PROGRAM REVIEW

DEVELOPMENTAL MATHEMATICS PROGRAM

November 2012

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I. Program Overview

Introduction

The mission of the Developmental Mathematics Program is to provide all students, regardless of their academic preparation, with the means to develop the foundational mathematical skills necessary to meet their educational plans. The heart of the Developmental Mathematics Program consists of a collection of non-transferable mathematics courses: Arithmetic (Math 12), Pre-algebra (Math 23, math 25), Elementary Algebra (Math 40), Basic Accelerated Mathematics (Math 50D, soon to be Math 37), General Education Mathematics (Math 50C, soon to be Math 67), Intermediate Algebra for General Education (Math 73) and Intermediate Algebra for Science, Technology, Engineering, Mathematics (Math 80). Instructors teaching within the Developmental Mathematics Program share two goals. The first goal is to provide appropriate conceptual and computational preparation to enable students to advance to the necessary mathematics courses for their certificate, major, or transfer plans. The second goal is to provide a valuable mathematical experience in which students gain an appreciation for, an understanding of, and basic utility with the mathematics that they will encounter in their everyday lives. These goals are in line with the college mission statement: "El Camino College offers quality comprehensive educational programs and services to ensure the educational success of students from our diverse community."

The impact of the Developmental Mathematics Program is broad; in any semester, roughly 30% of the total El Camino College student population is enrolled in one of these courses.

The faculty who teach within the Developmental Mathematics Program are committed to continuous improvement. We use external recommendations from educational and professional societies, such as the Research and Planning (RP) Group of the California Community Colleges, the American Mathematical Association of Two-Year Colleges (AMATYC), and the Student Success Task Force. We use evidence from ECC Institutional Research and assessments of student learning to make informed decisions. We also collaborate to discuss ways to improve student success (Strategic Initiative B) and create professional development opportunities for full-time and adjunct instructors that promote the use of a variety of instructional methods (Strategic Initiative A) that serve the diversity of students in our program.

Recent longitudinal studies reveal deeply disconcerting evidence that far too few college students are completing the associate-degree-level mathematics courses and even fewer ever succeed in a transfer-level mathematics course. The picture is bleakest for students placing at the arithmetic level, but the statistics for students entering at higher levels, while slightly better, is still dismal.

Figure 1 presents the data for the cohort of students who enrolled in Arithmetic (Mathematics 12) for the first time in Fall 2008. Within four years, only 112 of the original cohort of 1069 students, or about 11%, successfully completed Intermediate Algebra (the developmental completion rate) and 59 of 1069, or slightly less than 6%, successfully completed a transfer-level mathematics course (the transfer-level completion rate). These outcomes are unacceptable. It is imperative we improve the situation, but how?

One tactic would be to improve the success rates in the individual courses. The faculty who teach within the Developmental Mathematics Program will continue to improve our effectiveness as instructors through professional development opportunities. We will continue to support programs, such as Supplemental Instruction and Counselor Intervention, which have shown much promise. However, these strategies are likely to have only an incremental and modest positive effect on our developmental and transfer-level completion rates.

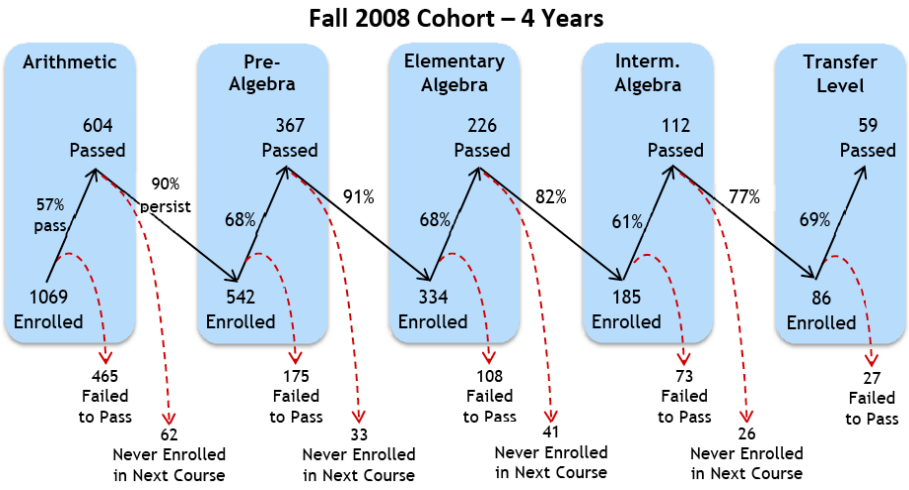


Figure 1: After four years, 11% passed Intermediate Algebra and 6% passed a transfer-level mathematics course.

The 11% developmental completion rate is the product of the course success rates and the intervening persistence rates. In other words,

$$11\% \approx (57\%) \times (90\%) \times (68\%) \times (91\%) \times (68\%) \times (82\%) \times (61\%).$$

Increasing the success rates in individual courses is possible and will improve the developmental completion rate. However, reducing the number of courses in the developmental sequence would have a more significant impact. If, for example, students who place in arithmetic were to have a four-semester developmental pathway where each course had an unrealistic success rate of 80% and a course-to-course persistence rate of 90%, we would have a 30% developmental completion rate. In contrast, if these same students were to have a two-semester accelerated developmental pathway, and if each course had a more realistic success rate of 60% and the same 90% persistence rate, we would see a 32% developmental completion rate for these students in half the time.

In response to our poor developmental and transfer-level completion rates, the Developmental Mathematics Program set for itself the following challenge:

> "Design and offer a program of courses and support services so that all El Camino College students have the opportunity to be ready for a transfer-level mathematics course after at most two semesters."

The faculty has made some preliminary steps in this direction. Since Fall 2011, we have been testing two new courses, Basic Accelerated Mathematics (BAM) and General Education Algebra (GEA). This accelerated pathway, in conjunction with our traditional developmental sequence, is our first response to this challenge.

Other projects that deserve our attention include creating more sustainable and meaningful assessment procedures for our program and course student learning outcomes; scaling up our placement support programs by offering more Summer Mathematics Academy courses and having more students use a program such as My Math Test to prepare for the placement test; and developing alternatives to intermediate algebra for Career Technical Education (CTE) students seeking an associate degree.

The faculty working on these projects has a diversity of talents and experiences. But the team is relatively small and their collective energy is stretched thin. We must find ways of growing the number of instructors who contribute their time and effort outside the classroom to the many tasks necessary for running the Developmental Mathematics Program, such as learning assessments, course reviews, and program review.

In this program review, we present the work we have done; the challenges we face and our initial responses; and how, through future institutional support and collaboration, the Developmental Mathematics Program will continue to help all students develop the foundational mathematical and quantitative reasoning skills they will need to attain their academic goals.

Note: The analyses and recommendations contained in this program review are those of the committee who conducted the research and created the document. We are advocating for change, but we cannot nor do we intend to impose change. A vote was taken at the December 6, 2012, Mathematics Department meeting: 15 approved this document and 22 disapproved. Since this vote, numerous revisions have been made based on comments received from mathematics faculty and the college-wide program review committee.

Program Description

There are two primary sequences in the Developmental Mathematics Program; a traditional four-course sequence, **Basic Arithmetic → Pre-Algebra → Elementary Algebra → Intermediate Algebra,** and an accelerated two-course sequence, **Basic Accelerated Mathematics (BAM) → General Education Algebra (GEA).**

The accelerated sequence is new and still under development. Students may move from one sequence to another, as needed. Together, the two sequences support all developmental mathematics students, regardless of their educational goals. We include more details about our new accelerated sequence in our Institutional Research, Curriculum and Staffing/Professional Development sections. Figure 2 provides a quick look at our program.

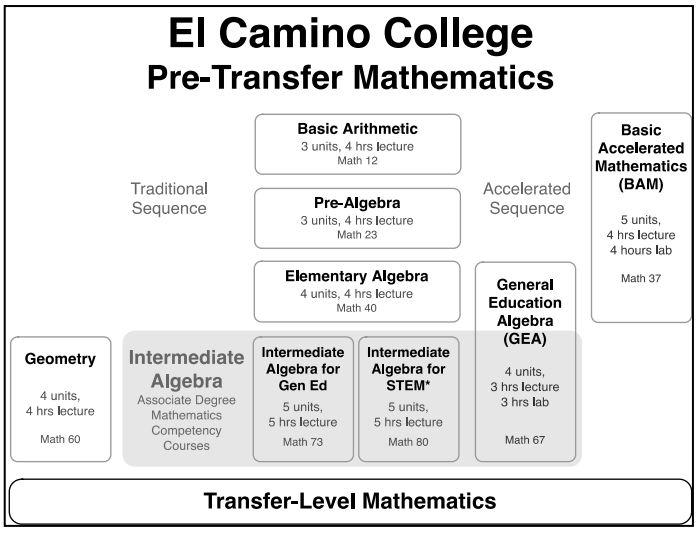


Figure 2: Course Sequence Diagrams, after the Introduction of the Accelerated Developmental Courses

In addition to courses, the Developmental Mathematics Program helps coordinate a number of instructional support services (tutoring and supplemental instruction); placement support efforts (Summer Math Academies and MyMathTest); and student support projects, such as Counselor Intervention. Using Title V (Mathematics Title V and the Graduation Initiative) and Basic Skills Initiative funds, we have also sponsored multiple professional development opportunities for full-time and adjunct faculty, including Faculty Cohorts, BSI Teacher Development Workshops, and the Summer Institute for Developmental Education (SIDE).

Status of Previous Recommendations

We list the recommendations from the previous Basic Skills program review, completed in April 1, 2008. We have grouped them into two categories (active and inactive) and have addressed the status of similar recommendations together.

