Edward J. Bloustein School of Planning and Public Policy

Mathematics Immersion Program Evaluation

A Report to the Office of the Secretary of Higher Education of the State of New Jersey

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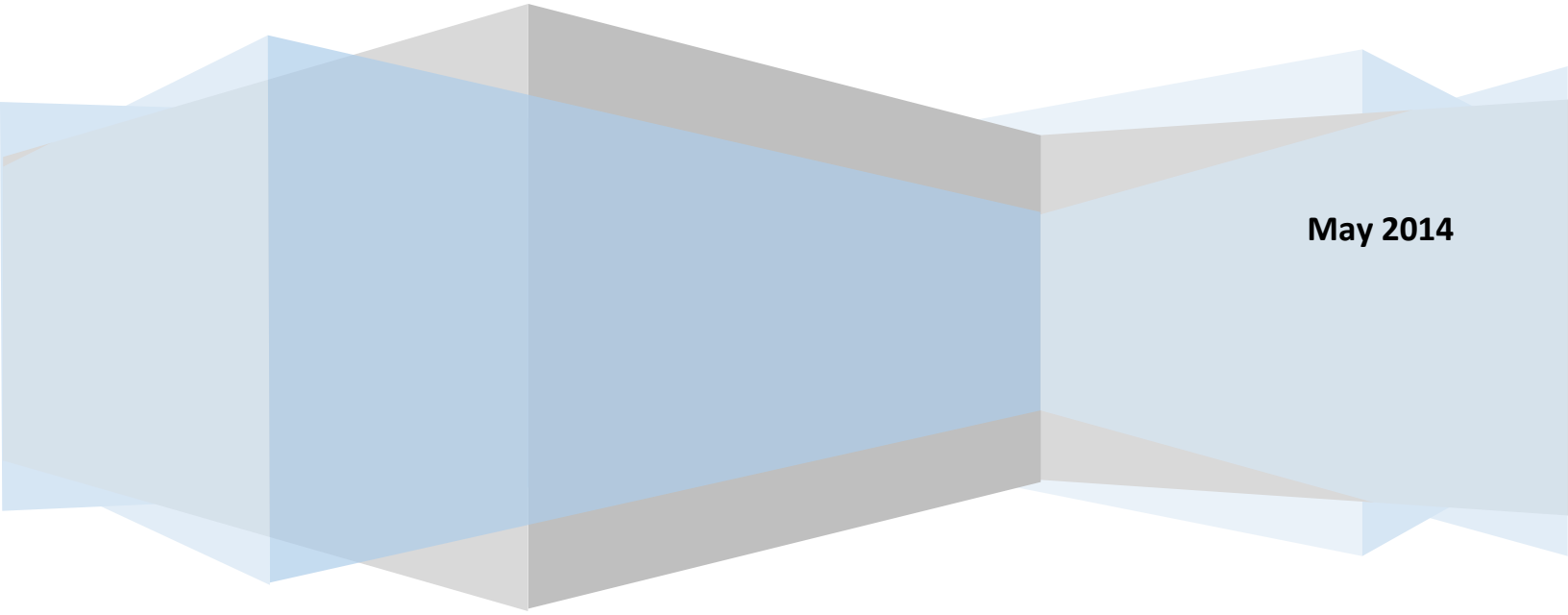

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Executive Summary

The New Jersey Office of the Secretary of Higher Education commissioned us to evaluate the performance of the Mathematics Immersion Program (MIP) at Stevens Institute of Technology from the years 2008 to 2013. The MIP provides a select group of students receiving Education Opportunity Fund (EOF) assistance the opportunity to improve their mathematics skills during an intensive three-week summer program. The New Jersey Department of Higher Education and the Educational Opportunity Fund Office established the MIP in 1985, and it has been housed on Stevens Institute's campus since its inception. The last systematic evaluation of the MIP occurred in 1990-1991. As such, it is necessary to understand whether the MIP is currently achieving its goals, and to determine how it can be improved.

In this report, we attempt to understand the degree to which the MIP has succeeded in reaching its stated goals, which are: 1) "To encourage students to pursue more advanced courses in mathematics," and 2) "To help students gain more confidence in their ability to succeed in technology majors."[1] Encouraging students to major in mathematics, engineering, and science is currently the main focus of the MIP, but it also attempts to help students develop other skills, such as presentation and computer literacy skills. Thus, our analysis includes the consideration of math and non-math outcomes. We assess the academic performance of students before and after MIP participation and include the viewpoints of various stakeholders.

For consistency, we maintain many of the indicators used in the previous report (such as, graduation rates, choice of major, and grade point average). The bulk of our analysis derives from student transcripts, but we also complement the transcript analysis with interviews of EOF Directors from sending and non-sending institutions, key MIP personnel from Stevens Institute, former student participants of MIP, and an analysis of MIP pre-test and post-test scores.

[1] Mathematics Immersion Program, http://web.stevens.edu/mip/cgi-bin/program.php

Our findings suggest that students' dramatic improvements in MIP pre- and post-test scores do not typically translate into success in math coursework at their home institutions. Our primary findings are as follows: First, the transcripts revealed a pattern of student withdrawals from math courses after MIP participation. Second, the program does not appear to be effective in encouraging students to declare math majors. Third, the passing rate of students in all coursework improved significantly after MIP participation, although there is no statistically significant increase in the passing rate of math courses in particular. Fourth, the majority of students were deemed to have positive academic outcomes (i.e. have completed a degree or are in progress toward a degree with a C average or above), while less than one-fourth have had negative academic outcomes. Finally, our interviews with EOF Directors, MIP personnel, and former students revealed overwhelmingly positive attitudes toward the MIP, though they also identified some need for improvement.

To improve the program, we recommend that the MIP should target students who do not necessarily plan on majoring in a math intensive major, but still need to fulfill certain math requirements; and students who suffer from math anxiety and/or need a greater level of confidence and study habits to succeed at college level math. We also make more specific recommendations regarding the functioning of the MIP program, such as awarding students a certificate for successful completion of the program.

1. Introduction

Higher education has been the focus of public policy debates for decades. Among the most pertinent topics relating to higher education are student debt, rising tuition costs, and whether colleges and universities are supplying students with the necessary skills to compete in a global economy. This report will hopefully inform the debate relating to skills, while also providing practical recommendations to improve the MIP program.

The number of college remediation courses has expanded in recent decades, and more money is being spent on ensuring college students' skills approach the college level. The MIP is a specific math remediation program, established in 1985 by the New Jersey Department of Higher Education and the Educational Opportunity Fund (EOF). It is administered by Stevens Institute of Technology with the goals of: 1) improving EOF students' math skills, 2) increasing students' confidence in math and ability to persist in math and math-related courses, and 3) demystifying math and decreasing students' math anxiety.

The MIP targets New Jersey EOF students, who are low-income and first-generation college students. EOF students disproportionately belong to racial and ethnic minority groups, and many are not native English speakers. This population is statistically less likely to graduate from college and work in well-paying jobs. They often lack the resources that facilitate success in college and the workplace, such as economic, social, and cultural capital. The EOF program in general and the MIP in particular, are attempts to reduce inequalities between these students and the broader population and to improve educational outcomes for these students. As such, it is necessary to understand whether the MIP is achieving its goals and in which ways it can be improved.

Unfortunately, remediation courses, especially math courses, do not have high rates of success. Fixing this problem in its entirety is incredibly difficult, and it is by no means the goal of this report. Rather, our goal is to identify the positives and the negatives associated with the MIP,

and to offer ideas on how to fix the negatives while maintaining the positives. While the MIP encourages students to pursue careers in mathematics, engineering, and science, the program also attempts to build other skills in students, such as presentation and computer literacy skills. Thus, our analysis includes the consideration of both math and non-math outcomes. We assess the academic performance of students before and after MIP participation and include the viewpoints of various stakeholders.

In this report, we seek to update the previous evaluation of the MIP, conducted in 1990-1991, while also building upon it. For consistency, we maintain many of the indicators used in the previous report (such as, graduation rates, choice of major, and grade point average). While the bulk of our analysis derives from student transcripts, we also complement the transcript analysis with interviews of EOF Directors from sending and non-sending institutions, key MIP personnel from Stevens Institute, former student participants of MIP, and analysis of MIP pre-test and post-test scores.

We provide recommendations based on findings from these analyses. Our recommendations include broad areas, such as the need for MIP personnel to redefine the program's goals, as well as specific areas, such as the advantages of awarding students a certificate for successful completion of the program. The major limitation of this study is the lack of a control group. Thus, we cannot state with confidence that our findings were *caused* by MIP participation.

The remainder of the report is organized as follows. Section II reviews the literature on college-level remediation and successful and unsuccessful models. Section III describes our data and methods. Section IV explains our findings, including our transcript and interview analysis and provides examples of students with typical positive, negative, and indeterminate academic outcomes. Section V includes our recommendations for improving the MIP. Lastly, Section VI includes the appendix.

2. Existing Knowledge on Math Remediation

Ideally, most students should enter colleges and universities prepared to enroll in college-level mathematics courses, and those whose math skills are too low for such courses should be able to bridge the gap with successful remediation programs. That is not the case, unfortunately in many universities around the country. Researchers from the Carnegie Foundation for the Advancement of Teaching summarized the state of remedial math education: "The academic success rate of developmental mathematics students at community colleges is alarmingly low." Of the 14 million community college students in the United States, over 60 percent (about 8.4 million) enroll in remedial math courses, and 80 percent of such students (about 6.7 million) do not complete college level math courses within three years (Van Campen, J., N. Sowers, and S. Strother 2013, page 2).

Approximately one-third of all college freshmen are underprepared for college-level math courses, and the problem is especially acute among female, Black, Hispanic, and low-income students (Long, Latarola, and Conger 2009). One study, which looked at first-time freshmen who enrolled in a public two-year college in Ohio in 1998, found that nearly 62 percent of female students were placed in math remediation, compared to 54 percent of male students. Additionally, more than three-fourths of Black and Hispanic students enroll in math remediation courses, compared with 55 percent of White students (Bettinger and Long 2005). As of 1999, 46 percent of U.S. college students with more than 10 credits have taken at least one remedial course (Hagedorn, Siadat, Fogel, Nora, and Pascarella 1999).

Students who take math remediation courses are different from non-remedial students in certain key metrics. The Ohio study mentioned above reported that remedial math students had "lower high school GPAs in math, had taken fewer semesters of high school math, and scored lower on both the overall ACT and the math portion" (Bettinger and Long 2005). Non-remedial students also have certain advantages when it comes to family achievement. Parents of non-remedial students are more likely to have achieved higher education and higher total income. They are more likely to encourage their children to attend college. Non-remedial students also have better

study habits than do remedial math students. Non-remedial students reported spending more time studying in high school, and they earned higher high school grade-point averages in college. Also, non-remedial students are more likely to study cooperatively with other students (Hagedorn, Siadat, Fogel, Nora, and Pascarella 1999).

Students who take remedial math courses perform worse in college than do students who do not take such courses. According to the same Ohio study, on average, students who enrolled in mathematics remediation courses completed 5.4 fewer course credits than those who were not in remediation. Students in remedial math courses were also 15 percent more likely to have dropped out without a two-year degree, and four year students were 3.6 percent more likely to have dropped out without a degree. Full-time remediation students were 4 percent less likely to have completed a four-year degree and 11 percent less likely to have completed a two-year degree within five years (Bettinger and Long 2005).

One study looked at students who took remedial math courses at community colleges, and found that the rates of completion and transfer were quite low. Among students who initially enrolled in remedial math courses and ended up completing at least one college-level math course, about 19 percent did not transfer or receive a degree; 10.5 percent received an associate's degree, and about 70 percent transferred to a four-year institution. Among students who initially enrolled in remedial math courses, but failed to complete a college-level math course, only 6 percent ended up earning an associate's degree and only about 9 percent transferred to a four-year institution, with or without an associate's degree. Among these students who did not complete a math course, 81.5 percent failed to receive a credential or transfer to a four-year institution (Bahr 2008). Approximately thirteen times as many students did not complete a math course as did complete one.

Many remedial math students are unprepared for the remedial coursework. According to a 1995 study from the United States Department of Education, "Failure rates are also high in remedial courses in both math and English. A significant proportion of remedial students have academic

backgrounds so weak that they cannot complete even pre-collegiate courses" (Adelman 1995, page 267). About three-fourths of remedial math students do not remediate successfully, which means that they fail to "achieve college-level math skill" in their remedial courses (Bahr 2008, page 421).

Students who do successfully remediate have much higher rates of accomplishment. In fact, one researcher found that students who successfully remediate and students who were not required to take remedial courses are "indistinguishable from one another in terms of credential attainment and transfer." The researcher argues that "it is clear that mathematics remediation is extremely effective for students who remediate successfully" (Bahr 2008, page 446).

The existing literature paints a dreary picture of mathematics remediation programs. This should not be construed to mean that all math remediation programs are necessarily doomed to fail. For example, New York City's Hunter College developed a fairly successful mathematics remediation program in the early 1970s. Hunter College spent several years tweaking its approach to determining who is qualified to enroll in remediation programs. In addition to remedial coursework, poorly prepared students enrolled in a freshman orientation seminar, in which they learned about "study habits, note taking, test and exam taking, academic rules and regulations, decision making, program planning, and choice of major." Freshmen students who passed Hunter College's remedial math course, Arithmetic and Topics in Algebra (ATA), achieved statistically significant higher outcomes than those who did not take or pass the course, even controlling for high school G.P.A., age, and scores on Hunter College's entrance examinations. This course "was the single most significant factor . . . in retention for freshman entering in 1974," and students' G.P.A. were .63 points higher on average than those who failed to complete the course. It should also be noted that 83 percent of students completed this course (Baranchik and Ladas 1979, page 3).

Another example of a successful mathematics remediation program is the Community College Pathways Program, developed by the Carnegie Foundation for the Advancement of Teaching, the

Bill and Melinda Gates Foundation, the William and Flora Hewlett Foundation, the Kresge Foundation, the Carnegie Corporation of New York, and Lumina Foundation in 2009. There are two "pathways" for students to follow: Statway and Quantway. Both pathways are two semesters long, and they offer the chance for remedial students to catch up on their math skills while also receiving college credit. Statway focuses on algebra and statistics, while Quantway centers on quantitative reasoning.

In the inaugural year, 1,133 students across the nation were enrolled in Statway, and its enrollment reached 1,553 students in its second year. Quantway's enrollment figures were more modest at first, with 418 students in year one, but rose to 1,402 students in year two.

Only 4.6 percent of Statway students were deemed ready for college level math courses. Still, 49 and 52 percent of Statway students successfully completed the program in the first two years; success here is measured as receiving a C grade or higher. In contrast, among remedial students who did not take Statway, only 5.9 percent received college credit in mathematics after one year, only 15.1 percent after two years, 20.4 percent after three years, and 23.5 percent after four years.

Not a single Quantway student was equipped with college-level math skills at the beginning of the program, yet 56 percent received a C or higher in year one, and 52 percent received a C or higher in year two. By comparison, only 20.6 percent of remedial math students finished their remediation within one year, 28.5 within two years, 31.6 after three years, and 33.3 percent after four years. Researchers from the Carnegie Foundation for the Advancement of Teaching note that the completion rates for Statway and Quantway students are "dramatically higher than the typical completion rates of other developmental math students" (Van Campen, Sowers, Strother 2013). Along with the success of Hunter College's mathematics remediation program, Quantway and Statway demonstrate that it is possible to design programs that successfully improve math skills.

