Faculty & Student Experiences Across Redesigned Developmental Math Course Models

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Graduate NYC (GNYC) is an initiative that operates in partnership with the New York City Department of Education (NYC DOE), The City University of New York (CUNY), and the Office of the Mayor, while also convening and engaging the local college access and success community. It works closely with these partners on efforts to drive greater rates of college readiness and college degree completion in New York City, particularly with regard to low-income students, first-generation college goers, and students of color.

Throughout the 2016–17 academic year, GNYC supported a study of three types of reforms to developmental (or remedial) math courses in three CUNY community colleges. Drawing on interviews with developmental math faculty and focus groups and interviews with students, the study focused on stakeholder experiences within and across redesigned course models. All student participants were invited to participate based on their enrollment in a course type among those being studied and were compensated for their participation.
Executive Summary

Disappointing outcomes from developmental (or “remedial”) college courses have recently drawn national attention.1 Nationwide, 68 percent of new high school graduates entering community colleges are placed into remediation because they failed to meet the standards of college readiness set by the institution; at CUNY, the figure is 63 percent.2 Students that are initially placed into college-level courses. The problem is especially acute in mathematics. Nationally, 59 percent of community college students are placed in remedial math, but only 49 percent of these students go on to complete remedial math requirements and enter college-level courses.3

In response to the poor outcomes in remedial math courses, colleges have undertaken a host of reforms. These reforms alter the structure, curriculum, and/or pedagogy of remedial courses to address perceived causes of poor student outcomes. The research summarized in this report seeks to consider as they implement reforms to their remedial math offerings:

1. Inform students about remedial options and consider best fit. A necessary complement to remedial math redesigns and expanded math pathways is to ensure that advisors and faculty members can inform students about the options available to them. Importantly, different course designs may be better suited to different kinds of students. Advisors should focus on finding the best fit between course structure and demands and the students’ preferences, proficiency level, and time available to devote to the course.

2. Prevent repeated failures by recommending students to redesigned courses. Because remedial math courses have low pass rates and these courses are mandatory for academic progress, it is common for students to repeat remedial math courses. Given the damage to student and faculty morale inflicted by repeated failures, colleges should identify students who have failed previous courses and evaluate whether these students can be referred to redesigned course models in which they may be more successful.

3. Address broad problems with academic behaviors. Faculty members in this study observed that weak academic behaviors are often more significant barriers to student success than challenges understanding math content. It may be beneficial for colleges to take a more holistic approach toward preparing students for college-level work by teaching them to strengthen their academic behaviors, including consistent attendance, homework completion, and seeking additional help when needed, in addition to supplying developmental math content.

4. Beware of tension between accelerated progress and mastery of content. Most reforms to remedial math seek to move students into college-level courses as quickly as possible. As a result, tension arises in many course designs between the impetus to move students quickly through large amounts of content and developing mastery of topics in the curriculum. For students with weak foundations in math and many competing priorities for their time, accelerated models can be particularly challenging. Colleges should consider what demands are placed on students in some accelerated course designs, including high numbers of hours in the classroom per week, large amounts of curricular content, and significant expectations for homework or other independent study, and seek to provide academic and/or non-academic supports to enable students to meet course demands.

Overall, the study finds that each remediation reform is built upon certain assumptions or theories about student and teacher behavior and preferences. Every reform is designed with imagined users in mind—faculty and students who will come to the course with certain skills and preferences and exhibit certain behaviors. The intended benefits of a reform may not materialize when actual faculty and student preferences and behaviors differ from those assumed in the reform design.

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2. Prevent repeated failures by recommending students to redesigned courses.
3. Address broad problems with academic behaviors.
4. Beware of tension between accelerated progress and mastery of content.
Introduction

Large numbers of students in the United States graduate from high school and enroll in college only to discover that they are not deemed ready for college-level coursework. Sixty-eight percent of new high school graduates who enroll in community colleges and 40 percent of those who enroll in open-access four-year colleges are referred to developmental (or “remedial”) coursework, typically by virtue of a low score on a placement test. Students who are assigned to developmental courses in math or English are much less likely to earn a college credential than are those who place into college-level courses, indicating that, at a minimum, such courses are not effective in preparing students for college-level work. The math content area is of particular concern. Fifty-nine percent of community college students place into one or more developmental math courses, but only 49 percent of these students complete their developmental coursework and move on to college-level math.8

These national statistics are similar to those at CUNY. In the fall of 2016, when this study was conducted, 63 percent of incoming freshmen in CUNY community colleges were assigned to remedial mathematics courses. These students are about half as likely as students not referred to remedial courses to complete an associate degree in three years. Furthermore, black and Hispanic students are twice as likely as white and Asian students to be assigned to remedial courses, thus contributing to gaps in access to bachelor’s programs and educational attainment.6

In recent years, many colleges and college systems have undertaken reforms of their developmental math offerings to improve student learning and outcomes. Different types of remedial reforms seek to redress distinct problematic aspects of “traditional” remedial courses such as structure, curriculum, and/or pedagogy that are each thought to be a major barrier to student progress. Reforms may alter course structures or streamline course sequences, limit the content that students must complete, or address problems with student motivation and engagement through redesigned content and innovative approaches to instruction.

While there has been much recent work examining the problems associated with remedial placements and the high failure rates within remedial classes, less research has focused on student and faculty experiences in redesigned remedial courses. This research contributes to the current knowledge about math remediation reforms by examining student and faculty experiences across redesigned courses and looking at the opportunities and challenges presented by different redesign models.

CUNY offered an ideal context in which to compare student and faculty experiences with different course models, because there has been a large amount of experimentation with remedial math course design in the CUNY system. In 2016, CUNY launched a comprehensive redesign of its remediation policies from placement through course offerings and exit procedures. The courses described in this report predate CUNY’s centralized reform initiative and are instead the result of efforts on the part of individual instructors or departments to better meet the needs of their students. Nonetheless, the three types of courses examined for this study—the computer-mediated hybrid elementary algebra course, the co-requisite college-level and elementary algebra course, and the quantitative reasoning alternative to elementary algebra—are currently among the most popular and widely implemented reforms to remedial math nationally. It is important to note that the current study does not focus on course outcomes. However, the findings of this study provide useful insights to colleges considering reforms to their developmental math offerings.