Active Recommendations	
Recommendation	Status
Recommendation A: Increase the number of full-time math instructor positions, including those dedicated to teaching basic skills courses.	**In Progress** *The number of full-time instructors has remained nearly constant these past four years, between 38 and 40. New hires have replaced faculty who have left or retired. In the past four years, most new instructors have become involved with the Developmental Mathematics Program. We hope we can continue this trend. Increasing the number of full-time instructors dedicated primarily to developmental mathematics would* ***support Strategic Initiatives A and B.***
Recommendation B: Offer more sections of basic skills math courses during "prime time" (weekdays between 9 AM – 3 PM), while maintaining the current level of offerings at the transfer level.	**Not Done** *Due to the budget cuts in the past four years, sharp reductions in the number of sections of developmental mathematics courses have occurred, particularly at the lowest levels. The developmental math program has borne the brunt of the mathematics department's budget cuts. At this time, this recommendation is no longer a concern.*
Recommendation C: Coordinate resources with the Basic Skills Initiative (BSI) campus wide. **Recommendation D:** Develop strategies for improving the success rate in the basic skills math courses.	**In Progress** *The Basic Skills Initiative (BSI) has been an important feature in the developmental math program. Its activities have promoted increased student success in multiple ways. BSI, with the assistance of the Title V Graduation Initiative, has funded most of professional development opportunities for full-time and adjunct instructors through the BSI Teacher Development Workshops and the Summer Institute for Developmental Education. Despite the difficulties of coordination across disciplines, English and Mathematics have coordinated professional Development efforts with SIDE.* *Together with the Mathematics Title V Grant (MTV), BSI has supported Supplemental Instruction (a peer mentoring program) and "Just-In-Time" Workshops (a weekly tutorial program). BSI also supported the Counselor Intervention program and the Summer Math Academies (a placement support program). BSI also helped fund the math study center tutoring program.* *Developmental Mathematics instructors have participated in evaluating both of these programs. These efforts* ***support Strategic Initiatives A and B.***

Recommendation E: Increase faculty training specific to teaching basic skills math courses.	**In Progress** *The Title V Graduation Initiative supported the Developmental Education Specialist Certification of two instructors (one from mathematics and one from English) at the National Center for Developmental Education.* *MTV supported the Faculty Cohorts Project, in which teams of instructors (both full-time and adjunct), worked on semester-long projects to improve student learning, met weekly to discuss pedagogy, and shared resources, including office hours. There now exists a compendium of activities for all of our developmental math courses and are available online for any instructor to use. All of these efforts* ***support Strategic Initiative A, B and C.***
Recommendation F: Increase office space for adjunct faculty and grant them paid office hours.	**In Progress** *Currently, we still do not pay adjunct faculty to hold office hours, so students in sections taught by adjunct instructors are still denied access to the instructional support available to students in sections taught by full-time instructors. For the students in the Developmental Mathematics Program, where adjunct instructors teach 60% of sections, this is a serious issue of equitable access to support services. The lack of office hours for these students* ***undermines Strategic Initiative B.*** *On a positive note, with the reservation of room MCS 218 for adjunct faculty, and our expectation to continue offering adjunct instructors office space in the new MBA building, where adjunct instructors will have the opportunity to hold office hours. These developments* ***support Strategic Initiative F****.*
Recommendation G: Develop and institute a tutor-training program for all tutors in the mathematics department.	**In Progress** *Supplemental instruction coaches are considered peer tutors and receive 20 hours of professional development per semester. This current year (2012), a plan has been developed by the Tutoring Committee to institute an extensive tutor-training program. These developments* ***support Strategic Initiative B.***
Recommendation H: Create and maintain Student Learning Objectives (SLOs).	**In Progress** *The Developmental Mathematics Program has developed aligned program and course student learning outcomes. Multiple assessment cycles have been completed. In response to our assessment results, we are now redesigning our entire assessment process to improve adjunct instructor participation and assess all program-level student learning outcomes twice in a four-year cycle. Further details are included in the SLO Assessment These developments* ***support Strategic Initiatives A and B.***
Recommendation K: Increase and fund Supplemental Instruction.	**In Progress** *The number of sections offering Supplemental Instruction (SI) has increased dramatically. The number of mathematics course sections with SI has increased from seven in Fall 2008 to 42 in Spring 2011. From 2008 through January, 2011, SI was supported in large part by BSI and MTV funds. Currently, SI is supported through general college funds. SI was institutionalized because of the evidence of its efficacy for students. These developments* ***support Strategic Initiative B.***

Inactive Recommendations	
Recommendation	Status
Recommendation I: Increase interaction with the math faculty at the Compton Center.	**Done** *The dean of the math department instituted a directive to include the Compton Education Center math department in all department correspondence. It has become our common practice to do so and the Compton math department is often represented in meetings regarding the developmental education program. At this time, this recommendation is no longer a concern.*
Recommendation J: Increase other faculty resources including While-You-Wait copy service.	**Not Done** *MYECC has become a valuable resource for the storage of department files and documents. The ability to send copy jobs to the copy center electronically has greatly improved copying services. At this time, this recommendation is no longer a concern.*
Recommendation L: Assess online offerings and resources.	**Done** *We have compared the success rates of our hybrid and face-to-face sections and found that the hybrid sections were generally just as successful as the face-to-face sections. At this time, this recommendation is no longer a concern.*

II. Research Data Analysis

Faculty in the Developmental Mathematics Program are committed to using research data to drive decisions. We gather information from our own assessments of student learning and through surveys of instructors and students; from the El Camino College Office of Institutional Research (ECC IR); from professional research studies in peer-reviewed journals; and from external professional resources, such as the Center for Urban Education (at USC), the National Association for Developmental Education (NADE), the American Mathematical Association for Two-Year Colleges (AMATYC), the Community College Research Center (CCRC), the Research and Planning Group for California Community Colleges (The RP Group). We also consider recommendations from the Chancellors Office, such as those found in the Student Success Task Force Report (SSTF).

Since 2008, the Mathematical Sciences Division has initiated a number of studies through the ECC IR in order to acquire baseline data, to evaluate the efficacy of ongoing programs, and in general to gauge the effectiveness of our efforts to increase student success. In this section, we highlight the data and the research results that have had the greatest impact on our decisions in the last four years. We focus on five areas.

1. STUDENT SUCCESS AND PROGRESS – AN EQUITY ISSUE – Tracking Reports

The results of a Four-Year Arithmetic Tracking Report were startling and it propelled the faculty leaders of the Developmental Mathematics Program into action. Arithmetic is four levels below transfer. In this study, the ECC IR tracked the cohort of 1069 students who enrolled in Arithmetic for the first time in Fall 2008 for **four** years to determine how many students successfully completed the developmental mathematics sequence and continued on to a transfer-level mathematics course. Over the course of four years, only 112 students (11% of the original cohort) completed the developmental mathematics sequence. Moreover, in those four years, only 59 students (6% of the original cohort) passed a transfer-level course.

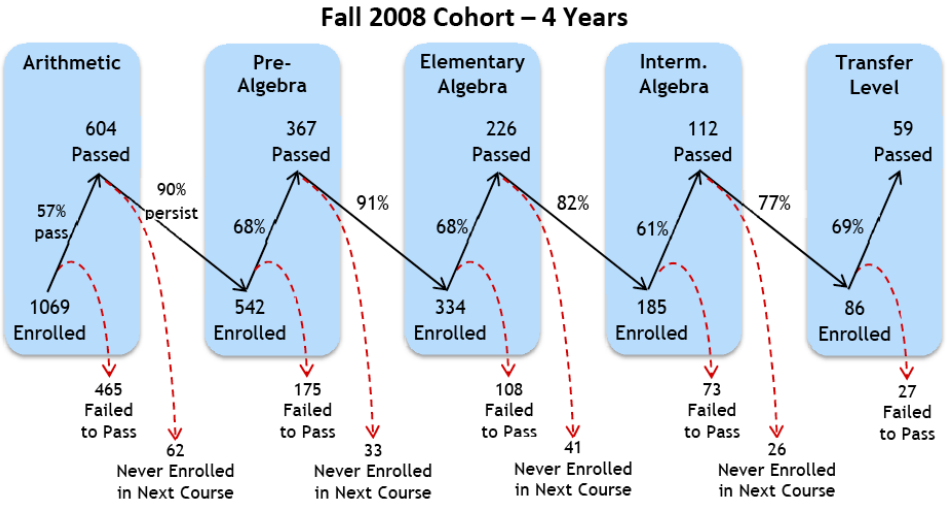


Figure 3: 11% developmental completion rate within four years
6% transfer-level completion rate within four years

The completion rates for students starting three or two levels below transfer are also not encouraging. The ECC IR Two-Year Pre-Algebra Tracking Report found that, of the students who first attempted Pre-Algebra (three levels below transfer) in Fall 2007, only 18% completed the developmental mathematics sequence and qualified for a transfer-level course. The ECC IR Two-Year Elementary Algebra Tracking Report found that, of the students who first attempted Math 40 (Elementary Algebra) in Fall 2007, only 30% completed the developmental mathematics sequence and only 12% completed a transfer-level course.

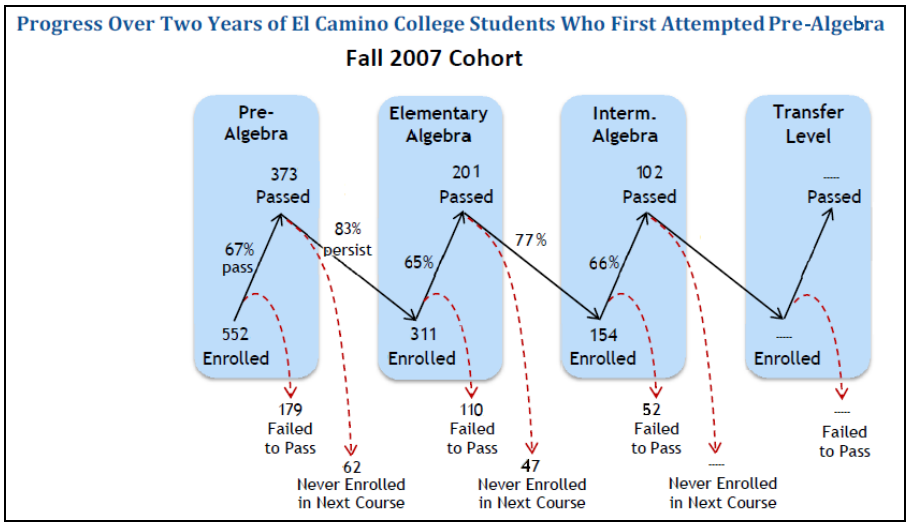


Figure 4: 18% developmental completion rate within two year (transfer-level completion rate not available)

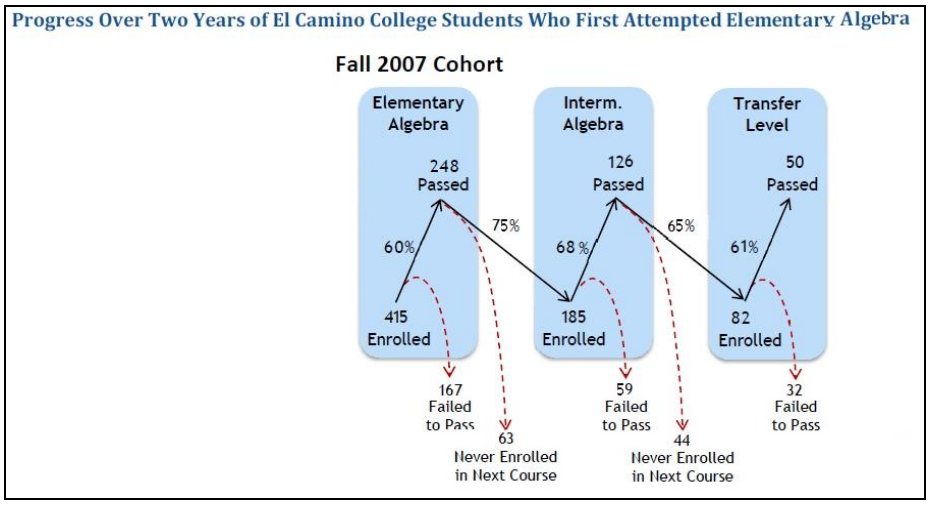


Figure 5: 30% developmental completion rate within two years 12% transfer-level completion rate within two years

There are also equity issues related to the long developmental course sequences. Figure 6 offers a look into the developmental course success rates, disaggregated by race and ethnicity for the developmental math courses. It is evident that success rates for African-Americans fall far below the average, Hispanic students are slightly above average and other ethnic groups are above average.