3. Data and Methods

To conduct a thorough analysis of the MIP, we collected both quantitative and qualitative data. Through cooperation with the New Jersey Office for the Secretary of Higher Education, we obtained the list of institutions that sent students to the MIP since 2008 and the number of students that each institution sent per year. The number of students sent by each institution from 2008 to 2013 is found in Appendix A. We then contacted the EOF Directors from each of these sending institutions requesting their participation in an interview via phone or in person. The interviews focused on the need for remedial mathematics courses at the institution, the ways in which students are made aware of the MIP, and the outcomes for students after participation in the MIP. We interviewed fourteen EOF Directors from the 23 sending institutions who responded to our inquiry, for a response rate of 61%.[2] We did not detect any noticeable differences between the Directors who responded to our request and those who did not. Our interview protocol for EOF Directors is included in Appendix B.

We also obtained contact information for 10 MIP personnel from Stevens Institute. These included staff members, professors, and tutors. We requested interviews from all ten individuals. We conducted interviews with the seven members who responded, for a response rate of 70%. Our goals with these interviews were to understand the process through which institutions are made aware of the MIP, the mathematical needs of MIP participants, the benefits derived from MIP participation, barriers to achieving these benefits, and the structure of the MIP, in general. Again, we did not detect any noticeable differences between those who responded to our request and those who did not. The interview protocol for MIP Personnel can be found in Appendix C.

From our interviews with EOF Directors from sending institutions and MIP personnel, we gathered contact information for 18 students who participated in the MIP between the years 2008 and 2013. We contacted each of these students and requested their participation in an

[2] In two cases, we were referred by EOF Directors to their assistants and conducted the interview with the EOF Assistant Director.

anonymous online survey. The survey questions focused on the preparedness of students for taking college-level mathematics courses, students' career goals, the usefulness of the instructional materials used in the MIP, the structure of the MIP, and outcomes of MIP participation. We received eight responses, for a response rate of 44%. The survey instrument is presented in Appendix D.

The last component of our qualitative data collection involved interviews with EOF Directors from institutions that did not send students to the MIP between 2008 and 2013. The names of these institutions are found in Appendix A. We contacted 19 of these institutions and conducted interviews with four, for a response rate of 21%. The response rate for non-sending institutions was much lower than that for sending institutions. This may be because EOF Directors from non-sending institutions are likely less familiar with the MIP and may have little opinion about the program. The interview guide for EOF Directors from non-sending institutions is presented in Appendix E.

The quantitative component of our data collection involved gathering test scores and transcripts for students who had participated in MIP. We obtained the MIP pre-test and post-test scores of students. These tests were administered on students' first and last days in the MIP. The pre-test and post-test contain similar questions that measure the same concepts. The tests contained three components: pre-algebra (23 points), pre-logs (6 points), and pre-trigonometry (7 points). The maximum score to be earned was 36 points.

Finally, we obtained the transcripts of students who participated in MIP between 2008 and 2013. Transcripts were received for 110 out of 113 students (97%) who participated in the MIP. These transcripts form the backbone of our analysis. We analyzed each student's transcript on a course-by-course basis for math and related courses and on a more holistic approach to determine positive and negative outcomes. Several criteria were used to assess student performance, including nuanced analysis for students who did not fit neatly into a positive or negative outcome category.

4. Findings

A. Transcript analysis

Profile of sending institutions

A total of 113 students participated in the MIP from 2008 through 2013. The students came from 23 sending institutions throughout the state. Roughly half (46%) of the students came from just five schools – Rutgers-New Brunswick, Saint Peter's University, Essex County College, Mercer County Community College and Kean University. Nearly two-thirds (64%) of the students came from 4-year colleges or universities and nearly 90% came from schools located in northern New Jersey (Appendix A).

Student performance in MIP

The MIP administers a pre-test to assess the needs of incoming participating students and a similar post-test. Pre-test scores were provided by the MIP for all 113 participating students from 2008 through 2013. Post-test scores were provided for 110 students who completed the program. Test scores were reported as totals as well as broken down into three categories: algebra, trigonometry and logarithms. Incoming students scored very poorly on the pre-test, with a mean score of 9.19 out of 36 possible points. Nearly all participating students (96%) scored less than 25 on the pre-test, or less than 70% correct.[3] Upon completion of the MIP, student performance improved dramatically as measured by the post-test, with a mean score of 24.52 out of 36. Over half (56%) of participating students who completed the program scored 25 or greater on the post-test. On average, participating students scored more than 2.5 times greater on the post-test with an average increase of 15.33 points from the pre-test mean. These results are statistically significant (see Appendix F for results of a paired-sample t-test between pre-test and post-test mean total scores and each mean component score); however, their meaning is not clear.

[3] The maximum total score on the pre-test/post-test is 36, with maximum component scores of 23 for algebra, 7 for trigonometry and 6 for logarithms.

Improvement in student performance as measured by the pre-test/post-test mean difference indicates that the MIP is successful in instructing participating students and improving immediate outcomes on the specific types of questions asked on the tests. However, the results are not an indicator of sustained improvement and effectiveness of the program and may not indicate a deeper understanding of the underlying concepts. The likelihood of sustained improvement is likely impacted by many other factors, including; lapses between participation in the MIP and a student's continuation of studies at his or her home institutions, differences in instruction style, support services and other variations between the MIP and these home institutions. In order to assess the effectiveness of the MIP in meeting its goal of improving student math outcomes on a sustained basis, a transcript review was conducted to provide a more complete picture of student performance in math and related fields.

Transcript review

The transcripts of all MIP participants (113) from 2008 through 2013 were requested by the Office of the Secretary of Higher Education from their sending institutions. Transcripts were received for 110 of the MIP participants. Transcripts were not received for one student each from Bloomfield College, Camden County College and Saint Peter's University, resulting in a total of three transcripts that were not reviewed as part of this analysis. A breakdown of students who participated in the MIP by sending institution, year and receipt of transcript is included in Appendix A.

The transcript review focused on:

1. Student retention and persistence;
2. The number of students who chose math or math-related majors;
3. The number of math and math-related courses attempted, taken and successfully completed before and after participation in the MIP; and
4. Overall student academic outcomes.

Limitations of the analysis

The main limitation of this analysis is the lack of a control or comparison group. As a result, specifying the precise impact of the MIP on student success in math is not possible. However, sufficient data were available to assess the MIP more broadly through various measures of student performance.

MIP participant retention rate and persistence

The number of students who enrolled in classes at their respective institutions during the fall semester immediately following their participation in the MIP was high. From 2008 to 2013, over 97% of students who participated in the MIP returned to school the following semester. The results do not differ between students from 2-year colleges and 4-year colleges or universities, nor does the retention rate vary by year (Tables 1a and 1b).

The student retention rate from 2008 through 2013 is slightly higher than the rate observed (90%) in the MIP evaluation from two decades ago. However, it is difficult to draw any conclusions from retention rate alone. Students may enroll in classes in the fall semester immediately following their participation in the MIP, but drop out in a subsequent semester. Student persistence towards a degree is a more telling measure. Here we define persistence as: 1) students who have attained a degree or 2) students who are currently pursuing a degree and have taken classes as of the spring 2013 semester.[4] Conversely, students who have not taken classes as of spring 2013, or whose transcripts expressly indicate they have been dismissed from their institution, are not considered to be persisting towards a degree. In total, the persistence rate of participating students is 78% (Table 2). It is possible that some students may have taken an extended leave or have transferred schools without these developments being reflected on their transcripts.

[4] Enrollment was available for the fall 2013 semester. The spring 2013 semester was chosen as the cutoff point to accommodate any unforeseen circumstances that may have prevented a continuing student from taking classes during the fall 2013 semester.

Table 1a: Retention rate by institution type

Student retention post-MIP	Institution type		Total*
	2-year	4-year	
Yes	97.2%	97.1%	97.2%
No	2.8%	2.9%	2.8%
Total	100%	100%	100%
N	36	70	106

Table 1b: Retention rate by year

Year	Student retention post-MIP (# of students)		Retention Rate*
	Yes	No	
2008	20	2	90.9%
2009	24	0	100%
2010	8	1	88.9%
2011	22	0	100%
2012	11	0	100%
2013	18	0	100%
Total	103	3	97.2%

*Does not include the 4 students whose degrees were conferred prior to attending MIP

Table 2: Student persistence rate

Degree status	# of students	Percent	Cumulative Percent
B.S.	6	5.5%	5.5%
B.A.	13	11.8%	17.3%
B.S.W.	2	1.8%	19.1%
A.S.	14	12.7%	31.8%
A.A.S.	1	0.9%	32.7%
A.A.	3	2.7%	35.5%
Non-degree certificate	1	0.9%	36.4%
In progress	46	41.8%	78.2%
Not in progress	24	21.8%	100%
Total	110	100%	

Students whose degrees are considered not in progress are not persisting towards their degrees. All other categories are considered persisting.

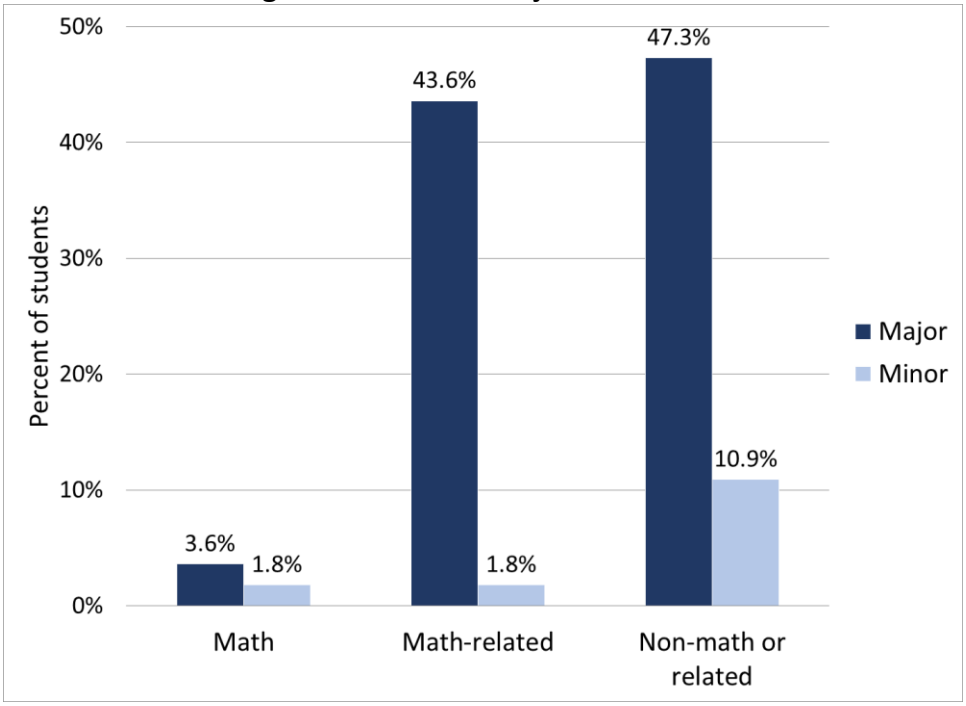
Choice of major

In total, only 4 out of 110 participating students chose math as their major. However, many participating students chose math-related majors in the fields of science, business, economics, computer science/information technology and engineering.[5] Taken together, 47% of

[5] For analysis of major/minor and subsequent analyses involving math-related courses, the category of science includes physics, chemistry, biology, environmental sciences, forensic science and general science; business includes accounting, finance, marketing and all other business disciplines; and engineering includes all engineering

participating students chose math or math-related majors compared to 47% who chose non-math or related majors (6% were undeclared at the time their transcripts were issued) (Figure 1). These results are both encouraging and discouraging.[6] On the one hand, nearly half of the students have chosen math-related majors, a positive sign that the MIP is meeting its goal of encouraging students to pursue science and technology majors and career paths involving math. On the other hand, nearly half of all students have chosen majors that involve little to no math. Combined with our expansive definition of the "math-related" category, which includes majors that vary substantially in their math requirements, this is a sign that students who participate in the MIP may be doing so for reasons other than pursuing a math-related major and career path.

Figure 1: Choice of major and minor[7]



disciplines and engineering technology. The statistics category includes math-sequence statistics and social science statistics courses.

[6] In order to compare choice of major by MIP students and their peers, we also asked EOF Directors for data on the majors of all students (MIP and non-MIP). Only two EOF Directors responded. From these two schools (one two-year institution and one four-year institution), an average of 18% of students majored in math or a math-related field, while 51% majored in non-math or non-related fields (31% were undeclared). These results suggest that MIP students majored in math or math-related fields more often than other EOF students. However, we cannot tell whether this has anything to do with the MIP or whether students selected for the MIP would be more likely to major in math or math-related fields regardless of their attendance in the MIP.

[7] Figure 1 does not list the percent of students whose majors or minors were undeclared on their transcripts. 5.5% of student transcripts did not list majors; 85.5% of student transcripts did not list minors.

Three of the math majors have completed their degrees and one is in progress. Among the 48 math-related majors, 15 have completed their degrees, 1 was awarded a non-degree certificate, 22 are in progress and 10 are no longer pursuing their degrees (Table 3). There was a greater tendency among participating students from 2-year colleges to major in math or a related field (60%) compared to their counterparts from 4-years colleges or universities (40%). This result suggests that differences between degree requirements for math majors or related fields at 2-year colleges and 4-year colleges or universities, e.g. the amount or level of advanced courses required, plays a role in the degree choice and career paths of students.

Table 3: Student persistence by major

	Major				
Degree status	Math	Math-related	Non-math	Undeclared	Total
B.S.	0.0%	10.4%	1.9%	0.0%	5.5%
B.A.	25.0%	0.0%	23.1%	0.0%	11.8%
B.S.W.	0.0%	0.0%	3.8%	0.0%	1.8%
A.S.	50.0%	18.8%	5.8%	0.0%	12.7%
A.A.S.	0.0%	2.1%	0.0%	0.0%	0.9%
A.A.S.	0.0%	0.0%	5.8%	0.0%	2.7%
Non-degree certificate	0.0%	2.1%	0.0%	0.0%	0.9%
In progress	25.0%	45.8%	36.5%	66.7%	41.8%
Not in progress	0.0%	20.8%	23.1%	33.3%	21.8%
Total	100%	100%	100%	100%	100%
N	4	48	52	6	110

Courses attempted, taken and passed pre-MIP and post-MIP

Courses were analyzed by the number of courses attempted, taken and passed. The term "attempted" includes all courses taken for letter grade, non-letter grade (including transfer courses), all forms of withdrawals and other non-credit terms (including audit). It refers to enrollment in a particular course, but does not necessarily mean that a student has completed the course. The term "taken" means a student has completed the course with either a passing or failing grade.

In total, participating students attempted an average of 6.96 math and related courses per student (766 in total) post-MIP, compared to 5.15 math and related courses per student (567 in total) pre-MIP (Tables 4a and 4b). This result is not surprising considering students typically

attended the MIP following their first or second full year in college (so most students will take more courses of all kinds post-MIP than pre-MIP). There were numerous instances in which participating students attempted the same course several times, pre-MIP and post-MIP. A pattern developed among several students in which they would register and withdraw from courses multiple times before taking the course for grade (if at all), particularly in math. While most course withdrawals were not indicated as passing or failing, the pattern is concerning and may be a signal that the subset of students who regularly withdrew from courses post-MIP lacked confidence in those areas. Of all courses attempted post-MIP, approximately 9% were withdrawn from, higher than the withdrawal rate pre-MIP (7.4%). The withdrawal rate from math courses post-MIP was even higher at 12% (Figure 2).

In total, participating students took 876 courses one time for a grade and 147 courses two or more times for a grade, pre-MIP and post-MIP combined. Math courses were more frequently retaken than courses in statistics or related fields, with 27% of math courses, 4% of statistics courses and 8% of related courses taken for grade more than once. In part, this reflects degree requirements. Certain math courses are required for graduation with a grade point value of 2.0 or higher. Many courses in statistics and related fields are not required for graduation, which decreases the need to retake these courses. The difference also reflects the higher failure rate in math courses among participating students.