Math remediation reforms all rest upon certain assumptions and theories about student and teacher behavior and preferences. Every reform is designed with imagined users in mind—faculty and students who come to the course with certain skills and exhibit certain behaviors. In the sections that follow, I introduce each redesigned course with the theory of action underlying the course redesign and then compare faculty and student experiences in each course with the corresponding theory. My goal is to surface the unanticipated consequences of course structure, curriculum, and/or pedagogy that may impact student success.

The remainder of this paper is organized as follows. The remedial landscape section details policies related to remedial placement in the CUNY system. The data collection section provides a brief description of the research activities undertaken for this study. The following sections describe the three remedial course types, including literature reviews of the theory of action underlying course redesign and stakeholder experiences in the courses. The faculty experiences section highlights common faculty experiences across colleges and reform contexts, and the common student experiences section describes common aspects of the developmental student experience. Finally, I offer recommendations regarding how colleges can strengthen their reform efforts in developmental mathematics.

5 Bailey et al. (2010).
6 Bailey et al. (2015).
7 5
The Remedial Landscape in CUNY Community Colleges

Almost 16,000 CUNY freshmen are assigned to remedial math courses each fall because they fail to meet university-defined standards of college readiness. CUNY allows students to demonstrate college readiness via a number of different tests, including the SAT or ACT, the New York State Regents Examinations, and standardized placement tests. Students are placed into developmental education only if they fail to meet or exceed the university cut points on all three sets of tests in the subject.

CUNY’s community colleges adhere to a common set of college-level placement exam cutoffs, but each college designs its own developmental course sequence. Consequently, developmental sequences at CUNY colleges vary in length. Most colleges offer two levels of math remediation, arithmetic and elementary algebra, but at least one college offers a single level of remediation, and another requires students with weak skills to complete three levels of developmental course work. Thus, depending on the college, the number of pre-curricular credit hours that students are required to pass ranges from three to seven on the low end up to eleven credit hours. Students must successfully complete the top-level course at their college before enrolling in a credit-bearing math course. As alternatives to a course, colleges also offer the CUNY Start and Math Start programs, which students complete before matriculating, and intensive developmental workshops during summer and winter terms. However, most students assigned to remediation enroll in traditional semester-based courses.

Data Collection

With a research fellowship provided by GNYC and support from CUNY’s Office of Policy Research, I conducted qualitative data collection in three community colleges in fall semester 2016. At each college, I focused on a single redesigned course (although all of the colleges were in the process of implementing a range of redesigned models). I partnered with one instructor, visiting their class three to four times over the course of the semester to observe class sessions and interview faculty, administrators, and students enrolled in the courses. The faculty members I invited to participate in the study all played a key role in developing the redesigned courses that they taught, thus they had a high level of knowledge of the course implementation process at their institution. I recruited student participants by making announcements before and after classes, inviting students to join one-hour focus groups to discuss their experiences in the course. I compensated students for their time during these interviews. In all, I conducted sixteen interviews with faculty and administrators, thirty-one focus groups and interviews with students, and sixteen classroom observations.

The Hybrid Course

Literature on Computer-Mediated Hybrid Course Redesigns

Computer-mediated instruction can take a range of forms, combining computer-mediated learning with traditional teacher-led, lecture-based instruction in differing proportions. The course I examined as a part of this study combined teacher-led and computer-mediated instruction. The instructor presented lectures daily, but students were also given a substantial amount of time in class to work independently on mathematics software with one-on-one support from the instructor or a tutor.

There are a number of potential advantages to learning within computer-mediated learning environments. Students spend more time doing math problems as opposed to their more passive participation in a lecture-based class environment. Computer-mediated formats afford greater flexibility, allowing students to work at their own pace and spend more time on topics they do not know as well. Computer-mediated instruction provides greater personalization, as the software identifies students’ deficiencies in math knowledge, allowing them to skip portions of the curriculum in which they have demonstrated mastery. It also delivers immediate feedback on students’ work and provides individualized study plans. Instructional software supplies a practically infinite bank of problem sets and worked examples for students and frees course instructors from lecturing, thereby enabling them to provide one-on-one support. The benefits of using instructional software seem to be particularly germane to developmental math students, who might profit from individualized attention and the opportunity to spend more time brushing up on specific material that they may have forgotten or never fully mastered.

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Computer-mediated remedial interventions seek to address the problem of individualization. For proponents of these models, students in math remediation fail because they are not being taught in a manner or at a pace best suited to their individual needs. As a result, they may be wasting time on topics they have already mastered or rushing through topics with which they could use more time and in-depth exploration. One of the chief theorized benefits of computer-mediated instruction is that the software facilitates increased student control over the learning process by allowing students to alter the pace of instruction and how the material is presented.

The promise of computer-mediated learning rests on the assumption that students will possess the motivation and academic autonomy to take advantage of the resources it offers. Computer-mediated courses afford students greater freedom and control over their course experience, but students may not all have the academic skills or disposition toward the course to benefit from this flexibility. Rather, students may flounder without the structure provided by lecture and instructor-dictated deadlines. Indeed, research has found that community college students in computer-mediated remedial math courses often struggle to meet course deadlines and fail as a consequence.16

Please note that the names of the community colleges in this study have been changed for the purpose of anonymity.