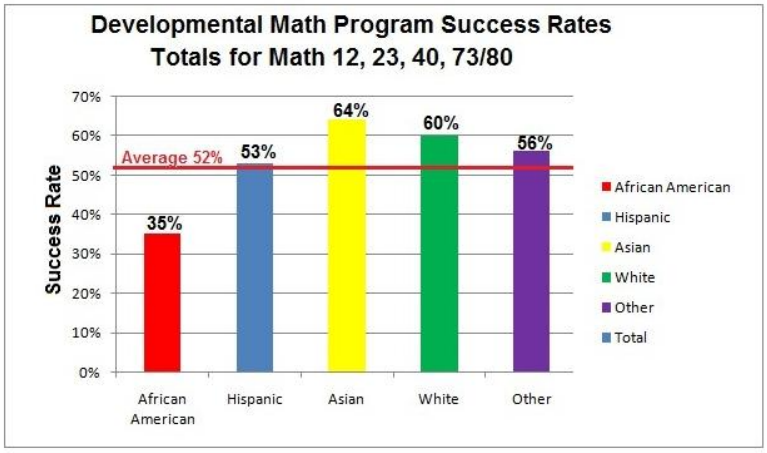


Figure 6: California Benchmarking Project
Disaggregated Developmental Math Success Rates

The significantly lower success rates for African-Americans demands our attention. A three-year tracking study of a cohort of students who first attempted Arithmetic (four levels below transfer) in Fall of 2009 provides a different perspective on the same issue. Figure 7 presents the data for all students in the cohort, Figure 8 looks at African-American students, and Figure 9 focuses on Hispanic students.

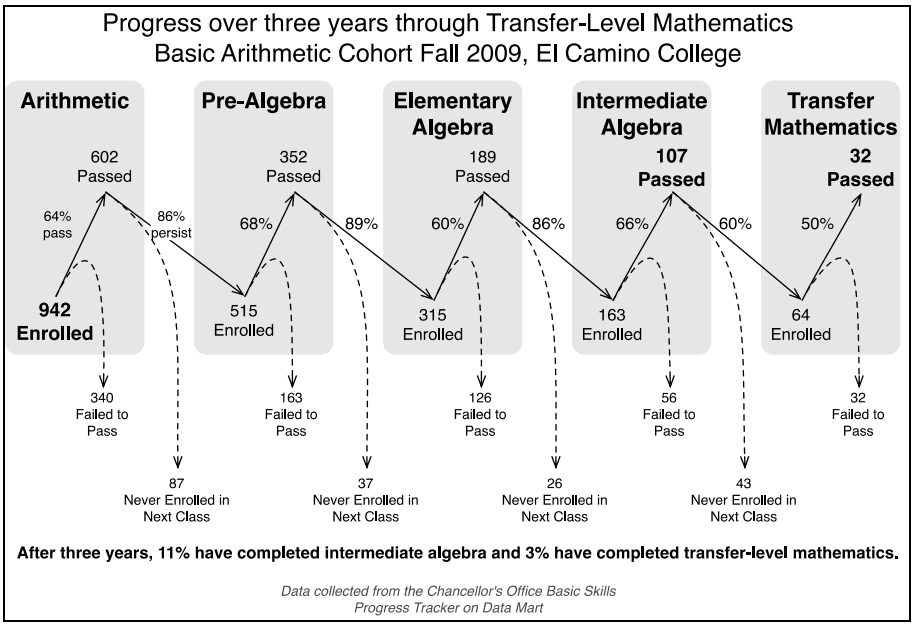


Figure 7: Fall 2009 Three-Year Tracking Report, All Arithmetic Students
11% developmental completion rate within three years
3% transfer-level completion rate within three years

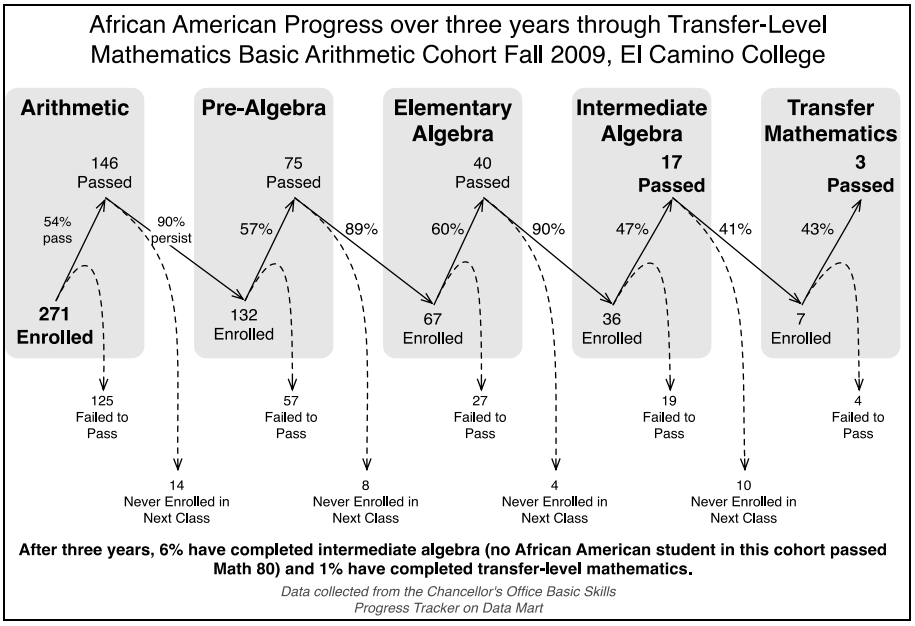


Figure 8: Fall 2009 Three-Year Tracking Report, African-American Students
6% developmental completion rate within four years
1% transfer-level completion rate within four years

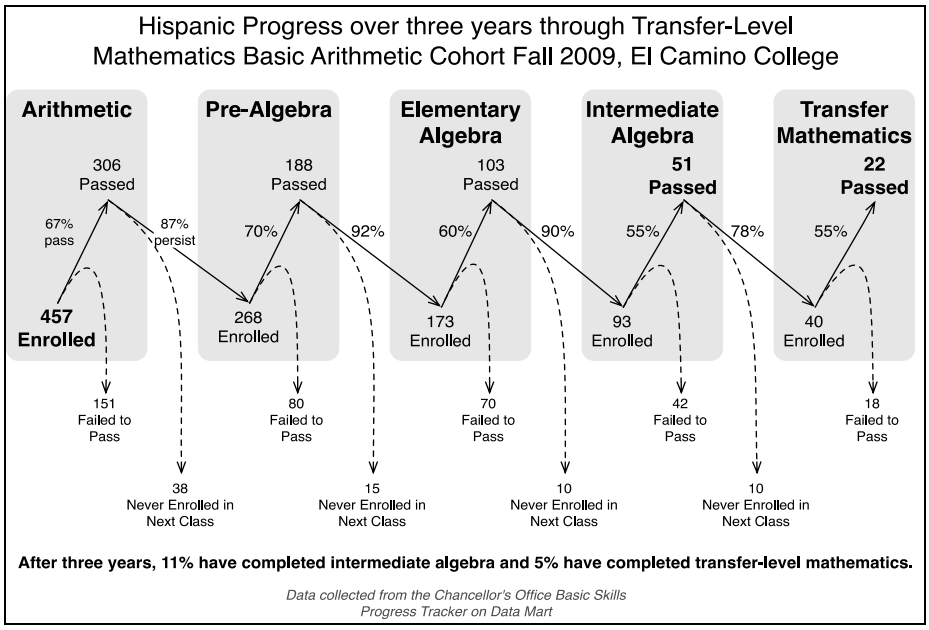


Figure 9: Fall 2009 Three-Year Tracking Report, Hispanic Students
11% developmental completion rate within four years
5% transfer-level completion rate within four years

Figure 7 shows an overall 11% developmental completion rate for this cohort of students. However, if we look at the data in Figure 8 for the African-American students (29% of this cohort), we find a 6% developmental completion rate. Even more disheartening is that, of the 17 African-American students who completed the developmental program, not one attempted Math 80, the Intermediate Algebra for STEM students. In Figure 9, we see that Hispanic students (49% of the cohort) completed the developmental sequence at nearly the same rate as all students, 11%. We plan to get more data

regarding these equity issues. Do other disciplines at ECC experience similar problems? Do other schools experience similar problems? What strategies have been successful in addressing similar disparate outcomes? The *Basic Skills as a Foundation for Student Success* (the Poppy Copy) promotes an effective practice of instruction that helps alleviate the achievement gap. We need to explore possible approaches.

The results at El Camino College are not unusual. Nationwide, we see similar developmental and transfer-level completion rates and similar equity issues. An increasing number of mathematics instructors across the nation recognize that a significant obstacle to student progress is the number of courses in the traditional developmental mathematics sequence. This is commonly called **the pipeline problem.** Researchers studying the pipeline problem conclude that it is both structural and curricular in nature.

Katie Hern (California Acceleration Project) notes that "as students fall away at each level, the pool of continuing students gets smaller and smaller until only a [small] fraction of the original group remains to complete the sequence" [Hern, 2010]. Thomas Bailey (Achieving the Dream) observes that many students "who complete one remedial course fail to show up for the next course in the sequence" [Bailey, 2010]. Shorter, accelerated developmental sequences appear to be a desirable alternative to the long traditional developmental mathematics sequence. In California alone, twenty community colleges are reshaping their developmental mathematics programs so that students have shorter pathways to transfer-level mathematics courses. At El Camino College, to reach this end, we created an accelerated course sequence: Basic Accelerated Mathematics (BAM) and the General Education Algebra (GEA). The accelerated sequence of courses is designed so that even students who place four levels below transfer can be eligible for a transfer-level course after just two semesters.

Content revision and pedagogical considerations are critical components of successful accelerated curricula. Long developmental course sequences not only produce more "drop-out" points between courses, but students face semesters of work before getting to mathematics that is interesting or pertinent to their intended careers. "As a result", David Bressoud (Mathematical Association of America) claims, "we often cut students off from their intended careers" [Bressoud, 2012]. Nikki Edgecombe reports that "preliminary analysis of accelerated classrooms suggests the frequent use of diversified instructional approaches that include more student-centered activities, such as peer-led small-group work and interactive student presentations" have the "potential to create more meaningful and engaging learning environments for students [Nikki Edgecombe, 2011]." The *Basic Skills as a Foundation for Student Success Report* [The Poppy Copy, 2007] recommends a pedagogical approach that emphasizes a "student-centered" rather than "teacher-centered" classroom environment, incorporating active learning strategies rather than passive learning strategies, where students are engaged in the learning process and collaborate with one another on mathematical problems. AMATYC, in *Beyond Crossroads* (2006), recommends the use of instructional strategies that provide for student activity and interaction and for student-constructed knowledge. Furthermore, the AMATYC standards are in agreement with the instructional recommendations contained in *Professional Standards for Teaching Mathematics* (NCTM, 1991).