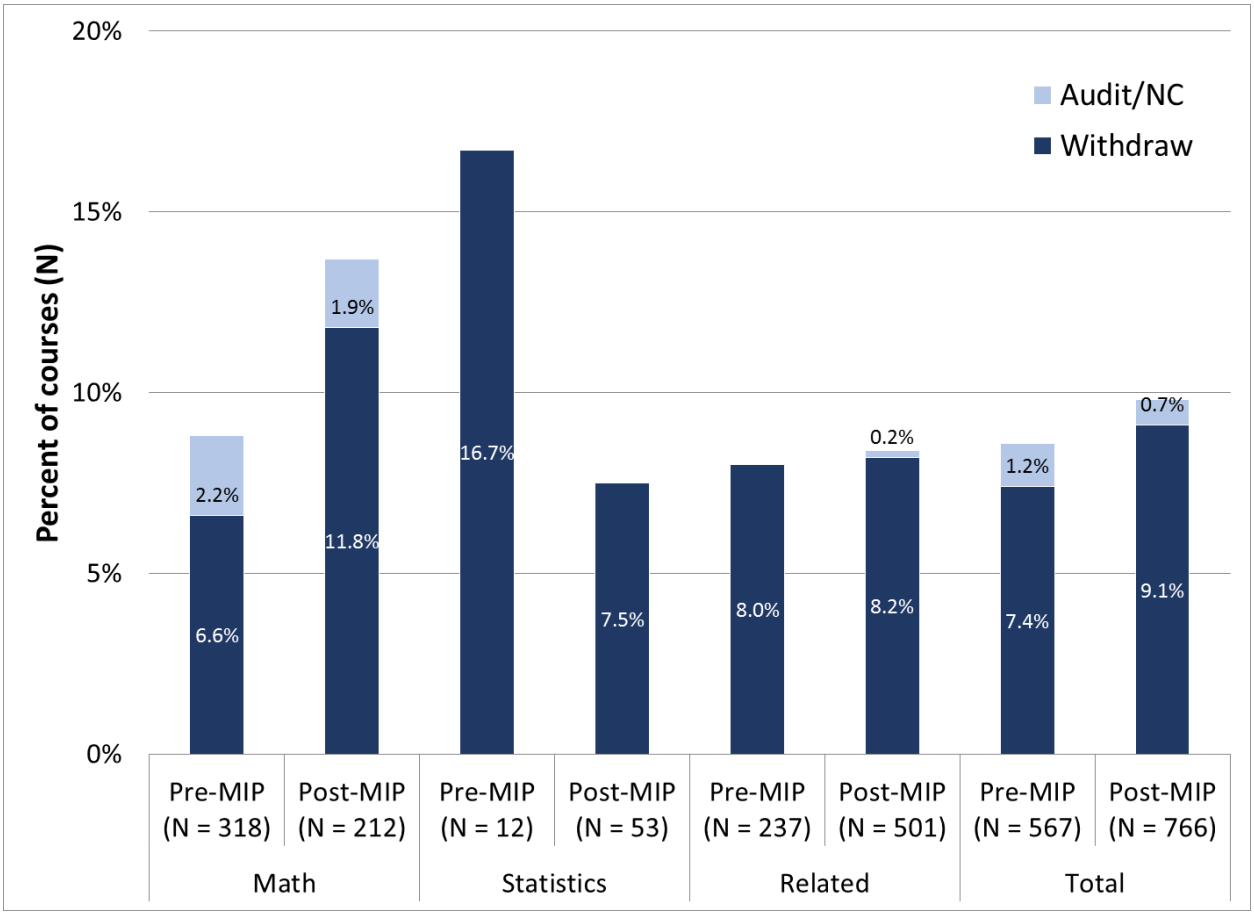
Table 4a: Courses attempted

	# of courses		
	Pre-MIP	Post-MIP	Total
Math	318	212	530
Statistics	12	53	65
Related	237	501	738
Total	567	766	1333

Table 4b: Math courses attempted

	# of courses		
	Pre-MIP	Post-MIP	Total
Developmental math	182	27	209
College-level math	136	185	321
Total math	318	212	530

Figure 2: Withdrawal and course audit rates by course type, pre- and post-MIP



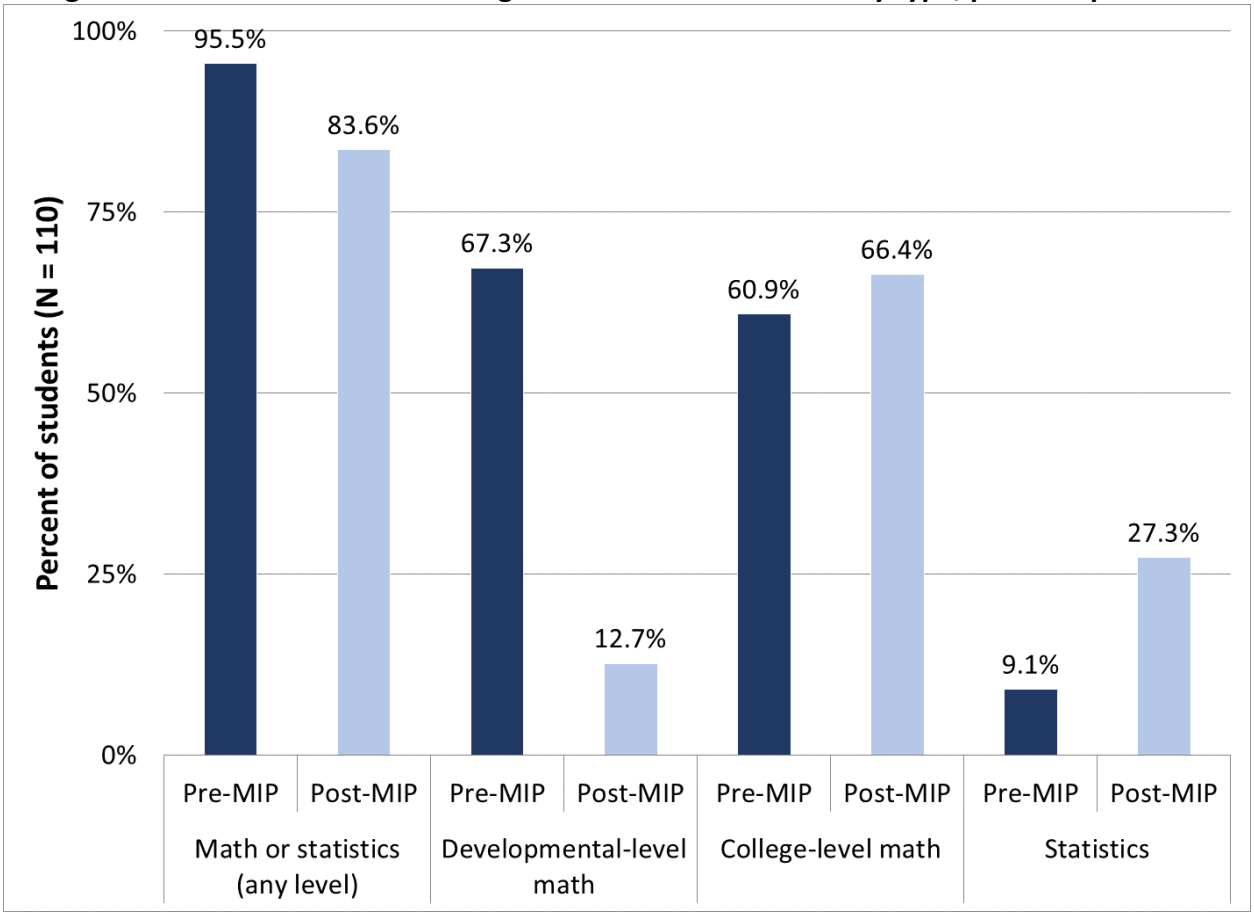
Math and statistics courses

All participating students took at least one math class either pre-MIP or post-MIP. Prior to attending the MIP, nearly all students (96%) had taken at least one math or statistics course of any level. However, after participating in the MIP, the number of students who took at least one math or statistics course of any level post-MIP dropped to 84% (Figure 3). A total of 12 students (11%) never progressed above taking developmental-level math.

There was a sizeable decrease in the number of students who took at least one developmental-level math course pre-MIP and post-MIP, with two-thirds (67%) of students in need of math remediation prior to participating in the MIP and only 13% taking at least one developmental-

level math course after completing the MIP.[8] Additionally, there was a threefold increase in the number of students taking statistics courses post-MIP (27%) compared to pre-MIP (9%). While these results are an encouraging sign that the MIP may increase the confidence of students to engage in more rigorous math courses, a closer examination casts doubt because of the lack of a statistically significant difference in the percent of students who took at least one college-level math course pre-MIP (61%) and post-MIP (66%). This indicates that the MIP has not led more students to take college-level math than would otherwise be expected (Figure 3).

Figure 3: Percent of students taking at least one math course by type, pre- and post-MIP



After completing the MIP, participating students took an average of less than one developmental math course (0.189) per student. Most students (87%) did not take any developmental math

[8] Developmental-level math courses vary by institution. Course catalogs of respective institutions were conferred to determine the level of each math course. All math courses indicated on transcripts which did not earn degree credits at the institution were coded as developmental, even if the same course title at a different institution would earn degree credits.

courses post-MIP, with a total of 15 students in need of additional math remediation. Of these students, most (12) only took one additional developmental-level math course. However, while most students in need of additional math remediation passed at least one of the developmental-level math course(s) they took post-MIP, three participating students did not pass any of the developmental course(s) they took after completing the MIP (Tables 5 and 6).

Participating students took an average of 1.5 college-level math courses and less than one (0.45) statistics courses post-MIP.[9] Two-thirds of all participating students took at least one college-level math course post-MIP, but only one-third took two or more college level math courses post-MIP. Additionally, less than one-third of all participating students took at least one statistics course post-MIP, with only six students (5%) taking two or more statistics courses post-MIP. Fourteen percent of students who took college-level math classes post-MIP failed to pass any of these courses, and 10% of students who took statistics courses post-MIP failed to pass any of these statistics courses. These results suggest that many participating students do not pursue advanced math courses beyond that which is minimally required (Tables 5 and 6).

Students who did not taken any developmental-level math courses post-MIP took, on average, 1.65 college-level math courses post-MIP. However, among students who needed further math remediation post-MIP and took at least one developmental-level math course, the average number of college-level math courses taken post-MIP was 0.5.

[9] College-level math courses included all math courses offered at a particular college or university for which college degree credits were available upon successful completion. Courses at this level vary by college or university, with some courses at 2-year colleges not transferrable for college credit at 4-year colleges or universities. However, this analysis classified math courses as college-level according to the home institution's classification. Typically, colleges code these courses as 100-level and above. College course catalogs were consulted to determine the level of math course at each institution.

Table 5: Number of students taking courses by subject, post-MIP

	Developmental math		College-level math		Statistics		Science		Business		Economics		Computer science		Engineering	
# of courses	# of students	%	# of students	%	# of students	%	# of students	%	# of students	%	# of students	%	# of students	%	# of students	%
0	96	86.4	38	34.5	78	70.9	45	40.9	84	76.4	89	80.9	89	80.9	103	93.6
1	12	10.9	35	31.8	26	23.6	28	25.5	9	8.2	17	15.5	12	10.9	1	0.9
2	1	0.9	15	13.6	4	3.6	9	8.2	7	6.4	2	1.8	5	4.5	2	1.8
3	1	0.9	12	10.6	0	0.0	10	9.1	3	2.7	1	0.9	2	1.8	1	0.9
4+	1	0.9	10	8.8	2	1.8	18	16.4	7	6.4	1	0.9	2	1.8	3	2.7
Total	110	100.0	110	100.0	110	100.0	110	100.0	110	100.0	110	100.0	110	100.0	110	100.0
Mean		0.19		1.47		0.45		1.93		1.19		0.25		0.36		0.44
Median		0		1		0		1		0		0		0		0
Std. Dev.		0.583		1.895		1.201		3.193		4.017		0.627		1.029		2.257
Min.		0		0		0		0		0		0		0		0
Max.		4		11		11		20		28		4		8		17

Table 6: Number of students taking courses, by subject, who failed to pass any courses within subject area, post-MIP

Subject	# of students who failed to pass any courses in subject area post-MIP	# of students taking courses in subject area post-MIP	Percent
Developmental-level math	3	14	21.4%
College-level math	10	73	13.7%
Statistics	3	30	10.0%
Science	8	65	12.3%
Business	3	26	11.5%
Economics	9	21	42.9%
Computer science	4	21	19.0%
Engineering	0	7	0.0%

Science courses

In the scientific disciplines—including physics, chemistry, biology, environmental sciences, forensic science and general science—participating students took on average 1.93 courses per student post-MIP. Fifty-nine percent of participating students took at least one science course following completion of the MIP, with one-third of all participating students taking 2 or more science courses. Of students who took courses in this category following completion of the MIP, eight out of 65 (12%) failed to pass at least one science course post-MIP (Tables 5 and 6).

Business courses

In business-related areas—including accounting, finance, marketing and other business areas—participating students took an average of 1.19 courses post-MIP. However, only 24% of participating students took at least one course in business-related areas post-MIP, with 17 students (15%) taking two or more business courses. Of students who took courses in this category following completion of the MIP, three out of 26 (12%) failed to pass at least one business course post-MIP (Tables 5 and 6).

Economics courses

In economics, participating students took an average of less than one (0.25) course per student post-MIP. Only 19% of participating students took at least one course following completion of the MIP, with 4 students taking two or more economics courses. Of students who took courses in this category following completion of the MIP, nine out of 21 (43%) failed to pass at least one economics course post-MIP (Tables 5 and 6).

Computer science courses

In the fields of computer science and information technology, participating students took an average of less than one (0.36) course per student post-MIP. Only 19% of participating students took at least one course following completion of the MIP, with 9 students taking two or more computer science or information technology courses. Of students who took courses in this

category following completion of the MIP, four out of 21 (19%) failed to pass at least one computer science or information technology course post-MIP (Tables 5 and 6).

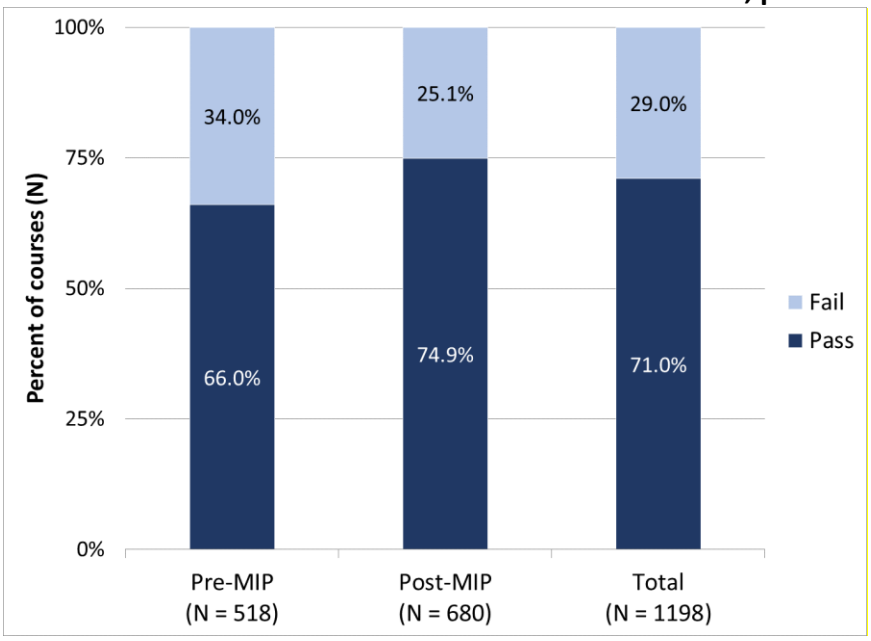
Engineering courses

In the engineering disciplines, including engineering technology, participating students took an average of less than one (0.44) course per student post-MIP. Only 6% of participating students took at least one course following completion of the MIP, with most of these students (6 out of 7) taking 2 or more engineering courses. All seven students who took courses in this category post-MIP passed at least one of the engineering courses they took (Tables 5 and 6).