**Borough Community College: Computer-Mediated Hybrid Elementary Algebra Course**

According to the math department chair, about two-thirds of entering Borough Community College (BoCC) students need math remediation. The course I observed at the BoCC is identical to other elementary algebra courses at BoCC in terms of curricular content and sequence of topics. The redesigned aspect of the course is its more extensive use of computer-mediated instruction. While many elementary algebra courses at the college use computers as a supplement to instruction, mainly for homework, the course that I observed was intended to be a hybrid course, with about 50 percent of instruction delivered by the software platform. The course, which I will refer to as Hybrid EA, offers zero credit and includes five class hours and an additional, mandatory hour of tutor-led instruction per week.

Echoing perspectives in the literature, the instructor who developed this course reported that her main motivation for implementing a computer-mediated course was to use a delivery format that would engage students with wide ranging levels of proficiency and learning styles, and also because computer-mediated instruction, she believed, forced students into a more active learning role. The instructor intended to shape the course to benefit from this flexibility. Rather, students may flounder without the structure provided by lecture and instructor-dictated deadlines. Indeed, research has found that community college students in computer-mediated remedial math courses often struggle to meet course deadlines and fail as a consequence.16

Interviews and class observations surfaced two main themes in the student experience: how students felt about learning on computers and navigating instruction across multiple platforms and in different time frames.

When educators discuss computer-mediated courses, they often suggest that “millennials” prefer learning with computers.17 My findings do not support this assumption. While some students liked the computer-mediated aspect of the Hybrid EA course, there was a wide range of opinions about learning on computers and no preponderance in favor of computer-mediated instruction. A number of students noted that they liked the option to study independently with some support from the help features of the software, as the following quotes illustrate:

"Even if I’m not with my teacher at the moment at home, I could still go onto the computer and have something teach me at the end if I’m forgetting [the material]."

"I like the software platform because we can work on it at home, it gives us—" It shows us our mistakes, it shows us examples, it shows us explanations. It’s—it doesn’t get clearer than that and it’s—we get it practically for free basically because we’re in college."

But others found the variation in instruction confusing:

"...the computer teaches me differently than how I was taught to do things. And it wants you to answer it how they teach it or you can’t show your work a different way, even if you get the same answer. So, it’s confusing in that sense."

15 Borko et al. (2016).


Others simply did not like computer-mediated instruction:

“[The instructor] teaches fine to me. It’s just that I get confused because like on [the software] I’m on like a different subject, and once she’s teaching so I’m getting confused, mixing up what I’m doing on [the software] to what she’s doing in class”.

“I finished the graphing before she got up to it so—the [software] is more of a personal thing but it should be like—we should be—it should be in unison with the lessons because it’s kind of throwing kids off. It could throw us off because it’s like something very similar can have different rules and directions and need different explanations.”

The asynchronicity introduced in classes by computer-mediated instruction is always a challenge in hybrid and online courses. Students taught via software are usually encouraged to move at their own pace through the material. This means that, at any moment in the class, students may be at different points in the computer-mediated portion of the curriculum, making full-class instruction challenging. Because the Hybrid EA course was not designed so that the computer-mediated and classroom portions of the curriculum would be complementary, the problem of asynchronicity was particularly noticeable. The potential for the computer-mediated learning to serve as a complement to material presented in class, or vice versa, was not fully realized due to the lack of cohesion in the course design. A student’s observation captures this tendency well:

“Well I feel like [the software] could help, but it’s not going hand to hand with what the teacher is teaching, so it confuses me more then it helps if that’s the way it’s being presented to me.”

The data I collected at the college does not support the idea asserted by the department chair and instructor that computer-mediated instruction creates more accountability around homework completion. According to my observations in class and interviews with students, students did not use the software much outside of class time; they tended to do homework during class and missed the lecture as a result. The following excerpt from an interview illustrates this:

Interviewer: “So, okay, so you don’t do a lot of homework because you do the homework in class, how about other folks, how much time would you say you spend on average doing homework for this class?”

Students: “None.”

Interviewer: : “None, okay. How about you?”

Studentsz: : “Usually I’ll do the [software modules] in class while she’s teaching most of the time.”

I noticed during my visits to the Hybrid EA classes that many students worked on the software during the lecture. Rather than serving as a complement to instruction, the computer-mediated portion of the course frequently supplanted instruction during class time, functioning as an instructor-condoned distraction from long lectures, as this student put it:

“Because it’s a long class and I like to kill two birds with one stone, so we’re doing [software modules] at the same time as learning with her because I feel like, you know, it’s a very long class. Not necessarily slow, but sometimes she’ll be doing something and I’m kind of getting it anyway so I’ll go into [the software], and it’s okay because she tells us to do it anyways during class. So it’s kind of like we have an option to either do [the software modules] or pay attention to her lesson.”
The Co-requisite Course

Literature on Co-requisite Course Redesigns

Co-requisite remediation allows students referred to developmental courses to enter directly into introductory level, credit-bearing courses while simultaneously receiving extra academic support to address remedial needs. Co-requisite course structures can take a variety of forms: students may be enrolled in a condensed remedial course in addition to a college-level course in a single semester, or students may be required to attend tutoring or a math lab in conjunction with the college-level course. Or, as is the case in the course examined for this study, the co-requisite course curriculum may blend the remedial and college-level material into a single semester-long course.

The co-requisite redesign is primarily structural; its main innovation is to eliminate the requirement that students complete remediation before moving into college-level coursework. The more levels of remediation a student is assigned to, the less likely he or she is to complete them.18 Bailey, Jeong, and Cho (2010) found that the majority of students referred to remediation fail to complete course sequences not due to course failure, but due to failure to enroll in an initial or subsequent course. Co-requisite course structures minimize exit points in the remedial sequence, thereby reducing rates of attrition among students and increasing the rate at which remedial students earn college-level credit in math.17 The success of the co-requisite strategy rests on the assumption that students referred to remediation are capable of accelerated progress. The design of these courses often requires that students master more material in less time. Students with very limited proficiency in math and/or students balancing multiple responsibilities with their studies may find the time demands of co-requisite courses daunting.