The faculty designed BAM with the belief that students develop arithmetic and algebra skills more easily when they are contextualized and intertwined; that students can successfully set up and solve algebra problems before they become proficient at basic arithmetic; and that basic skills students benefit when college-readiness skills are embedded in the course. In the classroom, students with a wide variety of

numeracy skills engage with one another on activities. The content of the online portion of BAM is modularized, so that students can address their individual mathematical needs.

The faculty designed GEA with the belief that students will use their numeracy, algebra and mathematical reasoning skills most often in the context of making or understanding the decisions based on data and statistics. In the classroom, students engage in contextualized activities that focus on the elementary and intermediate algebra skills needed to learn how to pose questions about data and how to interpret data in a meaningful ways.

2. PLACEMENT ISSUES - Summer Math Academy 2008, 2009, 2011, 2012

The proper placement of new students into their first math course at ECC is critical. Many students are misplaced for a variety of reasons. Students who were enrolled in advanced math courses in high school are often placed into courses two-to-four levels below transfer. When asked, many students claim they didn't prepare for the placement exam and were unaware of the consequences of doing poorly on this exam. Many have reasonable algebra skills, but if they perform poorly on the arithmetic sections of the placement test they can be placed several levels below transfer. For the student, a poor placement score increases the number of math courses to be completed and lengthens the time it takes to earn an associate degree or transfer. Improving a student's placement by one level roughly doubles the student's chance of completing developmental mathematics.

The math department has enacted policies and programs to support student upward mobility through the placement procedure, most notably the Summer Math Academies offered to new incoming students in the summers of 2008, 2009, 2011, and 2012. Participants in these three-week intensive courses complete the Mathematics Placement Test (MPT) to ascertain their initial placement level. During the three weeks, students review and strengthen their mathematical skills. A mathematics instructor and a counselor provide students with the information and tools necessary for success in the math courses they take at El Camino College. At the end of the Summer Math Academy, students retake the MPT to determine their new placement level.

The 2012 Summer Math Academy experienced the greatest increase in size and scope of the program since its inception in 2008. With the added support of the Title V Graduation Initiative Grant and the Chevron Grant, the Summer Math Academy was able to offer opportunities for students placed into Pre-Calculus, as well as for students who placed into Arithmetic, Elementary Algebra, or Intermediate Algebra. Of the 125 students who completed the academies, 47% placed at least one level higher in the math sequence. Roughly 35% placed one level higher, 7% placed two levels higher, and 5% placed three levels higher.

Figure 10 shows that, after the Summer Math Academy, students who placed into developmental levels made significant gains. About 60% of the participants in the SMA Arithmetic (Math 12) course were placed in Pre-Algebra (Math 23) or higher, and 89% of the students who participated in the SMA Elementary Algebra (Math 40) course were subsequently placed into Math 80 or higher. For students in the SMA Intermediate Algebra (Math 80) course, 19% were placed at least one level higher at the end of the academy.

Summer Math Academy Course 2012	Percent Moved Up (At least one level of math)
Math 12	60%
Math 40	89%
Math 80	19%
Math 180	41%

Figure 10: 2012 Summer Math Academy Results

The data in Figure 11 offer further evidence of the success of the Summer Math Academy. For example, in the 2008 Summer Math Academy, 22 students were initially placed in Arithmetic (Math 12), but after the academy, 19 of the 22 placed into a higher level: 14 students placed into Pre-Algebra (Math 23), one student placed into Elementary Algebra (Math 40), and four placed into Intermediate Algebra (Math 73or Math 80).

Summer Math Academy Results 2008 - 2012

	2008		2009		2011		2012	
Course Placement	**Students Before SMA**	**Students After SMA**	**Students Before SMA**	**Students After SMA**	**Students Before SMA**	**Students After SMA**	**Students Before SMA**	**Students After SMA**
Math 12	22	3	36	20	55	26	40	16
Math 23	-	14	24	31	5	28	7	16
Math 40	-	1	-	9	8	8	17	9
Math 73/80	-	4	1	1	1	10	48	38
Math 180	-	-	-	-	-	-	13	14
Math 190	-	-	-	-	-	-	-	8

- **Summer Math Academy 2008:** Of 22 students, 86**%** completed the academy and placed into a higher-level math course. All participants were from the First-Year Experience program.
- **Summer Math Academy 2009**: Of 61 students, 39% completed the academy and placed into a higher-level math course. All participants were from EOPS.
- **Summer Math Academy 2011**: Of 69 students, 56% completed the academy and placed into a higher-level math course. All students were recruited from the pool of placement test takers.
- **Summer Math Academy 2012**: Of 125 students, 47% completed the academy and placed into a higher-level math course. All students were recruited from the pool of placement test takers.

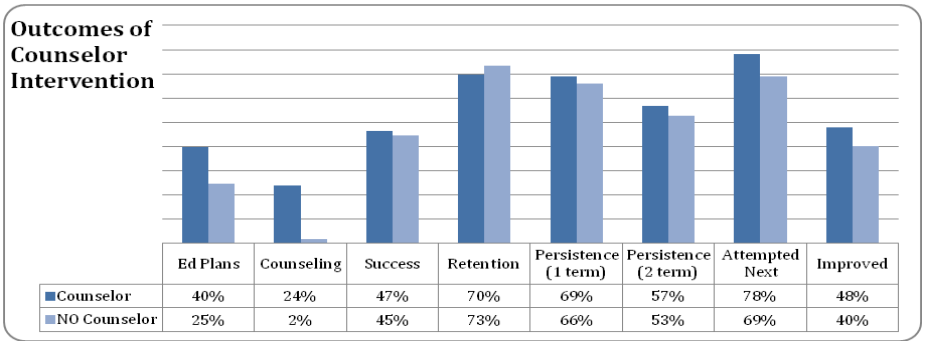
Figure 11: 2012 Summer Math Academy Results

Since 2008, the program has grown significantly and has served students well. We continue to seek the funding to pay for and expand this program.

We learn from the Summer Math Academies that students are often more capable than their MPT score indicates and we feel that giving students the opportunity to retake the MPT after some review is helpful. As a result of the success of the Summer Math Academies, we now have a policy of allowing Arithmetic students earning a grade of A or B the opportunity retake the MPT in order to place at a higher level. We plan to track these students to measure the success of this policy. We also plan to investigate similar programs at other community colleges to compare and learn how we can further improve.

3. COLLEGE READINESS – El Camino College Counselor Intervention – Outcomes Spring 2008 – Spring 2010

Beginning in Spring 2008, selected sections of Arithmetic were provided with an academic counselor to present student support services offered by the college along with regular mathematics instruction. The purpose of the Counselor Intervention Program (CI) was to promote student success and persistence by developing college success skills and increasing the number of basic skills students with education plans. The ECC IR studied the efficacy of the program (summarized in Figure 12) and found that 40% of students in sections of Arithmetic with a counselor established an educational plan during the same term, compared with 25% of students in sections without CI. Similarly, many more students in the CI-supported sections sought out other student support services, such as the Special Resource Center, compared with students in sections without a counselor (24% and 2%, respectively). Although the percentage of students passing Arithmetic was not much higher in the CI-supported sections than in the sections without a counselor, students in sections with counselors who passed the course seemed to receive an academic dividend exhibited by higher rates of achievement in the long-term outcomes of math progress, math improvement, and college persistence. College persistence rates were slightly higher (3-5 percentage points) for the CI-supported sections. More notable was that students who passed a CI-supported section of Arithmetic were more likely to attempt the next math course than students who passed a section of Arithmetic without a counselor (78% and 69%, respectively). Furthermore, successful Arithmetic students from CI-supported sections were also more likely to pass the next math class, with 48% passing their second math course compared with 40% from sections of Arithmetic without CI support.



	Ed Plans	Counseling	Success	Retention	Persistence (1 term)	Persistence (2 term)	Attempted Next	Improved
Counselor	40%	24%	47%	70%	69%	57%	78%	48%
NO Counselor	25%	2%	45%	73%	66%	53%	69%	40%

Figure 12: Comparing Arithmetic Sections with and without Counselor Intervention

As a result of this study, the Dean of Mathematical Sciences and the faculty of the Developmental Mathematics Program have decided that the Counselor Intervention Program is worth continued investment and support. The program is valuable because the persistence rates of our math students are an important factor in student progress through developmental mathematics. The Counselor Intervention Program is the only program so far that has shown an increase in these rates over the long term. Even with our plan to extend the Counselor Intervention Program to the new BAM courses, the program is sustainable because there are sufficient counselors to cover the two dozen Arithmetic and BAM sections offered each semester.

4. PROFFESIONAL DEVELOPMENT – Title V Grant Cohort 2006-2012 Success, Retention and Improvement Rate Analysis

In 2006, the math department was awarded the Mathematics Title V Grant (MTV), a Title V Hispanic-Serving Institution Cooperative Grant with Santa Monica College, to promote collaboration among instructors and create instructional materials that promote active learning methods. Some teams of faculty (faculty cohorts) wrote activities that emphasized conceptual learning to complement

computational learning for developmental mathematics students. Other teams focused on creating PowerPoint presentations of lectures that could be used effectively both in traditional face-to-face and hybrid online classes. As a result, all developmental mathematics courses (and three transfer-level courses) have handbooks containing interactive activities, coordinated homework sets, or PowerPoint presentations, designed to engage students. Faculty cohorts met regularly to create common course resources. One unexpected benefit of the faculty cohorts was that instructors agreed to open their office hours to all students in the cohort sections.

The collaboration that this grant fostered has created a team-like synergy that continues to manifest itself in many other ways in the department. The MTV grant initiated a culture of collaboration among faculty that has supported several of the department's innovative developments. Full and adjunct faculty share office hours, create active learning activities, create affective domain activities, plan acceleration courses (BAM, GEA), share assessment tools, and participate and contribute to in-house professional development workshops. The department has benefited greatly from this faculty collaboration and we continue to examine ways to include all interested faculty.

The lessons learned in the Faculty Cohorts informed much of the design of the BSI-funded Teacher Development Workshops and the Title V Graduation Initiative-funded Summer Institute for Developmental Education (SIDE).

In 2009, the ECC IR compared the success and retention rates for instructors participating in a cohort with instructors who did not participate in a cohort. The data in Figure 13 indicate that for a majority of these courses, cohort instructors had greater success and retention rates than non-cohort instructors.