Pass/Fail Rates

Students passed 71% of all courses taken for grade pre-MIP and post-MIP combined.[10] Prior to attending the MIP, participating students passed only 66% of all course types included in this analysis. After participating in the MIP, this pass-fail rate improved significantly as students passed 75% of these courses. The difference is statistically significant (confidence level > 99%) (Figure 4).

Figure 4: Pass-fail rate of all math and math-related courses taken, pre- and post-MIP



[10] Passing grades were considered letter grades A through C-, P, satisfactory and transfer courses; failing grades were considered D+ through F and unsatisfactory.

However, the pre-MIP and post-MIP pass-fail rates for the three broad categories of courses – math, statistics and math-related – were not statistically different. In particular, prior to participating in the MIP, students passed 57% of all math courses taken. Post-MIP, this pass-fail rate improved to 63%, but the difference is not statistically significant (Table 7). The results do not support the notion that the MIP is helping to improve the success rate of students in math courses. There was a statistically significant improvement in the pass-fail rate of students taking foundation college-level math courses post-MIP, which increased from just under 50% pre-MIP to 67% post-MIP. However, students taking intermediate and advanced college-level math courses worsened from 71% pre-MIP to 57% post-MIP (the difference, however, was not statistically significant).[11] Combined with no change in the pre-MIP/post-MIP pass-fail rate among students taking developmental-level math courses, these results suggest that the MIP may help students pass minimally required college-level math courses but not more advanced courses (Table 8).

The pass-fail rates of math-related courses varied widely by subject area, from a low of 57% passing in economics post-MIP to a high of 98% passing in engineering post-MIP.[12] Additionally, while there is variation in the pass-fail rate among subject areas pre-MIP to post-MIP, only in economics does this difference statistically differ (Table 9).

After participating in the MIP, students saw a 6 percentage point increase in the number of courses in which they earned grades of A or A- and a 3 percentage point increase in the number of B+, B or B- grades. However, the increase percent of grades at or above a B- is not evident in math courses students took, with students earning the same proportion of grades of A or A- pre-MIP and post-MIP (Table 10).

[11] Foundation college-level math courses are defined as college degree credit math courses lower than the opening calculus sequence at each college or university. These typically include college algebra, university mathematics, and pre-calculus, but the specific courses vary by institution. Intermediate and advanced college-level math courses correspond to the opening calculus sequence and more advanced courses.

[12] We believe that the students who endeavor to take engineering courses are the strongest students who participate in the MIP.

Table 7: Pass-fail rate of courses taken by course type

Course type		Pre-MIP	Post-MIP	Total
Math	Pass	56.6%	62.9%	58.9%
	Fail	43.4%	37.1%	41.1%
	Total	100%	100%	100%
	N	290	175	465
Statistics	Pass	100%	89.8%	91.5%
	Fail	0.0%	10.2%	8.5%
	Total	100%	100%	100%
	N	10	49	59
Related	Pass	77.1%	77.9%	77.6%
	Fail	22.9%	22.1%	22.4%
	Total	100%	100%	100%
	N	218	456	674
Total	Pass	66.0%	74.9%	71.0%
	Fail	34.0%	25.1%	29.0%
	Total	100%	100%	100%
	N	518	680	1198

	Math	Statistics*	Related	Total
Pearson Chi-square	1.793	1.115	0.053	11.141
df	1	1	1	1
Asymp. Sig. (2-sided)	0.181	0.291	0.819	0.001

*2 cells (50.0%) have expected counts less than 5. The minimum expected count is 0.85.

Table 8: Pass-fail rate by level of math courses

Math course level	Course	Pre-MIP	Post-MIP	Total
Developmental-level	Pass	59.4%	61.9%	59.7%
	Fail	40.6%	38.1%	40.3%
	Total	100%	100%	100%
	N	170	21	191
Foundation college-level	Pass	49.5%	67.4%	57.9%
	Fail	50.5%	32.6%	42.1%
	Total	100%	100%	100%
	N	103	92	195
Intermediate & advanced college-level	Pass	70.6%	56.5%	59.5%
	Fail	29.4%	43.5%	40.5%
	Total	100%	100%	100%
	N	17	62	79
Total	Pass	56.6%	62.9%	58.9%
	Fail	43.4%	37.1%	41.1%
	Total	100%	100%	100%
	N	290	175	465

	Dev.	Found.	Int. & Adv.	Total
Pearson Chi-square	0.048	6.373	1.106	1.793
df	1	1	1	1
Asymp. Sig. (2-sided)	0.826	0.012	0.293	0.181

Foundation college level courses were defined as college degree credit math courses minimally required at each college. These courses vary by institution but include college algebra, university mathematics, pre-calculus depending upon each institution's requirements. Intermediate & advanced college-level math courses correspond to the opening calculus sequence at each college (intermediate) and advanced calculus, analytical geometry, and other advanced courses.

Table 9: Pass-fail rate of math-related courses taken by field

	Related course type														
	Science			Business			Economics			Computer Science			Engineering*		
Pass-fail	Pre-MIP	Post-MIP	Total	Pre-MIP	Post-MIP	Total	Pre-MIP	Post-MIP	Total	Pre-MIP	Post-MIP	Total	Pre-MIP	Post-MIP	Total
Pass	63.0%	70.1%	68.2%	90.2%	85.3%	86.5%	85.0%	57.1%	68.8%	71.1%	85.0%	77.6%	100%	97.9%	98.7%
Fail	37.0%	29.9%	31.8%	9.8%	14.7%	13.5%	15.0%	42.9%	31.3%	28.9%	15.0%	22.4%	0.0%	2.1%	1.3%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
N	81	211	292	41	129	170	20	28	48	40	45	85	31	48	79
Pearson Chi-square			1.39			0.658			4.214			2.354			0.654
df			1			1			1			1			1
Asymp. Sig. (2-sided)			0.238			0.417			0.04			0.125			0.419

* 2 cells (50.0%) have expected counts less than 5 in Pearson Chi-square test. The minimum expected count is 0.39

Table 10: Distribution of letter grades post-MIP by course type

	Course type											
	Math			Statistics			Related			Total		
Grade	Pre-MIP	Post-MIP	Total	Pre-MIP	Post-MIP	Total	Pre-MIP	Post-MIP	Total	Pre-MIP	Post-MIP	Total
A- thru A	6.9%	7.1%	7.0%	10.0%	21.7%	19.6%	16.3%	20.4%	19.1%	11.1%	17.1%	14.6%
B- thru B+	20.1%	18.8%	19.6%	50.0%	23.9%	28.6%	27.8%	30.4%	29.5%	24.1%	27.0%	25.8%
C- thru C+	27.0%	35.9%	30.5%	40.0%	43.5%	42.9%	32.5%	26.8%	28.6%	29.7%	30.3%	30.0%
D- thru D+	17.4%	12.9%	15.6%	0.0%	4.3%	3.6%	13.4%	11.8%	12.3%	15.3%	11.5%	13.1%
F	28.6%	25.3%	27.3%	0.0%	6.5%	5.4%	10.0%	10.6%	10.5%	19.9%	14.1%	16.5%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
N	259	170	429	10	46	56	209	451	660	478	667	1145

Totals do not include transfer courses or courses passed by students on a pass-fail basis (for which no letter grade was given), which are included in the analysis of passing rates of students.

Overall academic outcomes

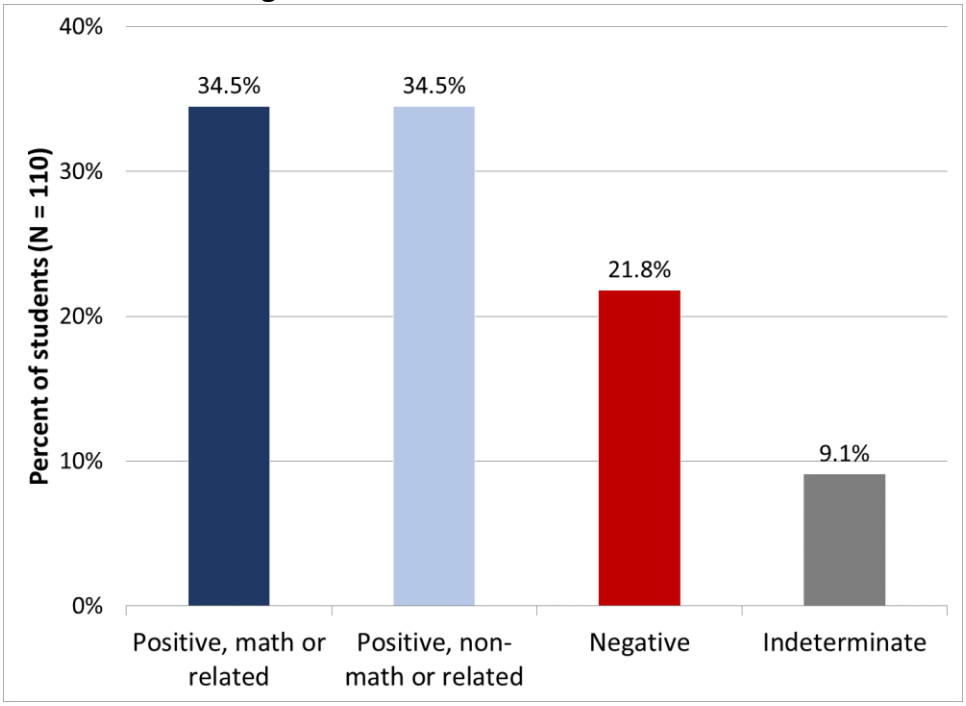
Taking a more holistic look, student transcripts were analyzed to determine overall academic outcomes based on degree status, major, grade point average (GPA) and degree timeframe. Degree status was divided into three mutually exclusive categories: degree conferred, in progress or not in progress (i.e. student persistence). Majors were divided into math or math-related majors and non-math or related majors (including undeclared). A threshold of 2.0 was set for cumulative GPA indicated on the transcripts. Degree time frame pertains to students who have not yet received their degree. Students were considered to be within degree timeframe if they were pursuing a bachelor's degree and had completed 6 academic years (12 fall/spring semesters) or less, or pursuing an associate's degree and had completed 4 academic years (8 fall/spring semesters) or less; all other students were considered not within degree timeframe.

A total of 28 mutually exclusive categories were coded and each transcript was assigned to the appropriate category. Student outcomes fell into fourteen categories. These categories were then combined to form four broad academic outcomes: 1) positive, math or related; 2) positive, non-math or related; 3) negative; and 4) indeterminate. Positive, math or related outcomes are those students who have received a math or math-related degree or who are in progress pursuing a math or math-related degree with a GPA of at least 2.0 and within the degree timeframe. Positive, non-math or related outcomes are the same as positive, math or related outcomes except for students whose majors are non-math or related. Negative outcomes are those students who are no longer pursuing degrees, regardless of major, GPA or degree timeframe. Indeterminate outcomes are those students who are currently pursuing a degree but have a GPA less than 2.0 or who have exceeded their degree timeframe, or both, regardless of major.

In total, 69% of participating students have had a positive academic outcome, split equally among math/math-related and non-math outcomes. These students have either graduated or are persisting toward their degrees in good academic standing without staying in the system for an extended period of time. Twenty-two percent of participating students have had a negative

academic outcome, with the outcomes of 9% of participating students still indeterminate (Figure 5 and Appendix G).

Figure 5: Overall academic outcomes



Students attending 2-year colleges showed a higher rate of positive, math or related outcomes and lower rate of negative outcomes than students from 4-year colleges/universities. The difference, however, was not statistically significant (Table 11).

Table 11: Academic outcome by institution type

Academic outcome	Institution type		Total
	2-year	4-year	
Positive, math or related	47.5%	27.1%	34.5%
Positive, non-math or related	27.5%	38.6%	34.5%
Negative	15.0%	25.7%	21.8%
Indeterminate	10.0%	8.6%	9.1%
Total	100%	100%	100%
N	40	70	110
Pearson Chi-square*	5.353		
df	3		
Asymp. Sig. (2-sided)	0.148		
*1 cell (12.5%) has an expected count less than 5. The minimum expected count is 3.64.			

Student academic outcome profiles

As indicated above, some MIP students successfully complete their college degrees while majoring in math or math-related fields. Some students successfully pursue non-math related degrees, yet others have negative or indeterminate outcomes post-MIP. In order to give a fuller picture of what MIP students "look like," we profile a "typical" student from each of these categorical outcomes. All names are fictitious.

Positive, math or related outcomes

Nancy, a student who attended MIP in 2009, completed a bachelor's degree in accounting and international business and trade, with minors in business law and finance. It took her eleven semesters to finish college, but not due to poor academic performance. She completed 156 credits, and made the Dean's List five times, including over the final three semesters. Her cumulative GPA was 3.473, including a perfect 4.0 in the final semester.

Nancy took many math and math-intensive courses during her time in college, both before and after completing the MIP. After taking one non-math course in the summer of 2007, she enrolled in Principles of Accounting I, Microeconomic Principles, and Elementary Calculus I, and received a C+, B, and B+, respectively. During the spring 2008 semester, Nancy took courses in Principles of Accounting II, Microeconomic Principles I (a different course number than the microeconomics course from the previous semester), and Elementary Calculus II, and received a B-, A-, and C+, respectively. In the fall 2008 semester, she took Intermediate Accounting Theory I and General Survey and Contracts, and received a C and B-, respectively. In the spring 2009 semester, she enrolled in Intermediate Accounting Theory II and received a C+.

Nancy attended the MIP during the summer 2009. The next semester, fall 2009, she took Advanced Accounting Theory, Principles of Management, General Biology I, Intro to Computers and Information Processing, Scientific Literacy; the grades were B+, A-, A, A, C, and B+, respectively. During the spring 2010 semester, Nancy took Cost Accounting, Auditing Principles, Taxation, Principles of Marketing, and Agency and Business Organization, receiving a B, A, B, A-,

and A-, respectively. The next semester, fall 2010, she enrolled in Real and Personal Property and Business Finance, and received a B+ in both courses. During the spring 2011 semester, she took Forensic Accounting, Accounting Information Systems, Uniform Commercial Code, Financial Management, and Investment Analysis, receiving an A, A, B, A-, and A-, respectively. In the fall 2011 semester, she took Export Management, Business Strategy, International Management, an Executive Seminar in business, Statistics for Business and Economics, and International Finance, and received an A, A-, A, A-, A, and A, respectively. In the final semester, spring 2012, she took International Marketing, E-Business, and Retail Banking and Marketing, receiving grades of A in all courses.

Nancy performed well throughout college, never receiving a term GPA below 3.0, but she performed especially well after finishing the MIP. In the six semesters following the MIP, her term GPAs were 3.500, 3.517, 3.325, 3.680, 3.900, and 4.00. In the five semesters prior to the MIP, her highest term GPA was a 3.460. At the very least, there is a correlation between her completion of the MIP and scoring higher grades.

One of the MIP's stated goals is to encourage students to take more math courses. Indeed, Nancy enrolled in more math-intensive courses after completing the MIP. But it is necessary to also note that Nancy did take math-intensive courses beforehand, as well. After all, as noted above, she enrolled in two calculus classes before arriving at the MIP, and received a B+ in Calculus I and a C+ in Calculus II (arguably classes that are more challenging than anything she took post-MIP). This indicates a relatively high math aptitude, which was not reflected in her MIP entrance exam. She received a score of 3 out of 36 on the MIP pre-test, which was the lowest entrance score in the 2009 class. Without knowing more details, it is very difficult to conceive of a logical explanation as to why she scored so poorly.

The extent to which her success can be attributed to the MIP is an open question. We cannot answer that question with precision. All we can do is point out the trends: Nancy performed well in school and in math-intensive courses prior to attending the MIP. After completing the program,

her grades improved noticeably, and she completed a bachelor's degree in math-related majors and minors in a timely manner.

