the college’s math faculty to encourage persistence and success by means of the mechanism referred to in the research literature and this report as “small wins.”¹⁰ Students often arrive in their developmental math courses discouraged and demoralized by their low placement test scores and by their past struggles with math in high school or college, and full of anxiety about once again trying to learn math. In sharp contrast with their control group counterparts, ModMath, students learn right away that they *can* experience success quickly and relatively easily in three ways: (1) when they demonstrate subject mastery in lesson checks and quizzes; (2) when they earn credit as frequently as every five weeks for passing mods; and (3) when they have the chance to return to math and pick up where they left off in the developmental sequence, without significant repetition, if they fail a mod or need to stop attending for any reason.

These small accomplishments and sense of forward momentum may strengthen students’ engagement in math, improve their attitudes toward math and their own abilities generally, and, through this heightened self-confidence, encourage them to persist and do better. In fact, program group students reported being somewhat more engaged and having more positive attitudes toward their math classes than did control group students. Again, it remains to be seen whether these higher levels of engagement among program group students translate to greater persistence in math, higher rates of completion in developmental math, and higher rates of completion in college-level math.

Next Steps

While this report contains final findings and conclusions regarding the implementation of ModMath, the findings it contains on the program’s effects on student outcomes are preliminary. Data were only available for three of the four participating cohorts, and only for one semester of follow-up. The final report from this study will provide additional evidence about ModMath’s effect on student outcomes. It will incorporate the fourth — and largest — cohort of students and follow the full sample for several more semesters.

¹⁰Karl E. Weick posits the “small wins” concept in “Small Wins: Redefining the Scale of Social Problems,” *American Psychologist* 39, 1 (1984): 40-49.

About MDRC

MDRC is a nonprofit, nonpartisan social and education policy research organization dedicated to learning what works to improve the well-being of low-income people. Through its research and the active communication of its findings, MDRC seeks to enhance the effectiveness of social and education policies and programs.

Founded in 1974 and located in New York City and Oakland, California, MDRC is best known for mounting rigorous, large-scale, real-world tests of new and existing policies and programs. Its projects are a mix of demonstrations (field tests of promising new program approaches) and evaluations of ongoing government and community initiatives. MDRC's staff bring an unusual combination of research and organizational experience to their work, providing expertise on the latest in qualitative and quantitative methods and on program design, development, implementation, and management. MDRC seeks to learn not just whether a program is effective but also how and why the program's effects occur. In addition, it tries to place each project's findings in the broader context of related research — in order to build knowledge about what works across the social and education policy fields. MDRC's findings, lessons, and best practices are proactively shared with a broad audience in the policy and practitioner community as well as with the general public and the media.

Over the years, MDRC has brought its unique approach to an ever-growing range of policy areas and target populations. Once known primarily for evaluations of state welfare-to-work programs, today MDRC is also studying public school reforms, employment programs for ex-offenders and people with disabilities, and programs to help low-income students succeed in college. MDRC's projects are organized into five areas:

- Promoting Family Well-Being and Children's Development
- Improving Public Education
- Raising Academic Achievement and Persistence in College
- Supporting Low-Wage Workers and Communities
- Overcoming Barriers to Employment

Working in almost every state, all of the nation's largest cities, and Canada and the United Kingdom, MDRC conducts its projects in partnership with national, state, and local governments, public school systems, community organizations, and numerous private philanthropies.