Success and Retention Rates by Cohort Group vs. Non-Cohort Group

Course	Cohort	N	Successful (A-C)		Retained (Non-W)	
		Total	N	%	N	%
Math-12	Cohort	652	320	49.1%	491	75.3%
	Non-Cohort	1546	632	***40.9%***	1103	***71.3%***
Math-23	Cohort	407	189	46.4%	315	77.4%
	Non-Cohort	1872	972	***51.9%***	1489	***79.5%***
Math-40	Cohort	458	216	47.2%	330	72.1%
	Non-Cohort	2469	1049	***42.5%***	1722	***69.7%***
Math-60	Cohort	145	71	49.0%	105	72.4%
	Non-Cohort	141	79	***56.0%***	105	***74.5%***
Math-70	Cohort	524	261	49.8%	396	75.6%
	Non-Cohort	3532	1687	***47.8%***	2557	***72.4%***
Math-150	Cohort	479	251	52.4%	365	***76.2%***
	Non-Cohort	644	342	***53.1%***	442	68.6%
Math-170	Cohort	239	134	***56.1%***	191	***79.9%***
	Non-Cohort	398	185	46.5%	279	70.1%
Math-180	Cohort	162	110	***67.9%***	136	***84.0%***
	Non-Cohort	486	242	49.8%	329	67.7%

Figure 13: Comparison between Cohort and non-Cohort Sections

5. INSTRUCTIONAL SUPPORT – El Camino College Supplemental Instruction (SI) Analysis of Academic Outcomes Fall 2003 – 2009.

Data from an ECC IR study showed that Supplemental Instruction (SI) was a highly effective way to help students succeed in passing their mathematics courses. SI is a form of peer mentoring where more advanced students (SI coaches) are trained and assigned to mathematics classes to serve as in-class tutors and conduct workshops outside of class to assist students in passing. The entire analysis can be viewed at the ECC Institutional Research web page (www.elcamino.edu/administration/ir/).

Irene Graff, the Director of Institutional Research, conducted the study and observed that the success rates in sections supported by SI were 6% higher than in sections without SI. The difference in success rates was even more pronounced among developmental mathematics courses, where the success rate for SI-supported sections averaged 8% greater than success rates in sections without supplemental instruction. Moreover, in SI-supported basic skills sections, students who attend three or more SI sessions, are more likely to be successful than students who attend fewer than three sessions (75% and 51%, respectively). Even when controlling for other factors such as student academic preparation and full-time instructor status, the effects of SI remain. Irene Graff recommended Supplemental Instruction as an academic intervention with positive results.

As a result of this study, the number of mathematics course sections with SI has increased from seven in Fall 2008 to 42 in Spring 2011. The mathematics department has accepted and embraced the conclusions of this study and plans to incorporate SI as much as possible in future educational plans and policies. Within the Developmental Mathematics Program, we have made SI a central feature of our two accelerated courses.

Related Recommendations:

Recommendation 2012A.1 (Professional Development – Training Opportunities for BAM and GEA Instructors)

Recommendation 2012A.2 (Professional Development – Future Training Opportunities)

Recommendation 2012D.1 (Instructional Support Services – Expand Supplemental Instruction Program)

Recommendation 2012D.2 (Instructional Support Services – Expand Counselor Intervention)

Recommendation 2012C.3 (Staffing and Course Offerings – Faculty Course Cohorts)

Recommendation 2012E.1 (Placement and College Readiness – Expand the Summer Math Academies)

Recommendation 2012E.2 (Placement and College Readiness – MyMathTest Preparation for Placement)

III. Developmental Mathematics Curriculum

Current Curricular Challenge

The primary challenge facing the Developmental Mathematics program was summed up in the Program Overview sections, where we observed that when students taking Arithmetic for the first time in Fall 2008 were tracked over four years, roughly 10% qualified to take a transfer-level mathematics course and just under 6% successfully completed a transfer-level mathematics course. Faced with these and similar statistics from other student cohorts, the Developmental Mathematics Program created a set of accelerated courses that work alongside and with our traditional developmental sequence to offer all of our students (from our STEM and business majors to students whose only transfer-level mathematics course will be for general education purposes) the opportunity to reach a transfer-level mathematics after at most two semesters. Developing accelerated courses marks a significant departure from past practices. To see how, we examine the history of the Developmental Mathematics Curriculum at El Camino College.

History

The Developmental Mathematics Curriculum at El Camino College has always been a standard copy of the student-deficiencies-driven curriculum that developed over the course of five decades at most community colleges in California. As a result, we have a four-course developmental mathematics sequence: **Basic Arithmetic → Pre-Algebra → Elementary Algebra → Intermediate Algebra.**

Details of the history of how we came to this point are highlighted in Figure 14 below.

Year	Curricular Development
Prior to 1977	The **first pre-transfer mathematics courses** established: **Intermediate Algebra** (Math 80, formerly Math 70 and originally Math 1), **Elementary Algebra** (Math 40, originally Math A), **Geometry** (Math 60, formerly Math B) and a self-paced **Basic Arithmetic** course (Math 12, formerly Math 10A/10B, and originally Math R).
1988	**Pre-Algebra Review** (Math 25, originally Math PA) was created when too many students completing Math R were unable to pass Elementary Algebra.
1994	**Pre-Algebra** (Math 23, originally Math XPA) was created, that doubled the contact hours of Math 25 and **included group work** for all of the material in the course.
2001	An **additional lecture hour** was added to **Intermediate Algebra.** The **number** and **class-size** of the **large lecture sections** of **Elementary** and **Intermediate Algebra** were **reduced.**
2001	A two-semester version of Elementary Algebra, Extended **Elementary Algebra, Parts I and II** (Math 33/43, originally Math 41A/41B) was created to offer students a slower-paced option for elementary algebra.
2001	The idea of **Basic Arithmetic** as a completely self-paced course was abandoned and was replaced with **two eight-week courses** (Math 10A/10B).
2006	A more traditional 16-week version of **Basic Arithmetic** (Math 12) took the place of the two eight-week courses, Math 10A/10B, when these proved to be a logistically impractical.
2009	A second version of **Intermediate Algebra** (Math 73) for general education students was created, which narrowed the breadth of topics while increasing the depth of learning expected of students.

Figure 14: Developmental Mathematics Program Curriculum History

Despite all of these curricular adjustments, the only curricular changes that increased student success in significant, measurable and lasting ways occurred in those courses where we changed the instructional methods, increased student time-on-task, and adjusted the content to increase the depth of students' experience with each topic. Pre-Algebra, in which group work was incorporated into the course outline of record, consistently reveals the highest individual success rate among the developmental courses (averaging around 60% compared to elementary algebra, with a success rate that averages about 45%). Creating Intermediate Algebra for General Education (Math 73) increased the success rate slightly in both intermediate algebra courses.

With the advent of the statewide Basic Skills Initiative and the accreditation-motivated emphasis on using evidence in planning, we began working with the Office of Institutional Research in 2008 to create a data-driven narrative that explains the unacceptably low developmental completion and transfer-level completion rates in developmental mathematics. The results of this work are presented in Figure 15 below.

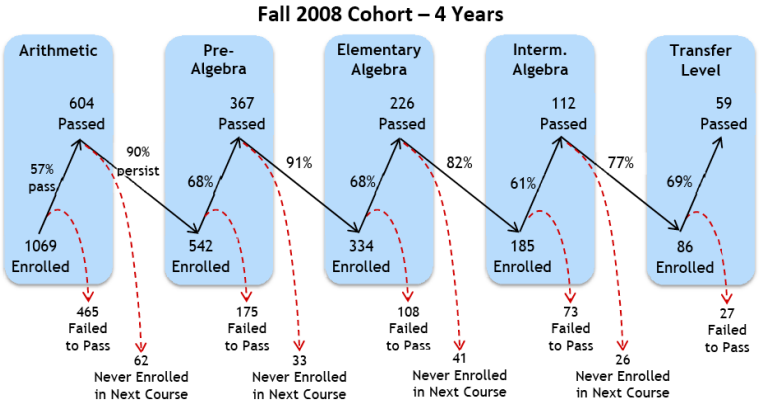


Figure 15: Fall 2008 Four-Year Tracking Report

Looking more carefully at this diagram, we see a clear illustration of the intrinsic shortcoming of a long developmental mathematics sequence: there are too many drop-out points along the way. Fully 79% of the students failed to pass the last math course they took in this sequence; about 15% passed the last course they took in the sequence, but failed to enter the next course. Not included in the diagram is the number of repeats at each level. In light of this analysis, shortening the sequence, while maintaining the quality of the courses in terms of student learning outcomes, became an imperative.

To address this situation, two accelerated courses were developed and piloted, starting in Fall 2011: Basic Accelerated Mathematics (currently experimental course Math 50D, soon to become Math 37) and General Education Algebra (GEA, currently experimental course Math 50C, soon to become Math 67).

Basic Accelerated Mathematics (BAM) is a pass/no pass, degree-applicable, five credit-unit course designed so that students gain the arithmetic and algebra competencies needed for success in an intermediate algebra-level course after one semester of intense work. This course is open to all students who place below the elementary algebra level. Students spend four hours a week in a computer laboratory, where they use a self-paced, mastery-learning online program designed to reinforce procedural knowledge. Students also spend four hours a week in a classroom, where they engage with activities that strengthen numeracy, problem solving skills, and conceptual understanding. An important feature of this course is its attention to affective learning. Students are required to explore activities that

promote positive self-belief and goal-setting techniques; effective self-management skills; assertive self-advocacy; and a wide variety of study skills. Some activities are embedded into the class itself. Other activities, such as creating an education plan with a counselor or regularly attending Supplemental Instruction sessions, are options a student can choose. The course has multiple exit target courses depending on each student's educational goals and demonstrated competencies.

General Education Algebra (GEA) is a graded, degree-applicable, four credit-unit course in which students, using descriptive statistics as the primary application, develop the algebraic and mathematical reasoning skills necessary to succeed in a transfer-level statistics course and other general education transfer-level mathematics course and which are important for a generally educated populace. This class is open to anyone who is eligible for elementary algebra and who is planning to take the transfer-level mathematics course for general education purposes only. Students spend three hours a week in a classroom working on group activities that explore algebraic concepts in the context of real world situations often involving data gathered from many sources, including data gathered by the GEA students themselves. Students also spend three hours a week in a computer laboratory, practicing algebra skills often involving contextual problems.

By themselves, these accelerated courses will not suddenly solve our problem in developmental mathematics, but both of these courses have shown some initial promise. For example, three sections of BAM were offered in Fall 2011, with 109 students, all of whom had placed into Arithmetic. After just one year, 39 students (36%) had completed developmental mathematics and 18 students (17%) had enrolled in a transfer-level mathematics course. In comparison, our Fall 2008 Arithmetic cohort (Figure 15) has an 11% developmental completion rate after four years and only 8% had enrolled in a transfer-level mathematics course. We expected a higher number of these BAM students to be enrolled in a transfer-level mathematics course this fall, but we ran into an unforeseen problem: Students passing BAM and GEA tend to have fewer total units than students progressing through the four-semester sequence. Our accelerated students have lower registration priority; many anecdotally, we know were not able to find space in a statistics course this fall. Four of the BAM and GEA students managed to enroll in Statistics (Mathematics 150) in Summer 2012 and two of these students passed, providing us with some modest proof-of-concept evidence. We will continue to study the effectiveness of the new accelerated sequence.

Course Creation and Review Procedures

Full-time and adjunct faculty from both campuses review the developmental mathematics programs on a regular, six-year cycle. Most of the developmental mathematics courses have been reviewed more frequently, in response to the design of our accelerated courses, BAM (Math 37) and GEA (Math 67). Figure 16 presents the review schedule for courses in the Developmental Mathematics Program.