Positive, non-math or related outcomes

Alex entered X College, a four year liberal arts college with an "undecided" major in the summer of 2007 and took an *Introduction to Drama* elective and received a grade of B. She also took an entry level language arts course titled *Applications of Learning* and received a grade of B+. During the fall, along with other entry level classes, Alex took *Basic Mathematics Tech* and received a grade of C+, and had a cumulative GPA of 2.6.

In the spring 2008 semester, Alex took a mix of history and philosophy classes along with *Basic Algebra Skills,* in which she received a grade of C. Prior to participating in the MIP during the summer of 2008, Alex was in good academic standing with a cumulative GPA of 2.5. Alex scored poorly on the MIP pre-test; a total score of 3 out of 36, receiving no marks in the logarithms or trigonometry components of the test. Alex's scores only improved on the algebra component of the MIP post-test, scoring a total of 13 out of 36, and receiving no marks in the logarithms or trigonometry components of the test.

After participating in the MIP, Alex returned to X College and took *General Biology I* and *General Biology I Lab* and received grades F and D respectively. Alex also took *General Chemistry I,* but withdrew from the course. In the same semester, she took *Foundations of Analysis I*, a math course, and received a grade of C. Thus, Alex's performance in the math class taken immediately after MIP stayed the same. Alex's GPA for that semester was 1.6, but she performed significantly better in the following semesters, mainly due to the non-math related classes she took.

During spring 2009, Alex took a mix of history and psychology classes. She also took *Survey of Economics*, a business course, and received a grade of B+. In the following two semesters, Alex took a variety of history and social science classes and performed well in those classes; 3 A's, 2

B's, 3 B-'s, 1 C and 1 C+. During summer 2010, Alex reattempted to take General Biology I and General Biology I Lab and received grades C and B respectively.

Alex graduated in May 2012 with a Bachelors of Arts, majoring in Social Studies with a minor in Drama. Her cumulative GPA was 2.87. Alex is an example of a student who showed a positive non-math or related outcome since her outcome in math related classes stayed the same before and after participating in the MIP. However, she performed well in her non-math related classes and graduated in 4 years with a degree.

Negative outcomes

Gerald entered a four-year university in the summer of 2010 and declared a psychology major. After completing non-credit earning coursework in college reading and math, he went on to take Introduction to Algebra in the fall semester. He received an F in the course, while only passing one out of four courses that semester. His term GPA for fall 2010 was 0.28.

In the spring 2011 semester, Gerald retook Introduction to Algebra. Again, he received an F. He received passing grades in his other two courses (both of which were non-math related) and earned a 1.67 GPA that semester.

Gerald participated in the MIP in the summer of 2011. In the fall of 2011, he took Introduction to Algebra for the third time. This time, he received a B. He also passed his other four classes and earned a 2.25 GPA that semester.

In the spring 2012 semester, Gerald enrolled in five courses, one of which was a basic math course. He received an F in this course. That semester, he received an F in one more class, withdrew from two, and received a C in the fourth – all of which were non-math related courses. Gerald finished the spring 2012 semester with a 0.49 GPA. He earned a cumulative GPA of 1.66 during his four semesters at the university and has not enrolled in courses in the past two years.

Gerald is an example of a typical student with a negative outcome. He received a failing grade in an introductory mathematics course twice before he participated in the MIP. In the semester directly following the MIP, he improved his grade in that course to a B. He also performed well in his other four courses that semester and received an average grade of a C. However, his progress seemed to be short-lived. In the following spring semester, he failed a basic math course and only passed one of five courses. He has not enrolled in courses since spring 2012, but if he does return to school, he may still graduate on time (i.e. within six years of his first semester).

Gerald represents the typical negative outcome in that he has neither graduated, transferred, nor enrolled in classes within the previous year. He also has earned a cumulative GPA of below 2.0. Other students who we classified as having negative outcomes shared similar paths, but with some differences.

Most students with negative outcomes did not see improvements in their math grades after MIP participation. Rather, they continued to fail and withdraw from math courses. Some students stopped taking courses, though they had a cumulative GPA of 2.0 or higher. Others were placed on academic probation or suspension. The key factor in this category of students is that they are no longer progressing toward a degree.

Indeterminate outcomes

Robert enrolled in a four-year college in the fall 2009 semester. He attended the MIP in 2011 after having twice taken Introductory Algebra, a developmental math course, and twice taken Abstract Reasoning, a foundation college-level math course. Robert failed Introductory Algebra on his first attempt, receiving an F, and passed the course during the subsequent semester, receiving a grade of C. He failed Abstract Reasoning on both occasions prior to attending the MIP, receiving a grade of F.

At the time of attending the MIP, Robert was in good academic standing with a cumulative GPA 2.23. In line with Robert's struggles in math at his home institution prior to the MIP, he scored

poorly on the MIP pre-test, well below the mean (9.19) with a total score of 3 out of 36 and zeroes on both the trigonometry and logarithms components. Robert saw vast improvement on the MIP post-test with a delta of 23. Robert's ability to solve trigonometry and logarithms problems improved, with scores of 4 out of 7 and 4 out of 6 on those components, respectively. Additionally, his score on the algebra component improved from 3 out of 23 to 18 out of 23. Robert's total score of 26 places him in the top 50% of all post-test scores, the cutoff point for high post-test scores in this analysis.

Immediately upon completing the MIP, Robert retook the Abstract Reasoning foundation college-level math course during the fall 2011 semester and passed with a grade of C+. While it is possible that the MIP helped Robert pass this course in the short-term, the long-term impact of the MIP on Robert appears to be negligible. Robert has attempted four additional math-related courses in statistics for behavioral sciences and economics post-MIP, failing two courses with grades of F and D- and withdrawing (while failing) from the other two courses. Subsequently, his cumulative GPA has dropped. Robert is a continuing student who was last enrolled at his college during the fall 2013 semester. He is persisting towards a bachelor's degree in psychology, a non-math related field, but his cumulative GPA is currently 1.86. Robert is within degree timeframe but has completed only 21 of 28.5 credits attempted at his college. [13]

Robert's experience is typical of participating students whose outcome is yet to be determined. Robert has struggled in math and math-related courses, both pre-MIP and post-MIP, and has chosen a non-math related major. Given his degree choice and prior struggles, it is unlikely that Robert will pursue advanced math courses and will complete only the minimally required math courses at his college. Additionally, Robert's low overall GPA and recent withdrawals from courses will likely be an impediment to him finishing his degree within timeframe, if he continues to persist.

[13] Robert's institution operates on a 1 credit per "typical" course basis. Converted to the more common 3 credit per course basis, Robert has completed 63 of 85.5 credits attempted.

B. Findings from interviews with EOF Directors from sending institutions

We interviewed 14 EOF Directors to gain an understanding of their institution's experience with the MIP and the feedback they received from the students that participated in the program. Overall, all EOF Directors said that the students who participated in the program gave positive feedback when they returned back to their institutions. The MIP helped ease the math related anxiety which all the students faced and also encouraged few of the students to consider pursuing a career that required them to take advanced level math courses.

One of the reasons attributed to the math related anxiety is under preparedness and lack of resources provided in high school. When we asked them to rate the average incoming freshmen students, on a scale of 1 to 10 (with 10 being the highest), for their preparedness for taking a college-level mathematics course, 65% of the EOF Directors gave a rating of 5 or below. An EOF Director said that "many of these students probably never thought they would go to college and most likely made the decision to attend college late in their high school career." This is a barrier because students might not be familiar with the academic environment and find themselves overwhelmed with the fast paced curriculum and heavy workload. The students who are part of the EOF program and attend the MIP have trouble with fundamental math concepts such as basic algebra, fractions and decimals. One EOF Director mentioned that one of the students who participated in the MIP "realized when he was at MIP that he had never conceptually learned how to multiply fractions." The individualized attention the students receive during the program helps them to grasp those basic math concepts that are needed in advanced-level math classes.

However, the EOF Directors don't follow up with students that participated in the MIP to discuss their performance in the next level of math classes they take the semester after returning from the MIP. Each participating student's performance can be analyzed through their transcripts, but it would also be helpful to receive feedback from the students regarding their post the MIP experiences. This tracking system would also be helpful when analyzing the MIP and it would help EOF Directors and counselors understand which (and which types of) students from their institution have positive outcomes after attending the MIP.

According to the EOF Directors, the MIP also helped the students sharpen the necessary non-math skills needed to succeed, such as time management and professional development. Several of the EOF Directors said that the students come back from the program “more mature” and more prepared to be involved on campus. Other students reported to their counselors that they “learned how to become better students” through the training they received at the MIP.

The application process for the MIP is straightforward. All the EOF Directors receive a flyer from the MIP supervisor at Stevens Institute, and an introductory email from the President of the EOF Association of New Jersey. The common advertising methods used were putting up flyers in the EOF office area, sending email reminders through the university portals and speaking with students individually. The EOF Directors, along with the counselors, reach out to students who they believe would benefit from participating in the MIP. The students to whom the EOF Directors reach out have demonstrated the need for additional help in math and possibly have shown an interest in pursuing a career that will require taking advanced-level math classes. Other strong qualities needed when targeting students for the MIP are commitment and determination. Some of the EOF Directors specifically mentioned that they look for hard working students who they believe will perform well in the MIP. We note that this leads to several different types of students in MIP. Some have shown a need for remediation and others have indicated an interest in pursuing math or math-related majors. Serving both of these populations is inevitably going to be a challenge.

The students then fill out the application form with the help of the EOF Directors and counselors and send it to the MIP personnel for the final approval. Since the EOF Directors and counselors target specific students, there has never been a case where a student applies to the MIP and does not receive a recommendation from his or her counselor. The level of interest in the MIP has stayed the same or increased slightly for all the participating institutions.

During our interviews with the EOF Directors and the MIP personnel, we found inconsistencies in the overall timeline and deadlines for the application. Two of the EOF Directors mentioned that they received the application and had to submit it to the MIP in 2 weeks; a very short turnaround time. They understand that MIP personnel cannot send the initial flyer or applications without the budget being approved and, accordingly, stated that the one thing they would like to see change was more legislative support for the program. However, during our interview with the MIP supervisor, it was mentioned that EOF Directors have approximately a month to submit applications after receiving the initial flyer and introductory email.

Another challenge is that students potentially have summer jobs or other commitments, which may prevent them from participating from the MIP. While the residential component of the program is helpful and a good experience for the students who come from a community college, it is also a barrier to other students who have personal obligations. Several of the EOF Directors said that even though students apply to the MIP, some of them may decide not to attend because of similar scheduling conflicts.

C. Findings from interviews with EOF Directors from non-sending institutions

We contacted a total of 19 EOF Directors from institutions that did not have students who participated in the MIP. We got responses and conducted interviews with four of the EOF Directors to gain an understanding of their experiences (or lack of experience) with the MIP and what particular challenges their students faced that prevented them from participating in the program. The interview questions we asked were similar to the questions we asked the EOF Directors that had students who participated in the MIP. The EOF Directors receive the same marketing information, through emails and flyers, and were all aware of the MIP and its goals. They also send the information to students who might be interested in applying and post the flyers in the office. The EOF Directors look for students who are committed and are comfortable exposing themselves outside of their comfort zone. The EOF Directors mentioned that usually, none of the students are interested in participating in the MIP, but some students have shown interest in the past but were not able to participate. One of the EOF Directors said that “MIP

sends the information, but the EOF office [at the home institutions] need to do more to make the students aware."

When asked about the factors that might have led their students to not participate in the MIP, all the EOF Directors mentioned that the students would prefer to work fulltime during the summer instead. Two of the EOF Directors mentioned that students would prefer to take "other avenues" during the summer, such as taking summer classes for college credit or classes that would help towards achieving their career goals. One of the EOF Directors said that students tend to be focused on "short term" benefits, such as working during the summer. They don't see that participating in the MIP may help them in the long term, even if they don't get paid as much as they would while working.

One of the EOF Directors said that one way to make the MIP more appealing and suitable for students would be to create satellite programs. If MIP could be conducted at and through the individual home institutions, students would be able to "contextualize the concepts at their own campuses." This would ensure that particular needs of the students are met, especially the students who cannot travel. Another EOF Director suggested having the option of offering online sessions that students can attend. It would be difficult to monitor the students, but it would also meet the needs of students who have financial barriers.

D. Findings from interviews with MIP personnel

We interviewed seven personnel from the MIP to gain an understanding of the program in detail and learn about their experiences and challenges over the years. Overall, all of the MIP personnel we interviewed, including tutors and instructors, said that the MIP had a positive impact on the participating students in many ways but also noted numerous limitations. Among the positive aspects, the students were able to overcome the biggest challenge which was entering the program with the conception that they were not good at math. A majority of the students who entered the MIP and were placed in the "algebra track" of the program, had trouble with basic math concepts such as multiplying fractions and doing basic algebra. One tutor mentioned that many of the students had a lot of trouble grasping overall concepts and "if they wouldn't

understand something, they would get frustrated." A professor noticed that the students have a lot of misconceptions about math and always learned concepts memorizing "tricks" or "short cuts," but those don't apply to all of the concepts going forward, making it important to understand the core concepts. This likely allows them to succeed on the exit exam for MIP but may explain some of their subsequent difficulties when returning to their home institutions.

Despite the challenges, a majority the students performed better in the post-test than the pre-test, and by the end of the 3- week program, the MIP personnel reported that the students had increased their confidence in grasping math concepts. One of the MIP staff members said that "being around other students who also faced the same challenges [in grasping math concepts] helped them feel more relaxed and less intimidated, which is not the case in a regular university classroom." Through our data collection we found that the questions on the pre-test and post-test are the same. Thus, it is important to note that while a majority of the students are performing better on the post-test, it is possible that the students are only being taught concepts during the program that would prepare them for the post-test. This becomes problematic when the students go back to their home institutions and have to take advanced level math classes that will include a variation of math concepts.

The non-math related component of the program is important and enhances the students' experiences in many ways. The professional development class focuses on appropriate dress attire and the difference between business casual and business formal, creating resumes and LinkedIn profiles, presentation skills, and professional etiquette. There is also an "etiquette dinner" at the end of the program, where the instructor takes the students to a restaurant off campus and the students learn table manners, conversation starters and appropriate use of utensils – all in a fun and interactive way. The instructor said that most of the students have never had such a fine dining experience before and it was a good exposure for them in a comfortable setting. These experiences increase the students' interpersonal skills. One of the instructors remarked that, at the beginning of the program, one of the students in his or her class "was so shy that she would not even face the audience when introducing herself to the class."

While only two of the MIP staff members directly suggested that extending the program to 4 weeks might be helpful, many of the other members said that the rigorous schedule of the program is a challenge. A full day consisting of lectures and tutoring sessions usually ends at approximately 10:00 pm and the students are often tired in the mornings. One reason for this is also that they want to socialize with their new friends and make the most of the residential component of the program. So, even though their schedule ends at a certain time, they go to sleep much later since they are socializing. One supervisor also mentioned that during the first week of the program, some of the students are still getting adjusted and they don't realize that they only have 3 weeks in the program and have to come prepared from the first day. A past tutor and current advisor of the program said that since the students don't get college credit for participating in the program and it doesn't affect their GPA, "what the students get out of the program is really [dependent upon] what they put in".

One of the other challenges faced by the supervisor of the program relates to the challenge mentioned by two of the EOF Directors: planning the program without knowing whether EOF budget will be approved for that year. The supervisor realizes that a majority of the students who are participating in the program are sacrificing their time and potential summer jobs. Thus, it would be a challenge for the participating students to commit to the program and find out that the program will no longer be conducted due to budget constraints.

One of the common lessons that the MIP personnel would like to impart on the students learn is the importance of repetition and practice. Especially in math, many concepts are related and there are similar patterns in the different problems. If the students keep practicing different problems, they will see those patterns and understand the concepts more clearly.