18 Bailey et al. (2010).

17 Jaggars et al. (2014).


Riverview Community College: The Co-requisite Course

According to the course instructor, in the 2015-2016 academic year, 70 percent of incoming Riverview Community College (RCC) students needed developmental math. The majority of math classes offered at the college are developmental math classes. One reason for the creation of the co-requisite remedial course that I observed at this college, according to the instructor who also participated in developing the curriculum, was “to create some courses that get students through [the developmental sequence] more than we had been previously in a single semester.”

The course I observed at the college, hereafter referred to as the co-requisite (CR) course, combined college-level and remedial content into a single semester-long course. Thus, the CR course, in contrast to other courses examined in this study, was a credit-bearing math class.

The college offers two levels of remedial math: introductory algebra and elementary algebra. The CR course was offered to students who were placed into elementary algebra or had completed introductory algebra. The CR course was designed for students whose majors required algebra. Students whose majors did not require algebra could take a co-requisite statistics course.

The CR course combined the performance objectives of the college-level algebra and trigonometry course with the basic pre-college level algebra content that students need in order to master college-level content. The instructor observed that the CR course contains basically all the content of the college-level course and all the content of elementary algebra, or “a massive amount of content.”... The college-level course is a four-hour, three-credit course. The co-requisite course, in order to accommodate the extra content, is a seven-hour, three-credit course. The college-level course and the co-requisite course are designed to be equivalent in terms of their place in the curriculum and performance objectives.

Student assessment in the course was based primarily on exams, which account for 65 percent of students’ final grades. However, because the co-requisite course was a college-level course, students were not required to take the CUNY Elementary Algebra Final Exam (CEAFE) at the end of the course, as is required of students in remedial math courses. This is a significant aspect of the course design. At least one student I spoke to had done well in elementary algebra previously but failed the CEARF several times. She was finally directed to the co-requisite course by an advisor in order to avoid the requirement to take the CEARF.

STUDENT AND FACULTY EXPERIENCES

Curriculum designers of co-requisite courses often choose to cut material from the remedial course in the interest of paring down co-requisite curricula to a manageable amount of content that is necessary to pass the credit course. However, the co-requisite course implemented at RCC essentially combined two entire courses into a single course that covered all the material in elementary algebra and all the material in college algebra and trigonometry. The large amount of content covered in the course had consequences for teaching and learning.

19 Jaggars et al. (2014).

20 Bailey et al. (2010).

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Pacing of the course material came up repeatedly in interviews with the instructor as a critical source of tension in the course. Adequately covering all of the curricular topics was a challenge. The instructor had to make judgments about when to spend more time on topics that students did not understand, which topics were crucial for students to learn, and when it was necessary to move forward in order to have time later in the semester for subsequent topics.

“There’s a little bit of flexibility, but I think you also have to be, you have to make a judgment on how important is this topic? Because some things, you know, we really, really do need to get to. And you don’t want to miss important things later because you ran out of time because you were spending too much time on things early in the semester.”

Spending too much time on remedial topics may cause the class to miss topics later in the semester that are critical preparation for the next college-level course.

“Basically as far as freedom to respond to students’ needs when they need more time, there is some, but not a lot. Because the syllabus does have to be covered. Otherwise, it’s not fair to the stronger students. We said we’re going to teach you this much stuff. And if we don’t do it then we’re not doing our job.”

Balancing students’ need for review with the amount of material that must be covered is a challenge that confronts instructors in every academic subject and at every level. However, this tension may be exacerbated by accelerated and co-requisite models that attempt to cover a “massive amount of material” at an accelerated pace. This tension may also introduce a level of variability into course outcomes as different instructors may make different determinations about what topics are critical to cover.

Interestingly, students in the course reported that, in comparison with other remedial math courses they had taken—and failed—at the college, the pacing in the CR course was more manageable. Several students reported that the instructor that I observed was more attentive to individual students than the instructors they had had in the past and ensured that everyone understood the material before moving on.

“She definitely puts more effort into trying to help people individually. In my past classes, it was just like, ‘All right, we have six weeks to do this, every day something new, we can’t review anything.’ So it was definitely harder than what I’m going through right now. And they wouldn’t just go around and help you one by one. It was just like, ‘This topic, this, and that’s it, done, moving on.’”

“Cause like for [elementary algebra], the last time I took it I had a professor—he didn’t like answering people’s questions when it came to not understanding something. And he would kind of like teach the topics really fast.”

There was no particular approach to pedagogy recommended for the co-requisite course, so this instructor’s pedagogic practice should be credited to her, and not to any aspect of the course design. It is curious that the instructor—and previous research on co-requisite models (see Jaggers, Edgecombe, and Stacey, 2014)—perceived pacing as a major challenge in the course, while the students did not. This may suggest that skilled teaching that couples some review and attention to individual students can overcome the challenge of presenting a “massive amount of material” in a short time frame. Indeed, many students noted that this instructor managed time in the course well.

The large amount of course content also had the consequence of tilting the instruction toward procedural approaches to learning math over conceptual approaches. Procedural approaches, those that emphasize the memorization of equations and processes for solving equations, are faster than conceptual approaches. However, developmental math students may benefit more from learning concepts. In their paper examining what developmental students understand about mathematics, Stigler, Givvin, and Thompson (2008) noted that developmental math students, as a group, have poor conceptual foundations in math.

Without mastery of concepts, students are left with only a list of rules and procedures, which erode quickly from memory if unconnected to conceptual understanding. As a result, students tend to apply procedures inappropriately and incorrectly, resulting in poor course outcomes. According to the CR instructor observed that,

“A lot of [instruction] is still procedural in this course, because in my experience procedural learning takes less time. And we have a massive amount of material in this course to cover in a single semester.”

However, the course instructor noted that the cost of emphasizing a procedural understanding of math was that the students did not retain the material well. “Because as I say the procedural learning is faster. But what is going to be retained?” As a result, she encouraged students to take all their math courses in immediate succession. If students took a year or even a semester off between completing the co-requisite course and enrolling in pre-calculus, they may forget most of what was taught in the course.