Our course review process is quite extensive and designed to include multiple voices. The process starts at the program committee level, which is made up of faculty who generally teach these developmental mathematics courses. The committee begins by gathering data, including student success numbers, surveys of instructors teaching the course and instructors teaching subsequent courses, results of student learning assessments, and comparisons of the course with similar courses at other colleges. The committee then reviews the course outline of record for clarity; determines if all topics are still relevant and appropriate for the course and makes other adjustments, such as updating the representative textbook. Course reviews then undergo technical review by the Division Curriculum Committee (DCC)

and are presented to the entire department for final approval. We contend that this process allows for a thorough investigation of each course and continual improvement of its content and instruction. New courses are also subjected to this detailed review and approval process.

Course	Last Course Review	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5		YEAR 6	
		FA 12	SP 13	FA 13	SP 14	FA 14	SP 15	FA 15	SP 16	FA 16	SP 17	FA 17	SP 18
Math - Developmental		P							P	P			
MATH-100	2007-2008					X							
MATH-10A	2009-2010	I											
MATH-10B	2009-2010	I											
MATH-12	2007-2008							X					
MATH-23	2007-2008		X										
MATH-25	2006-2007		X										
MATH-33	2011-2012												X
MATH-50D/37	2010-2011	X											
MATH-40	2011-2012												X
MATH-43	2011-2012												X
MATH-60	2007-2008				X								
MATH-50C/67	2010-2011	X											
MATH-73	2008-2009	X											
MATH-80	2008-2009							X					

Figure 16: Six-year Course Review Cycle

Future Curricular Plans

As we work to examine the efficacy of accelerated pathways within Developmental Mathematics Program, we believe we will encounter opportunities to make our entire developmental program more effective and more cost-efficient. For example, if BAM proves successful for most of our students, we may reclassify our arithmetic course as noncredit, allowing us to hire instructors with no more than a bachelor's degree to teach students not yet ready for an accelerated curriculum. If GEA proves successful for the majority of our students, the need for two intermediate algebra tracks might disappear to the point where our Intermediate Algebra for General Education course (Mathematics 73) is either inactivated, or retooled and renamed to serve as an associate degree mathematics course for CTE students. We may repurpose our pre-algebra review (Mathematics 25) to serve as an apportionment-generating base for our Summer Math Academy at the arithmetic/pre-algebra level. As always, future curricular changes will be motivated by evidence, from IR and our own experiences as instructors.

Related Recommendations:

Recommendation 2012A.1 (Professional Development – Classroom Observation Opportunities for BAM and GEA Instructors)

Recommendation 2012A.2 (Professional Development – Future Training Opportunities)

Recommendation 2012C.1 (Staffing and Course Offerings – Growth and Study of BAM and GEA)

Recommendation 2012C.3 (Staffing and Course Offerings – Faculty Course Cohorts)

IV. Assessments of Student Learning (SLOs)

Annually, the Developmental Mathematics Program offers approximately 335 sections (75% of the sections offered by the department) and serves roughly 6000 students each semester (30% of the college's student population). Using the language in the ACCJC Rubric for the implementation of SLOs and assessments, the Developmental Mathematics Program has moved from the Development level to the Proficiency level in the last four years. Every assessment cycle has resulted in revised outcome statements and assessment instruments for the following cycle. At this point, each of our eight courses has four student learning outcomes; each outcome is aligned with one of our four program SLOs. Our assessments are authentic; student work is evaluated using common rubrics. Assessment data are analyzed, learning gaps identified, and recommendations propagated through both face-to-face and email dialogue. Using data from our course SLO assessments, two of the four program outcomes have been assessed at once and the results have indicated a few concerns that we have tried to address.

For example, the Program SLO, "Visual and Graphical Methods", was assessed in Fall 2011. Each course within the program assessed the course-level SLO aligned with this program SLO. The assessment questions were embedded in quizzes or exams. Instructors used a detailed rubric to rate each student's work as "excellent", "satisfactory" or "needs improvement". In addition to the rating for each student's work, the student's grade in the course was submitted. After examining the results, the committee felt that too many students were passing the course who scored a "needs improvement" on the SLO assessment. We concluded that students were too weak in this critical area of "using visual/graphical information to solve problems". We noted that some default textbooks for these courses did not offer many exercises that address this SLO. We recommended selecting more appropriate textbooks, making our expectations for visual and graphical methods of problem solving more explicit among instructors teaching these courses, and including activities in future professional development opportunities that specifically address how to better engage students with the more visual aspects of quantitative reasoning.

In the past four years, comprehensive reports for more than 40 course and program SLO assessments reports have been completed, the most recent 23 of them on CurricUNET. Course syllabi contain course SLO statements, which inform students about what they can expect to gain through taking the course.

The ACCJC Rubric describes the Sustainable level as one where systematic and deep assessments of learning outcomes are used for continuous quality improvement; where pervasive and robust dialogue regarding student learning takes place; where organizational structures are fine-tuned to support student learning; and where learning outcome assessments are more visibly linked with program reviews. Moving the SLO and assessment work within the Developmental Mathematics Program from Proficiency to the Sustainable offers us new challenges.

The Developmental Mathematics Committee is composed of 13 full-time instructors, who are responsible for coordinating student learning outcome assessments for eight courses (among other duties). The committee is convinced that conducting ongoing, systematic course and program learning outcome assessments is essential for continuous quality control and improvement. However, when the team of full-time instructors coordinating the assessments of thousands of students each semester is small, the team's inherent restricted capacity limits the quality of every phase of the assessment cycle. Assessment instruments and rubrics are kept simple in hopes of encouraging broad participation and producing a

manageable set of consistently evaluated data. In the review of the assessment data and their implications, the viewpoints of instructors who attend the meetings carry greater weight than those of other instructors. Besides email, no practical venue exists for including the insights of other instructors teaching the courses. Due to the simplicity of the data collected and the limited discussion, recommendations for improvement are general in nature. Rather than disseminating possible ways to improve student learning, the focus for closing each cycle becomes the logistical concerns for the next cycle. We would like to create more comprehensive assessment instruments, involve more voices throughout the assessment process, and have more thorough follow-up on each assessment cycle.

One challenge we have set for ourselves is to grow our capacity to coordinate large and meaningful assessment cycles. In the next year, we will develop a more complete action plan to meet this goal, but the first step in the process is already underway. In Spring 2013, we will develop a standard outcome assessment instrument for each course that will be used to assess student learning for all course SLOs every semester. We will continue to focus on one program SLO assessment each semester, but we will be able to use data from multiple semesters. This will allow us to do a better job of long-term tracking of student learning, as well as increase faculty participation. In Fall 2013, this new assessment instrument will allow us to initiate a more robust four-year assessment cycle, where all course SLOs will be assessed each semester and each program SLO will be assessed twice in every four-year cycle.

Recommendation 2012F.1 (Student Learning Outcome Assessments – Improve the Quality of Assessment Cycles)

V. Facilities and Equipment

The Mathematical Sciences Division will be housed in the new MBA building beginning in Spring 2013. The physical layout of the new building gives the Math and Computer Science Division the following space. Classrooms will be equipped with overhead projectors, document readers, and a ceiling mounted projection system for the classroom computer. In addition to the classroom space, there are 33 faculty offices for full time and adjunct faculty, designed for double occupancy. Each floor has a workroom that will be shared by the Mathematical Sciences Division and the Business Division.

ROOMS	Units	Square Footage	Notes
Large Lecture classroom	2	1600	70-80 Students
Lecture classroom	23	800	40 Students
Computer classroom (Laptops stored in desks)	3	900	35 students
Dedicated CSCI Lab	1	800	22 students
Study lounge area	1	1250	Adjacent to 1st floor tutoring lab
Tutoring/study Lab	1	1600	With office
Shared drop in Lab	1	1400	Shared w/ Business

Figure 17: Mathematical Sciences Facilities in New MBA Building

We are excited by the new space. It is too early to say how well the new building will serve the needs of students in developmental mathematics. As we settle in, we will evaluate the new facilities with respect to access issues for developmental mathematics students. These issues include developmental mathematics classrooms that accommodate group work and the use of classroom manipulatives; access to technology in developmental mathematics classrooms and labs; student access to instructors during office hours (particularly for students in courses taught by adjunct faculty); and student access to informal study space.

In the last several years, the largest proportion of section cuts in the Mathematical Sciences Division ECC has occurred in developmental mathematics. There is concern that the facilities and equipment in the new building, while sufficient for the current math program, will not allow for growth. Should the economic situation allow us to increase sections in developmental mathematics to meet student demand, great care should be taken when assigning sections to classrooms belonging to other divisions. In the past, it has been mostly sections of developmental mathematics courses that have been farmed out to classrooms in other divisions. Sections of transfer-level courses have always taken precedence for classroom space within the division. In the days when most instructors needed no more than a board and something to write with, teaching in almost any classroom was manageable. As developmental mathematics instructors shift their teaching strategies to include both classroom manipulatives and access to technology, teaching in classrooms designed and equipped for other disciplines becomes challenging.

A study lounge will be available for students on the first floor of the new MBA building, adjacent to the tutoring lab, but it will be less than half the size of our current study lounge in the MCS building. Students need informal and unstructured space, such as the main foyer of the MCS building. On any given day, dozens of students are found huddled together around the many circular tables in the MCS foyer, preparing for lectures, completing homework assignments, studying in groups, etc. In addition, it is the

practice of many instructors to use hallways, or other non-office spaces like the MCS foyer, to accommodate the overflow from faculty offices when multiple students shows up for office hours (as frequently happens). With the greatly reduced informal spaces available in the new building, we will need to find creative solutions, so that instructors will be able to have the space to replicate the more efficient group work method for office hours.

Adjunct instructors teach 60% of all developmental mathematics courses. Currently, several offices have been designated for adjunct faculty use on a rotating basis. How well the offices in the new building will work for part-time instructors is another issue to watch.

VI. Technology and Software

Technology and software are essential tools for teaching and learning mathematics. Faculty frequently use computers to design and prepare curriculum and assessment materials, as well as for class presentations. Instructor and students use the Internet to bring mathematical ideas from the outside world into their classrooms to support instruction. Faculty often use technology and software to provide students with experiences that strengthen conceptual understanding of mathematics and to help students perform computations. Students gain a richer learning experience when they see real-world mathematical applications and develop a deeper understanding of mathematics when appropriate technology is employed.

For the Developmental Mathematics Program, the dependence on technology and software continues to grow. More and more instructors employ an online homework component in their developmental mathematics courses; students generally have responded favorably to this format for homework. A 2011 survey showed that 45% of instructors (full-time and part-time) use an online homework system. Since then more instructors have received training on online systems and have incorporated them in their courses. The new accelerated courses, BAM and GEA, are particularly technology-dependent. BAM students meet and work in the computer lab roughly four hours per week; GEA students meet in the lab two days per week for a total of three hours.