E. Findings from survey of participating students

We asked the EOF Directors and MIP personnel whether they have contact information for former students so we can contact them regarding their experiences with the program. We received names and contact information of 18 former students who participated in the program

and we distributed an internet survey to them. A total of 11 students started the survey, but only seven completed all the questions. This section only reports the findings of the seven students who completed the survey. The survey questions asked about the students' background in math and the resources available to them in high school, their level of confidence in taking college-level math courses pre-MIP and post-MIP, and their overall experience with the specific aspects of MIP including residential, instructional style and materials, final research project, and their experience after returning to their home institutions.

Experiences prior to attending the MIP

When asked about the highest level math taken in high school, two students had taken Algebra I, one student had taken Algebra II, three students had taken Pre-Calculus and one student had taken Calculus. While taking these classes, three of the students spent an average of 0-3 hours outside of the classroom either studying or completing homework assignments; two students spent 4-7 hours; and two students spent 8-11 hours. In high school, four students sought additional assistance from the instructor and/or a tutor and spent an average of 0-4 hours a week on the additional help. Surprisingly, only two students responded "yes" when asked if there were tutoring services available to students who needed guidance in a particular subject area. When the students were asked about their level of confidence in taking college-level math, three responded with "somewhat confident", three responded "neither confident nor unconfident" and one responded with "somewhat unconfident". The next question asked whether they were interested in pursuing a career that required advanced level math classes and six students replied with "yes" while one student replied with "no." When asked about the level and quality of assistance provided from their colleges during the MIP application process, three students said the assistance was "very adequate" and four students said it was "somewhat adequate."

Experiences during the MIP

Table 12 presents the responses for each of the 7 students regarding their experiences with the program. In contrast to the findings from EOF counselors, the students reported that the residential component of the program was not a barrier. However, it is worth bearing in mind

that the students who completed the survey may not be representative of all the MIP participants or all potential applicants. That is, these students may have chosen to participate in the MIP because travelling to and from Stevens was not an anticipated problem for them. Additionally, when asked whether travelling home during the weekends was a challenge, two students responded with "somewhat agree." The experiences that the students had with the instructors and/or tutors and the instructional materials used were positive overall.

Students were also asked about their experience with the non-math related aspects of the program, such as classes on creating effective presentations and etiquette. According to 5 students, these non-math related classes were "very helpful" in developing skills that are needed in college, and 2 students replied that the classes were "somewhat helpful." Additionally, two students viewed the final research project as "very helpful" in understanding the math requirements in their chosen career path, with four students reporting that it was "somewhat helpful" and one student responding that it was "neither helpful nor unhelpful." A follow-up question asked about their feedback on the research project and what they would like to change about it. One of the students said that the final project "is not needed since most students already understand what kind of math is required in their line of study." Another student said the project "should focus on a math model."

Experiences post MIP

When the students were asked how confident they felt about taking the next level math class at your home institution, six students responded with "very confident" and one student responded "somewhat confident." We also thought it was important to ask about their confidence level when dealing with math concepts that were not covered during MIP. Two students responded to this question with "very confident" and five students responded with "somewhat confident." All 7 students replied "yes" when asked whether they would recommend the program to other students at their home institution.

We also asked the students to share any other related experiences and feedback about the program. All five students who responded to that question shared the positive ways that the program impacted them, but also shared their feedback on how the program can be improved. One student said that it was “one of the best experiences in my life and I would like to thank the people for seeing something special in me.” Two students mentioned that the tutors and instructors were “very friendly and helpful” and “the amount of time spent on learning and practicing math is time consuming but enhances your skills.” Along with the positive impacts of the program, there were three recommendations that the students offered. First, two of the students mentioned that increasing the program length would be helpful so that more advanced-level concepts can be covered. Second, one of the students said that there should be some leisure time involved. Since the program was very intensive and did not leave room for leisure time amongst the students, it would be helpful to have some time to spend with their friends. Third, one student requested the stipend to be increased especially for those students who have to travel a great distance to get home on the weekends. She particularly mentioned that she had to take several modes of public transportation to get to Stevens Institute and at times when the public transportation was unreliable, she had to take a taxi. Thus, the entire stipend that she received went towards travel.

Table 12: Survey responses of MIP students

Question	Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree	Total
Before participating in the Mathematics Immersion Program, I was not confident in my ability to take college level math courses.	1	4	2	-	-	7
The living on campus component of the program was a burden for me.	-	-		1	6	7
Traveling home on the weekend was a burden for me.	-	2	1	1	3	7
The homework assignments enhanced my understanding of the material covered during class.	5	1	1	-	-	7
The exams and quizzes enhanced my understanding of the material covered during class.	5	1	1	-	-	7
The textbooks and other instructional materials used in the program were easy to understand.	5	2	-	-	-	7
The tutors were helpful in enhancing my understanding of the math concepts covered in class.	6	1	-	-	-	7
The instructor provided opportunities for students in the class to ask questions.	6	1	-	-	-	7
I felt comfortable asking the instructor for clarification if I did not understand a particular concept.	5	2	-			7
The concepts I learned during the program encouraged me to take advanced level math courses at my college or university.	5	2	-			7
After completing the Mathematics Immersion Program, I was encouraged to pursue a career that required taking advanced level math courses.	5	1	1	0	0	7

5. Recommendations

A. Big picture: direction taken by the MIP

The MIP has two primary goals, according to its website: 1) "To encourage students to pursue more advanced courses in mathematics," and 2) "To help students gain more confidence in their ability to succeed in technology majors."

As currently designed, the MIP is not meeting either goal. For starters, though they might claim to be more confident in their abilities, a minority of MIP students move on to major in math or a math-related subject. Only four out of the 110 students majored in math. Taken together, 47% of participating students chose math or math-related majors compared to 47% who chose non-math or related majors (6% were undeclared). Three of the students who pursued math majors have completed their degrees and one is in progress. Among the 48 students who pursued math-related majors, 15 have completed their degrees, one was awarded a non-degree certificate, 22 are in progress, and ten are no longer pursuing their degrees. If those ten students are excluded, the number of students in math or math-related majors drops to 38%.

It is true that MIP students have showed remarkable improvement from their pre-test scores to their post-test scores. On average, participating students scored more than 2.5 times greater on the post-test with an average increase of 15.33 points from the pre-test mean. But success on the MIP post-test does not necessarily translate to improved academic performances at home institutions. There are various reasons that students' successes at MIP may not continue throughout their college years. Improved test scores may not be an indicator of deeper understanding of the underlying math concepts, but rather an ability to answer specific types of questions. Lapses in time between participation in the MIP and students' coursework could lead students to forget concepts. Differences in instruction style, support services and other variables between the MIP and these home institutions could also make it harder for students to replicate their MIP successes at their home institutions.

As noted above, encouraging students to take more math courses is one of the MIP's two main goals, but the MIP seems to have very little to no impact on the number of math and math-related courses students take, let alone pass. MIP students take almost as many college-level math courses prior to enrolling in the MIP as they do after completing the program, and many students stop taking math courses once they have completed the minimally required math courses at their respective institutions. On average, participating students attempted, though not necessarily completed or passed, an average of 6.96 math and related courses (766 in total) post-MIP, compared to 5.15 math and related courses per student (567 in total) pre-MIP. The difference of 1.81 courses might be exaggerated, since students tend to enroll in the MIP early in college.

Students that participate in the MIP take few math courses after completing the program. Participating students have enrolled in an average of 1.5 college-level math courses and less than one (0.45) statistics courses post-MIP. Two-thirds of all participating students took at least one college-level math course post-MIP, but only one-third took two or more college level math courses post-MIP. Additionally, less than one-third of all participating students took at least one statistics course post-MIP, while only six students (5%) took two or more statistics courses post-MIP. Sadly, the failure rate was relatively high for these courses. Fourteen percent of students who took college-level math classes post-MIP failed to pass any of these courses, and 10 percent of students who took statistics courses post-MIP failed to pass any of them.

There is no evidence that MIP students pass their math, statistics, and related courses at higher rates after completing the MIP than they did beforehand. Prior to participating in the MIP, students passed 57% of all math courses taken. Post-MIP, this pass-fail rate improved to 63%, but the difference is not statistically significant. These results do not support the notion that the MIP is helping to improve the course success rate of students, particularly in math courses.

That is not to say that students received no benefit from the MIP. All of the EOF directors that we interviewed reported improved confidence among returning students. All of the MIP students

who responded to our survey requests likewise indicated that they felt "very confident" or "somewhat confident" in their ability to take the next level of math at their home institutions. The soft skills—like organization, etiquette, and public speaking—that are cultivated at the MIP, play a positive role in students' development. Since retaining these soft skills is not dependent on knowledge of specific facts or memorization of formulae, they are likely longer-lasting than the math skills the MIP hopes to develop.

What can be done?

In our view, there are three categories of students who could potentially benefit from the MIP: 1) Students who wish to major in mathematics or math-intensive majors, 2) students who do not plan on majoring in a math-intensive major, but still need to fulfill certain math requirements, and 3) students who suffer from math anxiety or just need a greater level of confidence and study habits to succeed on the college level. The second and third categories of students are not mutually exclusive. It is our view that the MIP should focus on serving either the first category of students, or categories 2 and 3, rather than trying to attract all three groups.

A student who plans on majoring in physics, for example, has very different needs than a student who wishes to major in the humanities. A student who wants to pursue a major in the humanities major might need to take a statistics course and an introductory level math course to fulfill his or her major, whereas the student majoring in physics would most likely have to take several high-level calculus courses, not to mention chemistry, biology, statistics, and other math intensive courses required for a physics degree. The differences between these two students become a chasm if the humanities student also suffers from math anxiety, and has struggled to complete remedial math coursework. Structuring a program to meet the needs of both kinds of students is extremely difficult. Creating such a course that lasts only three weeks is likely to be impossible.

In addition, it creates confusion among EOF Directors about the kind of students that should attend MIP. Several EOF Directors expressed to us in interviews contradictory opinions about the

kind of students who should attend MIP. The result is that EOF directors are signing up disparate students for the MIP, thereby expanding the skills and knowledge gap between students. MIP administrators should decide which type of students it wishes to attract, and make that decision well-known to EOF Directors.

Based on the analysis of MIP students' transcripts, we believe the MIP would be best suited in attracting students who suffer from math anxiety and/or need a slight boost in their math skills in order to meet core math requirements in their home institutions. Given the constraint of three weeks, trying to prepare students for math intensive major is too lofty of a goal. The average MIP student scores 9.19 out of 36 possible points on the pre-test scores. The pre-test scores indicate that a substantial amount of remedial work is needed in the concepts covered by the pre-test. It is simply unrealistic to expect three weeks of courses, no matter how intensive, to fill in for years of math education.

In the future, the MIP should place greater emphasis on developing soft skills, and should no longer focus on students majoring in math and technology majors. To clarify, choosing a STEM major should not be discouraged, but not many MIP students successfully pursue a major in math or math-related subjects, thus it should not be the primary focus of the program. The program should be reoriented to meet the academic and social needs of the students according to their chosen lines of study. Instead of treating calculus as the ultimate goal for students, the MIP should teach topics that will prove to be more practical for students—for example, statistics, advanced algebra, geometry, and broader mathematical concepts.

To summarize, we believe the MIP should target students who do not necessarily want to or plan on majoring in a math-intensive major, but still need to take certain math courses and will likely need a working knowledge of math in their future careers; and students who suffer from math anxiety or just need a greater level of confidence and improved study habits. The MIP should not be organized to encourage all students to major in a STEM subject, because all available evidence indicates that *it is not an attainable outcome* for the vast majority of MIP students.

B. Other recommendations

The big picture recommendations will require a fairly substantial change in the mission of the MIP, with which the EOF program ultimately may not agree. Regardless of whether or not the big picture recommendations on the direction of the MIP are adopted, we provide a few suggestions about the functioning of the MIP as it is currently constituted:

i. Mainstreaming the evaluation process

The best way to ensure that the MIP is meeting the needs of participating students is to integrate methods for continuously monitoring the program. This is already being done to some extent by administering pre- and post-tests to student participants and obtaining their evaluations at the end of the program. However, more should be done to assess whether the MIP is impacting student outcomes once the students return to their schools.

The evaluation process can be mainstreamed in the MIP by following up with former students through a survey or interview. This should be done during the middle of the fall semester immediately following MIP participation and again one year later. The two follow-up interviews will allow MIP staff to assess whether students received any benefits from MIP participation and whether these benefits were lasting. These interviews or surveys should focus on any perceived benefits or losses from MIP participation for the student; the areas in which students benefited most (e.g. algebra, basic math concepts, soft skills, or social networks); whether MIP affected the student's decision to continue with the same major or to change majors; and changes in the student's grades in mathematics courses after the MIP compared with before the MIP.

Other means of improving the evaluation process include 1) monitoring student transcripts after MIP participation, and 2) tracking demographic data of students who apply to and participate in MIP. The former would allow MIP personnel to ascertain whether the clear improvements from the pre-test to the post-test scores are translated into better academic outcomes, particularly higher grades in mathematics courses and higher graduation rates, after participation in MIP. The latter option would allow MIP personnel to track changes in the population of students who applied to the MIP and make the necessary adjustments to these changes. For instance, some

EOF directors from sending institutions remarked on the change in the characteristics of students who have expressed interest in the MIP in recent years. One noted that her institution is now more likely to send math majors to the MIP than in previous years, because the institution has made other services (e.g. tutoring and workshops) accessible to students who only need to pass basic math courses (i.e. non-math majors).

Integrating methods of monitoring and evaluation within the MIP can significantly improve the program's ability to respond to students' needs. One need which does not seem adequately met is the availability of instruction in non-English languages.

ii. Accommodating English Language Learners (ELLs)

During the course of our interviews, several EOF directors and members of MIP personnel stated that English was a barrier to learning for many MIP participants. This is unsurprising, considering that a large proportion of EOF students are English language learners (ELLs).[14] While the 3-week structure of the MIP understandably requires a fast pace, steps can be taken to ensure that ELL students are not left behind.

First, demographic information for incoming students should be collected and analyzed to determine the native languages spoken by students. Second, to the extent possible, measures should be taken to accommodate the learning needs of these students. These measures should include recruiting tutors and resident advisers who are fluent in the language(s) that the majority of students speak and the availability of instructional materials in one or more language, in addition to English. This will allow students to better comprehend instructions and word problems, while also giving them confidence to ask questions in their native language. Instruction in more than one language is not expected to result in a reduced ability to learn English, as many

[14] From the transcript analysis, we found that four of the 112 students who participated in the MIP from 2008 to 2013 had enrolled in English as a Second Language (ESL) courses at their home colleges and an additional sixty-four had enrolled in remedial English or writing courses. While four out of 112 is a low proportion, most non-English speaking students who migrated to the United States prior to their junior year in high school likely took ESL courses in primary and secondary school, but may not have achieved a level of academic English necessary for high performance in math courses.

studies have identified the ability of bilingual instruction to improve comprehension in both the native and the new language (Chin, Daysal, and Imberman 2013; Baker et al. 2012).

The provision of instructional resources in more than one language can help to ensure that the benefits of the MIP are enjoyed by all. It can also facilitate the comprehension of instructions and mathematical terms in English, which may lead to medium-term benefits for students (e.g. higher grades in math courses and greater likelihood of graduating).

In addition to being able to understand class materials, students must maintain adequate focus during their classes and nightly tutoring sessions to enjoy the potential benefits of MIP participation. The structure of the 3-week long MIP, however, may prevent some students from enjoying the rest and leisure time that they need for maintaining focus during their classes.

iii. Incorporating weekly leisure time

The short duration of the MIP necessitates tightly-structured daily schedules for students. Students attend multiple classes during the day and then return to their dorms to complete homework and participate in tutoring sessions, which often end as late as 10pm. This structure leaves little room for leisure. Since many of these students are enrolled in commuter colleges, they have had little opportunity to interact and socialize with other college students. One of the potential benefits of MIP is that it affords these students the opportunity to expand their social networks and build potentially lasting relationships.