A consequence of the course’s emphasis on procedural approaches to learning is apparent in students’ struggles with the content. In accordance with comments made by the course instructor regarding areas of the curriculum students found most challenging, many students reported that they struggled with word problems:

“I think I have had problems with word problems. I don’t have a problem with the math, like once I had an equation I can do it. It’s transferring it from a word problem into an equation that is my problem.”

Many students reported that identifying the correct procedure to use—when they were not provided with explicit guidance—was a challenge.

Additionally, the large amount of content covered made the class very time consuming for enrolled students. The class met for seven hours per week, and in addition to class time, students had to budget time outside of class to study. Given that allotting time outside of class for academic work is a challenge for many community college students, the time demands imposed by the co-requisite course may be unrealistic for some students. The course instructor’s quote below illustrates this obstacle.

“So I think there’s a conflict of expectations where [the students] expect it to be something that’s seven, maybe ten hours a week. But for a lot of students to really be successful, no it’s more like a twenty hours week. If they’re not particularly strong to begin with maybe more like a twenty-five, thirty-hour week commitment just to do well in this one class, and I don’t think that most students who come into the classroom consider that at all feasible.”
The Quantitative Reasoning Course

Literature on Quantitative Reasoning Redesigns

The quantitative reasoning course redesigns seek to address curriculum and pedagogy as major barriers to student success in traditional, algebra-based remedial courses. They operate on the assumption that developmental math students have had problems mastering math content through traditional teaching strategies and therefore require novel approaches to instruction in order to help students become college-ready.

This type of redesign seeks to address the emphasis on procedural—at the expense of conceptual—learning as a source of student failure. Research indicates that students need conceptual understanding to become truly college-ready in math. However, instruction in developmental mathematics often emphasizes memorization of rules and procedures, without developing students’ understanding of concepts that underpin mathematical procedures. Hinds (2009) notes that the emphasis on memorization of rules and procedures, as is typical of traditional remedial math instruction, is an adaptation that instructors use to accommodate the need for student acceleration. Many developmental math courses attempt to cover large volumes of pre-algebra and algebra content, causing instructors to rely on lecture and emphasize rules as more expedient approaches to instruction.

Additionally, proponents of quantitative reasoning interventions question why every student should be forced to complete an algebra-focused course sequence when many students do not go on to fields of study in which algebra is necessary. Further, algebra-based course critics also point out that students may be disengaged and lose motivation in algebra courses because the math is so abstract, and students fail to see the relevance of the content to their daily lives.

In response to these views of criticism, in 2012, the Carnegie Foundation for the Advancement of Teaching and Learning convened a group of community college administrators, faculty, and education researchers from across the country to design a research-driven curriculum that could serve as an alternative to traditional, algebra-based remedial math courses. One result of this work was the Quantway course, a quantitative reasoning curriculum designed to promote student acceleration through remedial math while engendering quantitative literacy. Some of the key reforms to the Quantway model involve presenting math in applied, real-world contexts and altering pedagogy to promote conceptual understanding of math in addition to procedural fluency. Because the Quantway model requires instructors to teach differently, the program also entails significant professional development for instructors.

The quantitative reasoning redesign operates on the assumption that, in order to be successful, developmental math students need to be taught in a different way than what they encountered in K-12 schooling. The redesign entails significant shifts in how students are asked to engage with course content and how instructors teach. The success of the quantitative reasoning redesign hinges on faithful implementation of the course model. But, as I found in interviews and class observations, implementing the changes to stakeholder behavior that are critical to the reformed nature of the course is often challenging.

Uptown Community College: The Quantitative Reasoning Course

Uptown Community College (UCC) offers three levels of algebra-based developmental math courses: basic arithmetic, elementary algebra, and intermediate algebra. The Quantitative Reasoning (QR) course was an alternative available to students who were placed into elementary algebra via the placement exam or who had completed basic arithmetic. QR is a zero-credit, four-hour course (the same as elementary algebra). The course was only offered to students who did not require intermediate algebra for their major. Students who completed QR were eligible to enroll in one of the credit-bearing mathematics courses that completes the mathematics requirements for liberal arts and humanities majors. There was still considerable demand for traditional developmental math courses at the college due to the large number of students pursuing majors that require algebra. As a point of comparison, the college offered seventeen sections of QR and around a hundred sections of elementary algebra.

According to the math department chair and a course instructor, the catalyst to adopt the QR course at UCC came from poor pass rates in traditional algebra-based developmental math courses offered at the college. The college no longer uses the official Quantway cur-
be exposed to topics in multiple contexts, and that this will enable them to make connections not just covered a single time. The idea behind this “spiraling” approach is that students will support and facilitate but also engage in limited direct instruction.

Another pedagogic feature of the course is that topics are revisited throughout the semester, independently or in collaboration with other students in order to arrive at solutions on their own. The instructor noted that the course design emphasizes that the instructor should not only support and facilitate but also engage in limited direct instruction.

Another pedagogic feature of the course is that topics are revisited throughout the semester, not just covered a single time. The idea behind this “spiraling” approach is that students will be exposed to topics in multiple contexts, and that this will enable them to make connections between math concepts and develop mastery of topics through repeated exposure. Additionally, according to the instructor, the course has more time flexibility than the elementary algebra course. The content is paced to devote an entire class period to every topic and sometimes more than one for more difficult content like modeling. Thus, instructors should be able to be more responsive to students’ needs if they require more instruction on certain parts of the curriculum.

The assessment structure of the QR course also contrasts that of the algebra-based developmental courses I studied. In QR, students were assessed based on a wider range of activities including attendance, class participation, homework, and exams. In contrast, the algebra-based course assessments were based primarily on exam performance. This dis-bursed assessment is an intentional aspect of course design. Of course, some stakeholders believe that demonstrating proficiency on exams is critical to assessing whether students have mastered the content. From this perspective, the more distributed assessment in the QR course is a way in which the course is “watered down,” thus producing better student outcomes by lowering standards.