In the past year, the delay of our move to the new building and our lack of a Computer Specialist has contributed to subpar technological infrastructure for the Mathematical Sciences Division. Personnel from ITS are called in when there is an emergency, but machines are getting old and will (understandably) not be replaced. Updating classroom computers and tracking down software licenses for faculty laptops have become increasingly problematic. Thankfully, most of these problems will be resolved in the new MBA building.

The new MBA building offers 3 computer labs (each with approximately 35 computer stations). It is hard to determine if three computer classrooms in the new building will be sufficient. As the number of BAM and GEA classes increase, the math department will need to find ways to meet the demands.

One way we might meet greater computing demand has been to use grant funds to purchase more mobile computing devices. Two years ago, HSI STEM grant funds purchased two classroom sets of laptops which are semi-mobile and primarily used by students enrolled in upper-division math courses. Also, three class sets (30 per set) of iPads were purchased recently with the last of the Mathematics Title V funds. We plan to use them in the Spring 2013 BAM courses.

We plan to continue and expand the Ti-84 Calculator Loan Program, which has been of great benefit for many of our developmental mathematics students. Up to this point, a variety of grants have paid for the calculators and the library has managed the program. For a deposit of $20, a student can use a Ti-84 for an entire semester and receive their deposit back upon return of the calculator. Currently 110 calculators are in use in the program. The department's policy was to prioritize these calculators for developmental math students enrolled in Math 40 and 80, and in the Fall of 2012 this amounted to more than 70 sections and approximately 3000 students. The calculators were also offered to Math 150 students, increasing the need for more calculators.

Other technological and software upgrades we may explore in the future include

- Tablet PCs/iPads **–***Math instruction can be improved using a tablet PC or iPad to manage active learning methods and group activities that use technology. Using these devices allows the instructor to roam the classroom and interact with the students while making presentations; they can be used as a textbook and document viewer, as well as a productivity, note-taking and administrative tool.*

- Acquire SMART boards or InterWrite pads – *With the rapid advancements of technology, students will benefit from other classroom technology like a SMART board or an InterWrite pad. Students may gain a better conceptual understanding of math concepts through the use of a SMART board. For example, with a SMART board the instructor can scan math manipulatives as separate objects and the let the students manipulate them on the screen. With an InterWrite pad, the instructor can have greater interaction with students while delivering the lesson from anywhere in the classroom. Moreover, the class notes written on the pad can be saved and converted as a PDF file for future use.*

Related Recommendations:

Recommendation 2012D.4 (Instructional Support Services –Technological upgrade: Tablet PC or iPad)

VII. Developmental Mathematics Staffing and Professional Development

Staffing

Each semester, roughly 6000 students (30% of the El Camino College student population) are enrolled in a developmental mathematics course. In the Fall 2012 semester, enrollment in courses one level below transfer (Math 60, 73, and 80) constitute 25% of **all** mathematics enrollment; and enrollment in courses two or more levels below transfer (Math 12, 23, and 40) constitute 40% of **all** mathematics enrollment.

Figure 18 below summarizes each course and who teaches it and includes the transfer-level courses for comparison for the Fall 2012 semester. Adjunct instructors comprise 70% of the instructors who teach math courses two or more levels below transfer; adjunct instructors make up 45% of the instructors who teach math courses one level below transfer. In any given semester, adjunct instructors teach about 60% of the developmental math courses.

	Developmental Mathematics Courses								CM2 and CM3	CM1
Fall 2012 Schedule	12	23	40	2+ levels below transfer	60	73	80	1 level below transfer	General Education Courses	STEM Major Courses
Full-time	7(35%)	3(11%)	11(48%)	30%	2(66%)	18(48%)	11(69%)	55%	58%	86%
Adjunct	13(65%)	23(89%)	12(52%)	70%	1(34%)	19(52%)	5(31%)	45%	42%	14%
Totals	20	26	23		3	37	16			

Figure 128: Fall 2012 Distribution of Fulltime and Adjunct Teaching Assignments

The large proportion of developmental mathematics courses taught by adjuncts results in uneven access to instructor office hours and Supplemental Instruction for a large number of students, particularly those taking mathematics courses two or more levels below transfer. More than half (roughly 3600 students) each semester find themselves in a class with an instructor who may not hold office hours. These sections are also less likely to have supplemental instruction (SI). In the past three years, close to 75% of students starting mathematics at El Camino College at the arithmetic level were African-American or Hispanic (Chancellor's Office Data Mart). Access to office hours and SI for students in courses taught by adjunct instructors is an equity issue throughout the college; it is especially pronounced among developmental mathematics students.

Professional Development and Training Opportunities

Full-time and adjunct faculty has varied backgrounds in teaching pedagogy. Professional development training, conferences, workshops, and meetings are crucial to serving our students well. In the past four years, the math department has provided professional development opportunities using funds from the Basic Skills Initiative (BSI), Mathematics Title V, and the Graduation Initiative:

Teacher Development Workshop Series

Two Teacher Development Workshop Series were held with more than 30 full-time and adjunct instructors participating each year. The goal of the workshops was to have instructors form a teaching community within the math department to explore issues to improve their instruction. Participants observed and collaborated with each other to create student-centered group activities and to explore On-Course strategies. This series of workshops was useful in informing instructors about best practices.

Faculty Cohort Groups

Teams of full-time and adjunct instructors teaching sections of the same course collaborated on student-centered projects, meeting weekly, and sharing resources, including office hours. As a result, the department now has hundreds of classroom activities, coordinated homework sets and PowerPoint lectures for developmental mathematics courses, as well as statistics, trigonometry and pre-calculus. In the last year of the grant, the faculty cohort model was used to create the two new accelerated mathematics courses, BAM and GEA.

Affective Domain Activities

In Spring 2011, 14 math instructors and two human development instructors worked collaboratively to compile a set of activities to build better academic habits and personal responsibility in students, and to embed these activities more naturally into developmental mathematics courses. Activities were designed, tested in class, and revised. The result was a booklet of 37 activities.

Summer Institute for Developmental Education (SIDE)

The goal of the Graduation Initiative-sponsored Summer Institute for Developmental Education (SIDE) was to bring together a community of teachers to review relevant research related to effective teaching practices in developmental courses. SIDE participants reviewed a number of successful practices, including sound principles of learning theory, proven, effective instructional methods, holistic development of all aspects of the student, and variety of instructional methods to accommodate student diversity with the inclusion of active learning strategies rather than passive learning strategies.

Professors Scott Kushigemachi (English department) and Art Martinez (Math department) served as facilitators. In Summer 2011, they both attended the National Center of Developmental Education's Kellogg Institute.

A pre- and post-SIDE survey was conducted to assess the impact of the program. The workshops were well received. The graphs below depict the change in perceptions of SIDE participants on two topics: instructional recommendations stated in the Poppy Copy, and alternative assessment techniques.

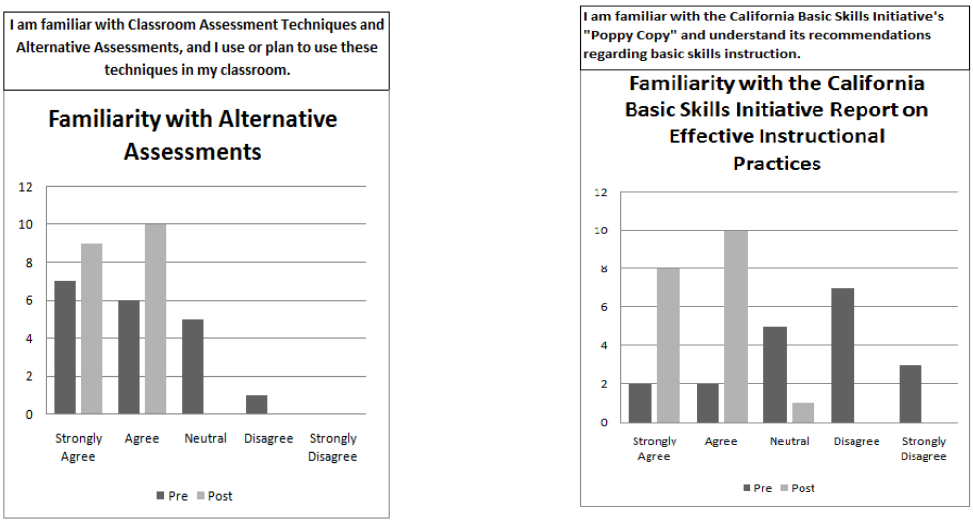


Figure 19: SIDE Participants' Perceptions

Management of the Developmental Mathematics Program

Although 65% of the courses offered in mathematics each semester are developmental, only 25% of fulltime instructors serve on of the Developmental Math Committee each year. Of these, a small, consistent core of committee members manages a program that serves 6000 students each semester. While the class schedule and teaching assignments are the dean's responsibilities, the duties of the Developmental Math Committee include conducting program reviews and annual program review updates, creating and implementing new courses, reviewing and modifying all courses, selecting default textbooks, revising course and program student learning outcomes and assessments, collecting and analyzing assessment data, working with IR on multiple statistical studies, providing professional development and training opportunities, staying current with emerging research into pedagogy and best practices, and participating in the state and national conversations about the future of developmental mathematics. Due to increased accountability demanded by accreditation standards and in light of the new Student Success Task Force legislation, the duties of this committee are likely to expand in the coming years.

Future Directions

We want to make improvements in the following areas: (1) professional development and training opportunities; (2) course and program management; and (3) instructional support programs and services for all students.

(1) Professional Development and Training Opportunities

Redesigning the developmental mathematics program increases the need for ongoing, experiential, and collaborative professional development opportunities for both full-time and adjunct instructors. Particularly for the two accelerated courses, BAM and GEA, with their nontraditional approaches to teaching, it is imperative that instructors, as well as supplemental coaches, have the training and support for effective instruction.

We hope to build a community of instructors who are in the habit of implementing proven successful strategies in the developmental courses that they teach. In order to achieve this level of professional development, we must have consistent and grant-independent funding and we must compensate instructors for participating.

(2) Course and Program Management

Managing the work within the Developmental Mathematics Program is an important challenge we must address. Whether through an administrative position (an Associate Dean for Developmental Mathematics), or reassigned time for faculty in some form (a single Faculty Coordinator for Developmental Mathematics or several Course Coordinators), it needs to be clear whose job it is to handle the large numbers of projects and tasks that allow the developmental mathematics program to function efficiently and effectively, including Counselor Intervention, Supplemental Instruction, student tutor training, Summer Math Academies, Faculty Cohorts, SLO assessments, and research.

We favor a solution that includes faculty course coordinators. Course coordinators would allow more meetings among instructors to help them incorporate online homework systems, integrate affective domain activities, use active learning methods in instruction, and conduct SLO assessment cycles with broader participation. In addition, serving as a course coordinator provides an instructor leadership experience.

(3) Instructional Support Programs and Services

We must find the resources and staff to ensure that all students have equitable and reasonable access to quality instructional support programs and services. These include the Summer Math Academies, Counselor Intervention, Supplemental Instruction, drop-in tutoring, and office hours.