As students start to form relationships with their fellow classmates and dormmates, they naturally try to find time to socialize with each other. However, the rigid structure of the MIP prevents much socialization during the daytime. As an MIP personnel member remarked, students stayed up late to socialize and then were tired and unable to focus in their classes the next morning.

This situation can be remedied by incorporating some free time in the students' weekly schedules. While it is understandable that the MIP requires the condensing of a substantial

amount of course material into a three-week time frame, including leisure time at least once or twice a week can produce positive outcomes for students. The majority of MIP students are young adults, who typically like to enjoy the nightlife and go to sleep in the very early hours of the morning.

Accordingly, restructuring the class schedule one or two days each week to accommodate the students' need to socialize would best be done by starting class a couple of hours later than usual on those days. For example, if class normally begins at 8AM each morning, the start time can be postponed to 10AM on Friday mornings to allow students more time to rest. This will, of course, require some adjustment to the schedule for the rest of the day or week.

If MIP administrators decide that discipline is a key component of the program, the idea of incorporating time for late-night socializing may be antithetical to this goal. Another option is to impose a curfew on students, such as requiring them to be in bed at 11PM. Invariably, some students will attempt to violate curfew. These instances of violation will not only create one more duty for resident advisers (i.e. they will have to monitor the whereabouts of students at night), but they will create the need for disciplinary action by MIP staff. Resident advisers will have to decide whether to report these violations to staff, and staff will have to decide how to react to one or more violations. Ultimately, some students may be forced to leave the program due to repeated violations of curfew, which is a poor outcome for all parties involved.

A third option would reconcile the negative aspects of the first two options, but may be difficult to carry out. This option would require allowing students to remain in the dorms during the weekends. Understandably, barriers to incorporating this option likely exist, but it would allow the students to socialize without creating the need for curfews or adjusting the class schedule.

iv. Allowing students to stay on campus during weekends

Through our interviews with MIP personnel, we learned that students are required to leave the dorms on Friday afternoons and are allowed to return on Sunday. There are likely logistical or budgetary reasons for this requirement, so we understand that there are considerable obstacles

to implementing this recommendation. In the event that these obstacles can be overcome, we think that students can benefit significantly from eliminating this requirement.

Allowing students to remain in the dorms during weekends will give them leisure time to socialize with each other. Thus, leisure time would not have to be incorporated into their weekly schedules. There is, of course, still the possibility that students will choose to stay up late on weeknights, but we believe that this possibility is significantly reduced by allowing them to prolong their socializing until the weekend.

An additional benefit to permitting students to remain in the dorms during the weekends relates to the ability of the MIP to attract applicants from diverse regions in New Jersey. From 2008 to 2013, only six of the twenty-three schools (i.e. 26%) that sent students to MIP are located in South Jersey. These schools sent a total of twelve students to MIP during those six years (i.e. 11% of all MIP students), while schools in North Jersey sent 100 students. Among the most commonly cited barriers to MIP participation mentioned by EOF directors from sending institutions is the location of the MIP. Directors often stated that traveling to and from Stevens presented a significant obstacle for many students.

Since there are simply a greater number of higher education institutions in North than in Central and South Jersey, we do not expect the proportion of MIP students coming from institutions from these two regions to be equal. However, if a goal of the MIP is to help a diverse population of students achieve improved educational outcomes, then the amount of traveling to and from Stevens each weekend creates a barrier to inclusivity.

Eliminating the requirement for students to vacate the dorms each weekend will likely attract a greater number of applicants who live a significant distance from Hoboken. Furthermore, this will dissuade students from socializing late on weeknights, as they will have the opportunity to do so on the weekends.

While we are aware that barriers exist to implementing the aforementioned recommendations, we believe that any attempts to implement even some of them will enhance the MIP's progress toward its goals.

v. Increased collaboration between MIP personnel and EOF Directors

In the interviews we conducted with the EOF Directors and the MIP personnel, we found that increased collaboration between MIP personnel and EOF Directors is necessary to ensure further effectiveness of the program. One of the ways to do this would be through an "information session" where MIP personnel can meet the EOF Directors and counselors and let them know about the program before receiving application related materials. Furthermore, an information session would be a good platform where EOF Directors and counselors can share their institution's experiences with the program and provide relevant feedback. Through the interviews we conducted with the EOF Directors, we also found that some of them were recently appointed to the position and were not familiar with MIP. Thus, it is important to ensure that all the EOF Directors have the same information regarding the goals and requirements of the program.

In the interviews we conducted with the EOF Directors who did not have any students participate in the MIP, we found that their students had similar barriers to students that participated in MIP; the financial barrier being the greatest challenge. Thus, it would be helpful to communicate with these EOF Directors and counselors to let them know about the stipend options and get their feedback on what other challenges their students are facing. This way, EOF Directors and counselors can ensure all students have the opportunity to participate in MIP.

vi. Establishing a form of recognition

Students that participate in MIP don't receive college credits, nor does it contribute to their cumulative GPA. In the interviews we conducted with the EOF Directors who did not have any students participate in MIP in the past, we found that students at those institutions were more interested in taking summer classes that would provide college credits and help them pursue

their degree. While MIP is unable to provide participating students college credits, other forms of recognition can be implemented that would encourage more students to participate.

One of the ways to do this would be to receive an official certificate from the New Jersey Office of the Secretary of Higher Education that the students would receive after completing the program. The participating students would also be able to put this information on their resume so potential employers can see that even though the students previously had difficulty in their math classes, there were determined to overcome those difficulties through the program. Participating in MIP, a summer immersion program, is a big commitment and establishing forms of recognition would ensure that students feel more motivated and accomplished.

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Appendix A: Profile of sending institutions and students

Table A1: Schools sending students to MIP, 2008-2013

Institution	# of students	Percent	School Geography
Rutgers-New Brunswick	12	10.6	North
Saint Peter's University	12	10.6	North
Essex County College	11	9.7	North
Mercer County College	9	8.0	North
Kean University	8	7.1	North
Bloomfield College	6	5.3	North
Caldwell College	6	5.3	North
New Jersey Institute of Technology	6	5.3	North
Ramapo College	6	5.3	North
Union County College	6	5.3	North
Bergen Community College	5	4.4	North
The College of New Jersey	5	4.4	North
County College of Morris	3	2.7	North
Georgian Court University	3	2.7	South
Ocean County Community College	3	2.7	South
College of Saint Elizabeth	2	1.8	North
Rowan University	2	1.8	South
Rutgers-Newark	2	1.8	North
Salem County College	2	1.8	South
Camden County College	1	0.9	South
Farleigh Dickinson University	1	0.9	North
Hudson County College	1	0.9	North
Stockton College	1	0.9	South
Total	113	100.0	

School Geography:
North: sending institutions were classified as North Jersey if located within the counties of Bergen, Essex, Hudson, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Passaic, Somerset, Sussex, Union and Warren.
South: sending institutions were classified as South Jersey if located within the counties of Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Ocean and Salem.

Table A2: Number of students by year

Year	# of students
2008	24
2009	25
2010	10
2011	23
2012	13
2013	18
Total	113

Table A3: Number of transcripts received per year

	Transcript received		
Year	Yes	No	Percent
2008	22	2	91.7%
2009	25	0	100%
2010	10	0	100%
2011	23	0	100%
2012	12	1	92.3%
2013	18	0	100%
Total	110	3	97.3%

Table A4: Percent of students per year by institution type

	Institution type		
Year	2-year	4-year	Total
2008	33.3%	66.7%	100%
2009	20.0%	80.0%	100%
2010	40.0%	60.0%	100%
2011	30.4%	69.6%	100%
2012	38.5%	61.5%	100%
2013	66.7%	33.3%	100%
Total	36.3%	63.7%	100%
N	41	72	113

Table A5: Schools with EOF programs that did not send students to the MIP, 2008-2013

Institution	City	School Geography
Atlantic Cape Community College	Mays Landing	South
Brookdale Community College	Lincroft	North
Burlington County College	Pemberton	South
Centenary College	Hackettstown	North
Cumberland County College	Vineland	South
Drew University	Madison	North
Felician College	Lodi	North
Gloucester County College	Sewell	South
Middlesex County College	Edison	North
Monmouth University	West Long Branch	North
Montclair State University	Upper Montclair	North
New Jersey City University	Jersey City	North
Passaic County Community College	Paterson	North
Raritan Valley Community College	Somerville	North
Rider University	Lawrenceville	North
Seton Hall University	South Orange	North
Stevens Institute of Technology	Hoboken	North
Warren County Community College	Washington	North
William Paterson University of NJ	Wayne	North
School geography is defined in Table A1.		

Appendix B: Interview protocol for EOF Directors (sending institutions)

Interview Questions for EOF administrators and/or counselors from home institutions

Interview leader:
Date:
Institution:

Agenda:

1. Introduction of interviewer
2. Explanation of project, goals for the interview, confidentiality, and the type of information covered in the interview
3. Informed consent form (if interview conducted in person)
4. Interview questions

Materials needed:

1. Questionnaire
2. Informed consent form for interviewee (if interview conducted in person)
3. Computer or paper/pens

Introduction

Hello. My name is _____ and I am one of four graduate student researchers from the Edward J. Bloustein School of Planning and Public Policy at Rutgers University. We are working with the Office of the Secretary of Higher Education to evaluate the Mathematics Immersion Program. The goal of the evaluation is to assess the implementation of the Mathematics Immersion Program and to inform the Secretary of Higher Education and other state officials on how effective the Mathematics Immersion Program is in improving the mathematics preparation and performance of undergraduate students attending institutions in New Jersey, and to provide recommendations on how to strengthen the Mathematics Immersion Program for improved outcomes.

We would like to ask for a half hour of your time to better understand your experience with the program and the experience of your institution. Before proceeding with the interview, we would like to make sure that you received and understand the consent form we sent you. All information is strictly confidential and no names will be used in our report to the Secretary.

Do you have any questions for us before proceeding?

The following questions are about [institution name]

1. Which remedial or developmental courses are offered at *[institution name]*?

2. What proportion of incoming freshmen need to enroll in a remedial mathematics course?

3. On a scale of 1 to 10 (with 10 being the highest), how would you rate the preparedness of the average incoming freshman for a college-level mathematics course?

4. Which mathematical skills do you think are most often lacking in students here?

5. What are the characteristics of students who are enrolled in remedial mathematics courses? *[Probe: Are they typically older students, male or female, white or minority, parents...?]*

The following questions are about the Mathematics Immersion Program (MIP) at Stevens Institute of Technology.

6. Are you aware of the MIP program at Stevens Institute? *[If yes, proceed to question 6a. If no, go to question 7]*.

    a. How did you hear about the MIP program?

    b. Does *[institution name]* make efforts to increase awareness of MIP on its campus?

    c. If yes, please describe these efforts.

7. Has there been a change in the level of interest in MIP in recent years? *[Probe: Have the number of applicants increased, decreased, or remained constant in recent years?]*

8. How does the recommendation process work? Do students typically approach their guidance counselors for a recommendation to MIP? Do guidance counselors normally initiate the process by identifying potential candidates and notifying them of their suitability for the MIP?

9. Which qualities are important for students to have in order to be recommended to the MIP? *[Probe: Which qualities do guidance counselors look for when recommending students to the MIP?]*

10. Have there been instances in which a student applied to the MIP, but did not receive a recommendation from a guidance counselor? *[If yes, proceed to question 10a. If no, go to question 11.]*

    a. What happens in these instances? *[Probe: Do students continue with the application process? Do they gain admittance into MIP?]*

    b. Why might a guidance counselor refuse to recommend a student to MIP?

11. Does *[institution name]* offer assistance to students with the application process? If so, please describe the form of assistance.

12. Do you think that participating students have benefited from participation in MIP? *[If yes, go to question 12a. If no, go to question 12b.]*

    a. In which ways have they benefited? *[Go to question 13.]*

    b. What factors do you think might prevent a student from benefiting?

13. Are you aware of any other positive outcomes for students as a result of participation in MIP? *[Probe: For instance, has participation in MIP improved students' computer or communication skills?]*

14. Can you think of any barriers that might prevent students who need help with mathematics from participating in MIP?

15. Can you provide us with the names or email addresses of some students who have gone through MIP so we can ask them about their experiences?

16. We would also like to get data on students who were rejected by MIP, would it be possible to get some names or email addresses from those students as well?

17. Is there anything else we should know about MIP?

Appendix C: Interview protocol for MIP personnel

Interview Questions for MIP personnel (instructors/tutors)

Interview leader:
Date:
Interviewee:

Agenda:

1. Introduction of interviewer
2. Explanation of project, goals for the interview, confidentiality, and the type of information covered in the interview
3. Informed consent form
4. Interview questions

Materials needed:

1. Questionnaire
2. Informed consent form for interviewee
3. Computer or pens/paper

Introduction
Hello. My name is _____ and I am one of four graduate student researchers from the Edward J. Bloustein School of Planning and Public Policy at Rutgers University. We are working with the Office of the Secretary of Higher Education to evaluate the Mathematics Immersion Program. The goal of the evaluation is to assess the implementation of the Mathematics Immersion Program and to inform the Secretary of Higher Education and other state officials on how effective the Mathematics Immersion Program is in improving the mathematics preparation and performance of undergraduate students attending institutions in New Jersey, and to provide recommendations on how to strengthen the Mathematics Immersion Program for improved outcomes.

We would like to ask for a half hour of your time to better understand your experience with the program and the experience of your institution. Before proceeding with the interview, we would like to make sure that you received and understand the consent form we sent you. All information is strictly confidential and no names will be used in our report to the Secretary.

Do we have your informed consent to proceed?

Do you have any questions for us before proceeding?

Interview questions

1. Tell us about your history of involvement and role with the Mathematics Immersion Program? *[Probe: are you a teacher or tutor with the program?]*

2. Can you tell us about the Mathematics Immersion Program (MIP) generally? Just walk us through the process, beginning with how sending institutions and participating students are made aware of the MIP?

3. Do you believe that students who participate in MIP improve their math skills over the course of the program?

4. In your opinion, what are the greatest challenges participating students face when grasping math concepts?

5. Are there any non-math-related barriers participating students have indicated to you while completing the MIP? *[Probe: have students indicated any financial or logistical barriers to their participation in the MIP?]*

6. Do you think that the MIP has a positive, negative or neutral effect on the math anxiety of participating students? *[Probe: does the MIP lessen or increase the math anxiety of participating students?]*

7. Which learning strategies for mathematics would you impart on participating MIP students if you could?

8. Do you think that the MIP is successful in getting the math skills of participating students to where they need to be in order to take college-level math courses at their home institutions?

9. Which branches of mathematics, for example geometry or algebra, are emphasized in the MIP?

10. How do you deliver the material to participating students? Do you use traditional lectures, more hands-on approaches, or other methods?

11. Is the MIP curriculum more theoretical, or do you try to emphasize practical uses of math?

12. Have you kept in touch with any of the students you have had participate in the MIP?

    [If yes, go to questions 12a. only for instructors/administrators. If no, or interviewee is a tutor, go to question 13.]

    a. Would it be possible for you to provide us with their contact information?