STUDENT AND FACULTY EXPERIENCES

Many students appreciated the contextualized course content and the use of group work and student inquiry. However, the theorized benefits of student engagement, productive struggle through independent work, and spiraling content were premised on the expectations of student involvement that did not always align well with the actual behaviors of many developmental math students.

When I asked the instructor to describe opportunities related to the course, he said that benefits come when he fosters more group work or a higher level of engagement, “you get the ‘ah ha’ moments when things start to click for the students.” He added that, in his calculus classes, he often does not know if students understand the material until the exams. In the QR course, he can tell immediately if students do not understand due to the high level of instructor-student interaction that the course design mandates.

A number of students reported that they liked the different pedagogical approach that supported group work and student inquiry:

“I really like how it’s—this math—how it’s set up. I like how there are groups and there are conversations. It’s more of like working together type of thing rather than just like sitting in a class and watching the professor talk the whole time, it’s more engaging, it gives you more focus.”

“I like in our class we usually are set in groups and the professor will always review everything and shows that he cares for the students. It kind of helps you, like it keeps you more motivated to continue, like a student could help me if I don’t understand something so I feel that it helps a lot.”
The instructor reported that enforcing group work was one of the biggest challenges of course implementation. Students frequently resisted working in groups. In the course that I observed, about 60 to 70 percent of the students worked in groups, often in pairs with their neighbor. However, I only observed a single section of the QR course, it is likely that there is significant variation across course sections in terms of the extent to which group work is utilized.

Many students liked the fact that the math was presented in a contextualized way it made what they were learning seem useful and relevant. This student, who was planning to go into construction, commented as follows:

“Well, I like the course so much that if I pass this course, I’m going to take the credit one (the college-level QR course), because it’s really, it deals with real-life situations. And that’s what I want, because that’s how I focus. And we use real-life situations in math, like with the whole like income, and you know like what’s the percentage of this? And like what’s the poverty line and population, the density. I like that because I’m—if I’m going to get into like you know building things, I’m going to have to know like square yards and units and all that.”

Other students remarked that the contextualized nature of the curriculum made it easier to learn the mathematical concepts. The fact that math was presented in terms of concrete, real-world examples made it easier to grasp and helped to illuminate the logic underlying the mathematics. In the following quote, the student contrasts the pedagogical style in QR to that in Intermediate Algebra:

“But like in [QR] it’s explained why we’re doing this, so even if you’re confused, you can always go back and understand like the relations between each of the steps and numbers and whatever, and why we’re doing it. But and like [Intermediate Algebra] was more like oh you just gotta do this. Like in order to get this answer, you just have to do this. And to me it’s like very hard because it’s like I don’t make sense of it as well as I do in [QR], it’s a whole different teaching.”

One of the major drawbacks of the QR reform is that it relies on fidelity to the course model including effective instruction and that students display a level of engagement and willingness to work collaboratively. These factors, which are crucial to the reformed nature of the course, are difficult to implement. The instructor noted that there is frequently a gap between the course design and implementation.

When I asked students what they liked most about the QR course, the vast majority responded that it was the instructor, raising the question of how much student experience in QR is dependent upon the strength of the instructor. In the following quote, a student makes a similar observation of whether the gains she made in the course would be sustainable with a different professor in her next math class:

“[QR] changed my perspective about math a little bit. Only because of [the instructor]. But watch me go into another class next semester and it’s not him, and the teacher is just the opposite of him and I’m just going to be like—why am I here? Exactly. Zero stars.”

The course also relies on student collaboration and engagement, and some level of consistency in their behaviors, but these do not always materialize. Despite the fact that the course was designed to engage students, student engagement remains a barrier. In the class I observed, a substantial number of students in the class (approximately 60 percent) appeared engaged and worked through the material on their own or in small groups. However, there were also students who were obviously disengaged, stayed on their phones throughout the class, and appeared to be lost with the material. I also observed that when they were not directly interacting with the instructor as he circulated the classroom, students would visibly disengage and become passive. They would start playing with their phones or stare off. Without the instructor’s direct attention and support, many students appeared not to know how to proceed and had no strategies to make progress independently. When I shared this observation with the instructor, he said that ideally as the course progresses and students become more proficient with the material, they should develop more academic autonomy and more stamina for tackling and solving problems on their own, but this does not always happen.

Finally, in contrast to the algebra-based developmental courses, the QR course is designed to have more time flexibility, and thus respond more readily to students’ needs for pacing through material. For example, the class always started with a review of material presented in the previous class, additionally, the course is designed to revisit concepts over the course of the semester. However, students with erratic attendance or who routinely came to class late benefitted less from these aspects of the course design. The course instructor described the following frustration:

“Definitely no cohesion is present at all, it’s like each class is going to start over again. It’s like I’ve got to give a mini-lecture of what happened the previous class and you know that’s a little frustrating.”
Faculty and Student Experiences Across Redesigned Developmental Math Course Models

Experiences Across Colleges

Common Faculty Experiences Across Colleges

So far, this report has described faculty and students’ experience in specific reform contexts. However, there were common faculty experiences with instruction across the three colleges and developmental math courses I studied. Across the colleges, the faculty discussed a common perception that community college students are not traditional students who can focus singularly on academic work. Furthermore, the faculty observed that remedial students tend to exhibit poor academic behaviors in terms of homework completion and class attendance. Finally, faculty, like students, expressed frustration at the stubbornly poor student outcomes in remedial mathematics.

Faculty considered competing demands for community college students’ time and attention to be significant barriers to success in remedial courses:

“*The other challenge that many of my students come from backgrounds, maybe they’re supporting families. They have two jobs, two or more jobs, and they need to find time to do the math. I mean there’s other responsibilities that are going on with my students. And so that’s a challenge. So somewhere in the middle of all of that we need to find a way so that the math will come alive to them. So those are challenges outside of the classroom.*”

“A lot of the students in general at [college] have a lot of outside commitments. Large numbers of them are working adults, so they have a job and this is kind of their second job. So, oh, families, a large number of them have kids. Or, take care—or are caretakers for like adult parents. So just a lot of outside responsibility is very, very common for our students; a lot of them, even if they’re traditional age, are expected to contribute financially to their household. So, they don’t have a lot of time. It’s not—you know some of them just can’t make time outside of class, which is unfortunate, because that means they also don’t have time to study. They budget time to go to class, but they don’t have time in their schedule to really spend any time on their academics outside of going. So I guess that’s a big one. Is that a lot of our students have a lot of commitments that aren’t in their—that aren’t just being a student.”

While it was a common perception among faculty that students did not have the time to devote to their academic work due to competing life priorities, my data and research conducted by the CUNY Office of Institutional Research and Assessment do not confirm this view. Of the forty-one students that I interviewed, thirteen reported having a job. One student in the study had a child. It would be an interesting avenue of future research to investigate why faculty perceptions of students’ outside responsibilities differ from what students report.

For whatever reason, faculty reported that developmental math students did little work outside of class. Faculty at the three colleges observed that these students tend to have weak academic behaviors in terms of persistence, attendance, and homework completion, and that this—more than challenges with math content—is central to their failure in remedial courses. The following quotes from two faculty members describe the lack of independent work among developmental math students.

“*Here is a reality: in developmental math classes, students tend to do nothing outside of the class. Whatever they do, whatever practice they get, whatever motivation they receive, it all comes from the faculty only. They do not tend to do the homework; only better students do, but the majority just do not do anything in my experience, anything outside of the class.*”

“*Because most of the students have not shown—who were placed at this level, do not show much in the way of desire to learn on their own.*”

It is difficult to disentangle poor academic behaviors from weak proficiency with math. Failure and withdrawal of effort tend to be mutually reinforcing. As a result, faculty stressed the importance of keeping students motivated and persuading them that they were capable of doing the math in order to help them continue to put forth effort in class.

Finally, faculty described their sense of frustration at watching large numbers of students fail these courses semester after semester.

“I think in other disciplines they don’t realize it’s like how—they’re like, “Oh, well, you know, it’s a bad day when like you’ve got a bunch of C’s,” it’s like, no, that’s a good day for me! That’s a good term! So it’s discouraging, but you know, you keep trying and it works and some of them get through and hopefully the ones that get through do understand it well enough that when they move on they’re not at a disadvantage in like pre-calculus and that they can, you know, hopefully it’s a good foundation.”

In the following quote, a faculty member observed that his frustration with the course outcomes and his inability to reach all students in the class affected the way that he taught. It caused him to abandon the course model and resort to more expedient strategies for teaching, although he realized that this was pedagogically incorrect for the course.

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"I do feel disappointed, I do get frustrated and I try to, especially at the beginning to be like, 'okay let me give them another chance, let me try it again, let me try a different strategy,' but when I keep seeing that, you know, that they keep not being responsive, I kind of transition more towards direct instruction because then I am losing hope for them that they can do anything on their own, so I’m starting to teach more as a direct instruction way."

Common Student Experiences Across Colleges

There were also aspects of the student experience in CUNY developmental math courses that were common across the three colleges and courses. All the students I interviewed for this research discussed challenges related to their initial placement into developmental math courses including testing and advisement. Another unfortunate common experience among students was failure in previous remedial courses. Finally, students across the courses expressed a strong preference for “caring” or individually attentive instructors.

Many students, particularly those entering college directly from high school, were shocked and discouraged to have been placed into developmental math. The following quotes from two female, traditional-aged, Latina students illustrate their sense of disappointment when they failed the CUNY placement test.

“I felt stupid when I failed. I was like, ‘how can I possibly fail this?’ I think it was thirty [correct] out of 100. I was like ‘this is horrible.’”

“When I took my placement test, since I wasn’t good at math in high school, and then I failed my placement test I felt really discouraged. I wasn’t even going to come to school, and I was ready to join the army and I signed papers and everything. But then I met a friend and she kind of talked me into at least trying and that’s why I am still here.”

Additionally, many students claimed that they had scored close to the college-ready benchmark on the placement test but had not been given opportunities to retest, even when they requested them. They were also not referred to shorter, alternative remedial interventions for students close to being college-ready. Starting in fall 2017, CUNY introduced an automatic re-test policy for students who scored close to the cut-off on placement tests. The central administration has also recommended that colleges offer more targeted summer interventions of short duration for students close to meeting college-readiness.

Of the forty-one students who participated in interviews, sixteen had failed a remedial math course previously, some of them more than three times. Many students had performed well on assignments and tests in a previous course but failed the final exam that was required for exit from remediation. One twenty-two-year-old Latina student described her experience: “I took [intermediate algebra] three times... and because in the exam that you had to take in the end, I failed it every time.”

Note that CUNY has since removed the requirement that students pass a stand-alone exit test and instead made the test one component of an overall course grade.

Others struggled with the courses throughout:

“When I finished [elementary algebra] I was motivated, and then in [intermediate algebra] I failed every assignment like every test on there. It was like a whole cycle type of thing where I felt so insecure, like I actually stopped going to the classes because I just didn’t think I was going to pass at all.”

Unfortunately, as this quote illustrates, there is a mutually reinforcing dynamic between failure and negative academic behaviors that will likely bring about failure.30 When students feel lost, they are less likely to complete homework assignments and attend class regularly. Additionally, the negative sentiment that arises as a result of repeated failures in remedial math becomes an additional barrier to success. The following quotes from traditional-aged, white, male students at two colleges depicts the level of frustration that students reach after repeated failures. Both of these young men had failed courses three or more times.

“I keep on trying to pressure myself to keep on doing better, and it’s just like every time I try my best, I fail. So it’s like what’s the point of trying anymore if I’m going to just keep failing? I’m just going to be stuck in remedial until I can’t frickin’ graduate.”