13. Do you have any suggestions for improving the MIP?

14. Do you have any other information related to the MIP that you would like to share with us?

Appendix D: Student survey instrument

Student Survey Instrument

1. **What is the highest level math course you completed in high school?**
   Algebra I
   Geometry
   Algebra II
   Pre-Calculus
   Calculus
   Other: enter answer

2. **While taking the highest level math course, how many hours a week (on average) did you spend outside of the classroom either studying or completing homework assignments?**
   0-3 hours
   4-7 hours
   8-11 hours
   More than 11 hours
   Don't know/Refused

3. **While taking the highest level math course, did you seek additional assistance for your coursework from your instructor or a tutor outside of the classroom, or not?**
   Yes
   No
   Don't know/Refused

   b. *If yes,* **how many hours a week (on average) did you spend seeking additional assistance related to coursework from your instructor or a tutor outside of the classroom? [***If no***, go to Question 4]**
   0-4 hours
   5-9 hours
   More than 9 hours
   Don't know/Refused

4. **In your high school, were there tutoring services available to students who wanted to seek additional guidance in a particular subject area, or not?**
   Yes
   No
   Don't know/Refused

   b. *If yes,* **did you take advantage of these services? [***If no***, go to question 5]**
   Yes
   No
   Don't know/Refused

5. **After graduating high school, how confident did you feel about taking college level math?**
   Very confident
   Somewhat confident
   Somewhat unconfident
   Neither confident nor unconfident
   Very unconfident
   Don't know/Refused

6. **Before participating in the Mathematics Immersion Program, were you interested in pursuing a career that required taking advanced level math courses, or not?**
   Yes, interested in pursuing a career that required advanced level math courses
   No, not interested in pursuing a career that required advanced level math courses
   Don't know

7. **How adequate or inadequate was the assistance provided to you by your college during the application process for the Mathematics Immersion Program?**
   Very adequate
   Somewhat adequate
   Neither adequate nor inadequate
   Somewhat inadequate
   Very inadequate
   Don't know/Refuse to answer

8. **The following questions pertain to your experience with the Mathematics Immersion Program at Stevens Institute of Technology. Please indicate whether you strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, or strongly disagree with each statement:**

   Before participating in the Mathematics Immersion Program, I was not confident in my ability to take college level math courses

   The living on campus component of the program was a burden for me.

   The homework assignments enhanced my understanding of the material covered during class.

   The exams and quizzes enhanced my understanding of the material covered during class.

   The textbooks and other instructional materials used in the program were easy to understand.

The tutors were helpful in enhancing my understanding of the math concepts covered in class

The instructor provided opportunities for students in the class to ask questions.

I felt comfortable asking the instructor for clarification if I did not understand a particular concept.

The concepts I learned during the program encouraged me to take advanced level math courses at my college or university.

After completing the Mathematics Immersion Program, I was encouraged to pursue a career that required taking advanced level math courses.

Code for each statement:
Strongly agree
Somewhat agree
Neither agree nor disagree
Somewhat disagree
Strongly disagree
Don't know/Refused

9. **During your participation in the Mathematics Immersion Program, did you miss any lectures or tutoring sessions?**
   Yes
   No
   Don't know/Refused

   b. *If yes,* **how many classes did you miss during the Mathematics Immersion Program? [***If no***, go to Question 10]**
   Enter number:
   Don't know/Refused

10. **In your opinion, were the non-math related classes offered during the Mathematics Immersion Program (example: professional development and presentation skills) helpful in developing skills that you believe you will need to succeed in college, or not? Please state whether they were very helpful, somewhat helpful, neither helpful or unhelpful, somewhat unhelpful, or very unhelpful.**
    Very helpful
    Somewhat helpful
    Neither helpful or unhelpful
    Somewhat unhelpful
    Very unhelpful
    Don't know/Refused

11. How helpful was the final research project in helping you understand the math requirements of your chosen major and career path? Please state whether they were very helpful, somewhat helpful, neither helpful or unhelpful, somewhat unhelpful, or very unhelpful.
Very helpful
Somewhat helpful
Neither helpful or unhelpful
Somewhat unhelpful
Very unhelpful
Don't know/Refused

b. **If you could change one thing about the final research project, what would it be?**
Enter answer:

12. After completing the Mathematics Immersion Program, how confident did you feel about taking the next level math class at your home institution?
Very confident
Somewhat confident
Neither confident or unconfident
Somewhat unconfident
Very unconfident
Don't know/Refused

13. When taking the next level math classes, how confident did you feel with math concepts that were NOT taught during the Mathematics Immersion Program?
Very confident
Somewhat confident
Neither confident or unconfident
Somewhat unconfident
Very unconfident
Don't know/Refused

14. Would you recommend the Mathematics Immersion Program to other students at your home institution?
Yes
Maybe
No
Don't know/Refused

15. Please use the space below to share any other comments or experiences you had about the Mathematics Immersion Program.
Enter answer:

Appendix E: Interview protocol for EOF Directors (non-sending institutions)

Interview Questions for EOF administrators and/or counselors from home institutions

Interview leader:
Date:
Institution:

Agenda:

1. Introduction of interviewer
2. Explanation of project, goals for the interview, confidentiality, and the type of information covered in the interview
3. Informed consent form (if interview conducted in person)
4. Interview questions

Materials needed:

1. Questionnaire
2. Informed consent form for interviewee (if interview conducted in person)
3. Computer or paper/pens

Introduction

Hello. My name is _____ and I am one of four graduate student researchers from the Edward J. Bloustein School of Planning and Public Policy at Rutgers University. We are working with the Office of the Secretary of Higher Education to evaluate the Mathematics Immersion Program. The goal of the evaluation is to assess the implementation of the Mathematics Immersion Program and to inform the Secretary of Higher Education and other state officials on how effective the Mathematics Immersion Program is in improving the mathematics preparation and performance of undergraduate students attending institutions in New Jersey, and to provide recommendations on how to strengthen the Mathematics Immersion Program for improved outcomes.

We would like to ask for a half hour of your time to better understand your experience with the program and the experience of your institution. Before proceeding with the interview, we would like to make sure that you received and understand the consent form we sent you. All information is strictly confidential and no names will be used in our report to the Secretary.

Do we have your informed consent to proceed?

Do you have any questions for us before proceeding?

The following questions are about [institution name]

1. Which remedial or developmental courses are offered at *[institution name]*?

2. What proportion of incoming freshmen need to enroll in a remedial mathematics course?

3. On a scale of 1 to 10 (with 10 being the highest), how would you rate the preparedness of the average incoming freshman for a college-level mathematics course?

4. Which mathematical skills do you think are most often lacking in students here?

5. What are the characteristics of students who are enrolled in remedial mathematics courses? *[Probe: Are they typically older students, male or female, white or minority, parents...?]*

The following questions are about the Mathematics Immersion Program (MIP) at Stevens Institute of Technology.

6. Are you aware of the MIP program at Stevens Institute? *[If yes, proceed to question 6a. If no, go to question 7]*.

    a. How did you hear about the MIP program? *[Probe: Do you receive email communications regarding the MIP from administrators at Stevens Institute? If yes, what timeframe do you normally receive these communications?]*

    b. Does *[institution name]* make efforts to increase awareness of MIP on its campus?

    c. If yes, please describe these efforts.

7. Have students at *[institution name]* expressed interest in the MIP during the last six years? *[If yes, proceed to question 7a. If no, go to question 8]*.

    a. How many students expressed interest in attending the MIP during this time period?

    b. Did any of these students apply to the MIP during this time period? *[If no, go to question 7c—d. If yes, go to questions 7e—7f]*.

    c. Did these student(s) request recommendation(s) from their guidance counselors?

    d. What factors, if any, led interested students not to apply to the MIP? Please describe these factors.

    e. Were any of the students who applied to the MIP during this time period accepted? If yes, how many? *[If yes, go to question 7d. If no, go to question 8]*.

f. What factors, if any, led accepted students not to attend the MIP? Please describe these factors.

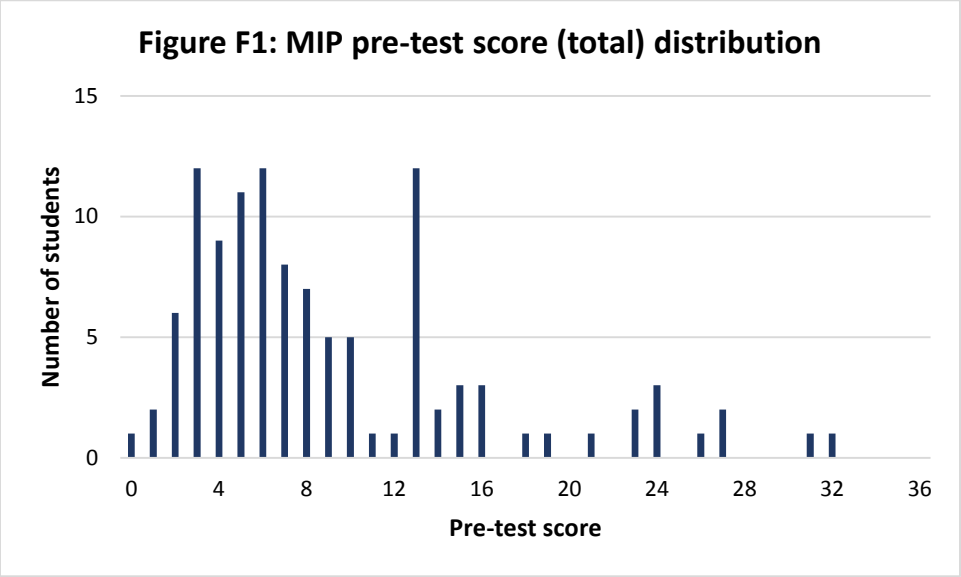
8. Do counselors at *[institution name]* actively target specific types of students to attend the MIP? *[If yes, go to question 8a. If no, go to question 9]*.

    a. What characteristics do counselors look for in potential participants? *[Probe: Do guidance counselors target students who perform well in their math classes, have math or related majors, or other characteristics?]*

9. Which qualities are important for students to have in order to be recommended to the MIP? *[Probe: Which qualities do guidance counselors look for before recommending students to the MIP?]*

Can you think of any barriers that might prevent interested students who need help with mathematics from participating in the MIP? *[Probe: Are there financial, logistical, and/or other barriers for students?]*

Appendix F: Student performance in the MIP (pre-test/post-test scores)



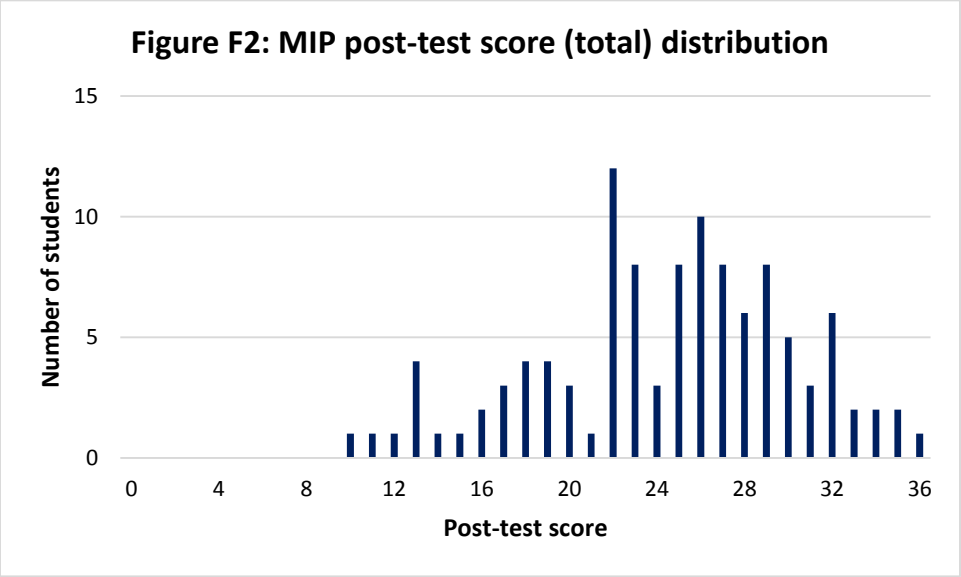


Table F1: Pre-test/post-test descriptive statistics

Component	Score	N	Minimum	Maximum	Mean	Median	Std. Deviation
Total	Pre-test	113	0	32	9.19	7.00	6.902
	Post-test	110	10	36	24.52	25.00	5.788
	Delta	110	-5	30	15.33	18.00	6.856
Algebra	Pre-test	113	0	22	7.86	6.00	5.13
	Post-test	110	7	23	17.05	17.50	3.744
Trigonometry	Pre-test	113	0	6	0.81	0.00	1.511
	Post-test	110	0	7	3.90	4.00	1.792
Logarithms	Pre-test	113	0	5	0.53	0.00	1.061
	Post-test	110	0	6	3.56	4.00	1.475

Pre-test and post-test have a total possible maximum score of 36. The algebra component has a total possible maximum score of 23; trigonometry is out of 7 and logarithms is out of 6.

Table F2: Pre-test/post-test score combination

Combination	# of students	Percent
High/High	27	24.5%
Low/High	26	23.6%
High/Low	12	10.9%
Low/Low	45	40.9%
Total	110	100%

Low pre-test score = 9 and below
Low post-test score = 25 and below
High pre-test score = 10 and above
High post-test score = 26 and above

Table F3: MIP pre-test/post-test score (total): paired samples statistics

Component	Score	Mean	N	Std. Deviation	Std. Error Mean
Total	Pre-test	9.19	110	6.858	0.654
	Post-test	24.52	110	5.788	0.552
Algebra	Pre-test	7.82	110	5.007	0.0477
	Post-test	17.05	110	3.744	0.357
Logarithms	Pre-test	0.55	110	1.072	0.102
	Post-test	3.56	110	1.475	0.141
Trigonometry	Pre-test	0.83	110	1.526	0.145
	Post-test	3.90	110	1.792	0.171

Table F4: MIP pre-test/post-test score: paired samples correlations

Component	Measure	N	Correlation	Sig.
Total	Pre-test & Post-test	110	0.422	0.000
Algebra	Pre-test & Post-test	110	0.357	0.000
Logarithms	Pre-test & Post-test	110	0.309	0.001
Trigonometry	Pre-test & Post-test	110	0.312	0.001

Table F5: MIP pre-test/post-test score (total): paired samples test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
Component	Measure	Mean	Std. Dev.	Std. Error Mean	Lower	Upper			
Total	Pre-test - Post-test	-15.327	6.858	0.654	-16.623	-14.031	-23.441	109	0.000
Algebra	Pre-test - Post-test	-9.236	5.068	0.483	-10.194	-8.279	-19.114	109	0.000
Logarithms	Pre-test - Post-test	-3.018	1.532	0.146	-3.308	-2.729	-20.657	109	0.000
Trigonometry	Pre-test - Post-test	-3.073	1.957	0.187	-3.443	-2.703	-16.468	109	0.000

Appendix G: Specific academic outcomes

Table G1: Specific academic outcomes

Overall outcome	Specific academic outcome	# of students	Percent	Cumulative Percent
Positive, math or related	Degree; math or related	19	17.3	17.3
	In progress; math or related; GPA ≥ 2.0; w/in timeframe	18	16.4	33.7
	Other (non-degree certificate)*	1	0.9	34.6
Positive, non-math or related	Degree; non-math or related	20	18.2	52.8
	In progress; non-math or related; GPA ≥ 2.0; w/in timeframe	14	12.7	65.5
	In progress; undeclared; GPA ≥ 2.0; w/in timeframe	4	3.6	69.1
Negative	Not in progress; non-math or related; GPA ≥ 2.0; w/in timeframe	8	7.3	76.4
	Not in progress; non-math or related; GPA < 2.0; w/in timeframe	6	5.5	81.9
	Not in progress; math or related; GPA ≥ 2.0; w/in timeframe	5	4.5	86.4
	Not in progress; math or related; GPA < 2.0; w/in timeframe	4	3.6	90.0
	Not in progress; undeclared; GPA ≥ 2.0; w/in timeframe	1	0.9	90.9
Indeterminate	In progress; non-math or related; GPA < 2.0; w/in timeframe	6	5.5	96.4
	In progress; math or related; GPA ≥ 2.0; not in timeframe	3	2.7	99.1
	In progress; non-math or related; GPA ≥ 2.0; not in timeframe	1	0.9	100.0
	Total	110	100.0	

*Other (non-degree certificate) categorized as positive, math or related because certificate was in a technical field and student performed well (GPA ≥ 2.0)