“Because I’m just extremely angry and frustrated at math in general. My least favorite thing [about the course] is that it’s a math class.”

Many students reported that they had received little or no information about the type of remedial course in which they enrolled. As a consequence, most students did not know ahead of time that they had enrolled in a redesigned course, or any of the innovative aspects of the course design. For example, one twenty-two-year-old international student reported the following about advisement into the co-requisite course:

“Honestly, [the advisor] didn’t explain me nothing. There was really weak advising. She told me like, ‘Oh, according to your, you know, assessment tests, rules, and your major, you have to take [this] English class and [the co-requisite] math—you know. Kind of like, ‘That’s what’s requested for your major and you’re not going to be able to take like more classes this semester.’”

Students also reported that they were not made aware of the “menu” of remedial courses available at their colleges. The following student lamented learning about the redesigned course option only after multiple failures in traditional remediation:

“They never told me about [the redesigned course]. I wish I would have known that from the beginning because I wouldn’t have wasted three classes that I failed, I wasted.”

Perhaps unsurprisingly, students’ experiences with instructors—either positive or negative—strongly affected their experiences in courses. One theme that emerged clearly from students was that they valued teachers who cared about the subject and the students, and they made it clear that they were invested in individual student success. The following quotes illustrate this point:

“He wants to make sure that you understand, and if you don’t understand in the way that he’s teaching, he will try to find another way. Alternate ways. That’s why I haven’t dropped his class yet.”

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“I guess because teachers I’ve had in the past, they never like explained it to the point where it’s like to my understanding. That’s why I guess I had so much trouble. But it was like—I actu-
ally—like and I knew I wasn’t going to pass those classes, but like this time like I actually feel like I’m going to pass his class because of the—the way he explains things to me. And like the way he like cares so much about if I learned it or not.”

“And then, she’ll just give individual, like she gave a—like a problem that we have to solve individually. And then, she goes like individually person-to-person and explains a little bit personally, you know, like, ‘No, this way. Think about this part here. This is how it’s supposed to be. Which I find really helpful because everyone has like the different—like different points like something that they don’t understand or like we just mess up everything. So to me, it’s helpful what she does.”

The preference for individualized attention from instructors was one of the strongest themes to emerge across student focus groups. Students responded positively to instructors who they felt cared about the topic, students’ success, and students individually.

Finally, a theme that emerged across all stakeholders and colleges was a commitment to improving student outcomes in developmental mathematics. Faculty and department chairs reported that they considered building foundational skills to be an important aspect of their work. Both faculty and students displayed grit and persistence in the face of the often-discouraging outcomes. Despite frustrations and disappointments, I observed that the instructors always gave students the benefit of the doubt, truly wanted all their students to be successful, and did everything possible to bring about their success. Students, particularly those with multiple failures, faced formidable barriers, but most kept trying to complete remedial courses and pursue their goals.

**Recommendations**

In 2016, CUNY convened a Developmental Education Task Force to examine research, consult stakeholders, and make recommendations to improve student outcomes. As part of this work, many CUNY community colleges are currently designing new developmental math curricula and piloting a range of course models. I applaud CUNY for the extensive work the system is undertaking to improve student outcomes in developmental mathematics. In order to strengthen these efforts, I offer the following recommendations based on insights from data collection:

1. **Inform students about remedial options and consider best fit.** With the amount of institutional energy being devoted to remedial math redesigns and creation of more math pathways for students, an important corollary to this work is to ensure that advisors and faculty members can inform students about the options available to them. Importantly, because different course redesigns may be better suited to different kinds of students, those providing advice should focus on finding the best fit between course structure and demands and the students’ preferences, proficiency level, and amount the of time the student can realistically devote to the course. Advisement offices might consider developing a one-page summary of all the remedial courses to pass out to students. These sheets could include information on eligibility requirements, what type of student the course is designed for (i.e., STEM versus non-STEM majors), how time intensive the course is, the expected amount of work outside of class, the technological components of the class, expectations regarding group work, and average pass rates.
2. Prevent repeated failures by recommending students to redesigned courses. Because remedial math courses have low pass rates and these courses are mandatory for academic progress, it is common for students to repeat remedial math courses. Given the damage to student morale inflicted by repeated failures, it would be beneficial to create systems to identify students who have failed and re-enrolled in remedial math and evaluate whether these students can be referred to redesigned course models in which they may be more successful.

3. Address broad problems with academic behaviors. Faculty members argue that weaknesses in academic behaviors are more significant barriers to student success than challenges with math content. It may be beneficial for colleges to take a more holistic approach by teaching students to strengthen their academic behaviors, including consistent attendance, homework completion, and efforts to seek appropriate help. Addressing problems with academic behaviors is no easy task and should not fall on the math faculty alone. Faculty and administrators observed that policies are in place to create accountability around homework and attendance, but these are largely ineffective. Thus, faculty and course designers may want to consider how to structure class time and create in-class incentives to reward strong academic behaviors.

   a. Explicitly describe the academic behaviors required for college success in class and during general student orientations.
   b. Create in-class time for students to work on homework assignments with the individual support of faculty and/or tutors.
   c. Structure class time in a way that incentivizes punctual attendance. For example, faculty may want to avoid offering reviews or other course elements at the beginning of class time for which students feel they do not need to be present.

4. Beware of tension between accelerated progress and mastery of content. Most reforms to remedial math seek to move students into college-level courses as quickly as possible. As a result, tension arises in many course designs between the impetus to move students quickly through large amounts of content and developing mastery of topics in the curriculum. For students with weak foundations in math and possibly competing priorities for their time, accelerated models may be particularly challenging. Colleges should consider what demands are placed on students in accelerated courses, including high numbers of hours in the classroom per week, large amounts of curricular content, and significant expectations for homework or other independent study, and seek to provide academic and/or non-academic supports to enable students to meet course demands. Given that remedial students may have weak independent work habits and time constraints or competing priorities, academic supports may be more effective if they are offered during course time.

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