We must find the resources and facilities to ensure that all students have equitable and effective access to instructor office hours. Strategies for achieving this goal may include compensating adjunct instructors for office hours, a more formal system for sharing office hours, or encouraging fulltime and paying adjunct instructors to hold some office hours in the tutoring lab.

Related Recommendations:

Recommendation 2012A.1 (Professional Development – Classroom Observation Opportunities for BAM and GEA Instructors)

Recommendation 2012A.2 (Professional Development – Future Training Opportunities)

Recommendation 2012B.1 (Management – Developmental Mathematics Program Coordinator)

Recommendation 2012B.2 (Management – Course Coordinators)

Recommendation 2012D.3 (Instructional Support Services – Equitable Student Access to Instructors)

Recommendation 2012C.2 (Staffing and Course Offerings – Fulltime and Adjunct Instructor Recruitment)

Recommendation 2012C.3 (Staffing and Course Offerings – Faculty Course Cohorts)

VIII. Direction and Vision

Direction: Overview of Developmental Mathematics

The developmental mathematics program serves the varied pre-collegiate mathematics needs of our students. Specifically, it serves the students who need to meet a mathematics competency requirement (for example to earn an associate degree or satisfy the requirements of the nursing program), students who need preparation for a college-level general education mathematics course required for transfer, and students who need preparation for a college-level mathematics course required for a particular program or field of study (for example one of the calculus sequences for Science, Technology, Engineering or Mathematics (STEM) or economics).

Student success is affected by experiences within the classroom as well as the overall structure of the program. Both areas must be addressed. Changes made within the classroom can transform the learning experiences for our students. We can measure the effects of these changes through course success rates, and to some extent in the persistence rates to the next course. However, improvements in the classroom, while important, have only marginal effects on the outcomes of the developmental mathematics program. Structural features, such as placement procedures and the pipeline problem, have a much greater effect on the developmental and transfer-level completion rates. Positive changes made to the structure of the program have the potential to make substantial improvements in student completion rates.

Vision Forward

Our vision forward is, very simply, to improve the course success and retention rates, the persistence rates, and most importantly, the overall developmental mathematics program completion rates. We will accomplish these goals by taking action in three directions: Professional Development, Placement Reform, and Accelerated Curriculum. We will monitor and continue to assess the on-going and new efforts to achieve this vision.

Directions

1. **Professional Development** Through our continued commitment to improve the quality of our instruction, we hope to have more opportunities for professional development in which each instructor can enhance *his or her own practice of teaching*. No one set of practices will fit the style or temperament of all instructors. We honor this diversity. We recognize that the greatest benefit to student learning is when a professional adapts a best practice to fit *his or her teaching style*. The Student Success Task Force challenges us all to expand our teaching methods to address various student learning styles.

   Developmental mathematics teaching is a challenge. As the Student Success Task Force declares, "We cannot simply place students into the classes that use the same mode of instructional deliveries that failed to work for them in high school." The list of best practices to improve success and persistence rates is long and varied and adaptable by instructors with equally varied teaching styles.

For example, to improve success rates we might refer to the Basic Skill as a Foundation for Student Success (Poppy Copy) from the RP Group and review the instructional practices that research has shown to be successful with developmental learners, including active, collaborative, and contextual learning methods. We may turn to the eight standards conveyed by the American Mathematical Association of Two Year Colleges (AMATYC, 2006): problem solving, modeling, reasoning, connecting with other disciplines, communicating, using technology, developing mathematical power, and linking multiple representations. Across the board, researchers and professional societies promote student-centered learning experiences. Classrooms incorporating these activities are characterized by students actively engaged in contextual problems, conversing with their peers in order to solve conceptual as well as computational problems. "Contextualization of pre-algebra mathematics was shown to increase the likelihood of successful remediation, accelerated entry into college-level coursework and success in college-level transferable coursework." (Wisely, 2009)

Strategies to improve persistence rates are a little trickier; work must be done to integrate them into the developmental mathematics classroom. Most strategies point to affective learning activities. According to the Poppy Copy, successful developmental programs are those that address the social, emotional and personal growth of learners. McCabe and Day (1998) recommend that model developmental programs should integrate learning and personal development strategies and services. Of equal importance with content knowledge and critical thinking skills, Conley states, "are the attitudes and behavioral attributes that successful college students tend to possess" (Conley, 2009).

We have a long track record of providing fulltime and adjunct instructors excellent professional development opportunities that promote real and measurable change. We hope to continue this strategy for improving the practice of teaching.

2. **Placement Reform** For many students, the current placement test has not been too effective at finding the appropriate level of math at which to begin their studies. It appears that one of the main reasons for this is that students regularly take the placement test with little or no preparation. We want to expand the use of three different strategies to improve placement.

   We have several short summer preparation courses, Summer Math Academies, after which students re-take the placement test. In the most recent summer, 47% placed into a higher-level course (see Summer Math Academy data in Section II), thus shortening the pipeline of courses for these students and increasing their chances to successfully transfer or complete an associate's degree. We hope to expand the number of Summer Math Academies.

   We also have the online program, MyMathTest (MMT) available for students who are taking the placement test for the first, second or even third time. We have no data on this effort and plan to study the impact of students using MMT as preparation for the placement test. If the results of the study are positive we would like to scale this up, perhaps making use of an open computer lab staffed by tutors who could assist students as they work on their developmental mathematics skills in preparation for taking the Mathematics Placement Test.

Finally, we plan to continue our policy of allowing students who are successful in Arithmetic (Mathematics 12) to retake the Mathematics Placement Test. We will follow-up with students who skip at least one level through this process to see how well they complete the developmental mathematics sequence and a transfer-level mathematics course.

3. **Accelerated Curriculum** Our biggest efforts at improving the structure of the Developmental Mathematics Program address the pipeline problem by creating the two accelerated mathematics courses: BAM and GEA. The accelerated courses use research-supported pedagogical strategies, including mastery learning, computer-aided instruction, and affective learning activities. The two courses provide a curriculum that blends well with the current traditional courses. The two acceleration courses BAM and GEA will allow students new pathways to become eligible for a transfer-level course after just two semesters regardless of where they place in the Developmental Mathematics Program or what their educational goals are. It should be noted that the California Community Colleges Student Success Task Force (CCC Student Success Task Force) recommends the development of alternatives to traditional basic skills curriculum and to take to scale model programs for delivering basic skills instruction; these acceleration courses do just that. We will continue to study the effectiveness of these new courses as we slowly grow the proportion of our developmental mathematics program dedicated to this accelerated pathway.

IX. Recommendations

Recommendations are organized into five categories: Professional Development, Management, Staffing and Course Offerings, Instructional Support Services, and Placement and College Readiness.

Recommendation 2012A.1 (Professional Development – Classroom Observation Opportunities for BAM and GEA Instructors) During the expansion of the accelerated courses, offer compensated opportunities for fulltime and adjunct instructors interested in teaching BAM or GEA to observe current instructors in their classrooms and labs and attend weekly meetings.

Estimated cost per instructor: 3 hours/week for 12 weeks @ $45.14/hr = $1625.04

Estimated cost per semester: 4 instructors @ $1625.04/instructor = $6500.16

Total estimated cost per year for Recommendation 2012A.1: $13,000.32

Possible source of funding: Title V Graduation Initiative

Recommendation 2012A.2 (Professional Development – Future Opportunities) In addition to continuing the Summer Institute for Developmental Education (SIDE), offer compensated workshop series every year, in which fulltime and adjunct instructors explore issues such as Culturally Responsive Teaching, peer teaching evaluations and mentoring, active learning methods and effective group work management.

Estimated cost per participant per workshop series: 4 hours @ $45.14/hr = $180.56

Estimated cost per leader per workshop series: 8 hours @ $60.18/hr = $481.44

Estimated total cost per workshop series: 15 participants @ $180.56 + 2 leaders @ $481.44 = $3671.28

Possible source of funding: BSI funds or Title V Graduation Initiative

Recommendation 2012B.1 (Management – Developmental Mathematics Program Coordinator) Assign a faculty coordinator or the associate dean to coordinate developmental mathematics. Duties may include assisting the dean with class schedules and teaching assignments; facilitating faculty collaboration; coordinating course reviews and program reviews; researching program effectiveness; supervising SLO assessments and reports; reviewing program technology and facility needs; organizing professional development; applying for external funding and managing grants.

Estimated cost: Use funds already budgeted for the approved position of associate dean

Recommendation 2012B.2 (Management – Course Coordinators) Provide reassigned time for a course coordinator for each developmental mathematics course with ten or more sections. Duties may include assisting instructors with course materials, student activities, and other resources, promoting professional development opportunities, coordinating faculty cohorts and shared office hours, managing course SLO assessments, conducting ongoing surveys of students and instructors, disseminating research results, and evaluating adjunct instructors.

Estimated cost per course coordinator: 10% to 16.5% reassignment per semester is approximately $11,000 - $18,150

Recommendation 2012C.1 (Staffing and Course Offerings – Growth and Study of BAM and GEA) Increase the number of sections of BAM (Mathematics 37) and GEA (Mathematics 67) through reducing sections of Mathematics 12, 23 and 73.

Replacing sections of Mathematics 12/23/73 with sections of Mathematics 37/67 does not involve explicit costs.

Recommendation 2012C.2 (Staffing and Course Offerings – Fulltime and Adjunct Instructor Recruitment) Hire full-time and adjunct faculty who are interested in and committed to serving developmental mathematics students.

Estimated cost: none

Recommendation 2012C.3 (Staffing and Course Offerings – Faculty Course Cohorts) Consider instructors' desire to form faculty course cohorts in scheduling and teaching assignments.

Estimated cost: none

Recommendation 2012D.1 (Instructional Support Services – Expand Supplemental Instruction Program) Increase the number of adjunct instructors teaching developmental mathematics courses with Supplemental Instruction.

Estimated cost per section of SI: $1400.00

Recommendation 2012D.2 (Instructional Support Services – Expand Counselor Intervention) Increase the number of sections offering Counselor Intervention to include all sections of Mathematics 12 and Mathematics 37.

Estimated cost per section of Counselor Intervention: $1500.00

Recommendation 2012D.3 (Instructional Support Services – Equitable Student Access to Instructors) Provide offices for adjunct instructors and compensate them for one or two office hours per week.

Estimated cost per adjunct instructor: 16 - 32 hours per semester @ $60.18/hr = $962.88 - $1925.76

Recommendation 2012D.4 (Instructional Support Services –Technological upgrade: Tablet PC or iPad) Provide instructors the option of choosing a tablet PC or iPad instead of a laptop for their primary computer.

Estimated cost: none

Recommendation 2012E.1 (Placement and College Readiness – Expand the Summer Math Academies) Expand the number of Summer Math Academies offered each summer.

Estimated cost per Summer Math Academy with 25 Students: $6,500.00

Recommendation 2012E.2 (Placement and College Readiness – MyMathTest Preparation for Placement) Integrate MyMathTest Preparation into the matriculation process prior to taking the placement exam and require MyMathTest Preparation before retaking the placement exam.

Estimated cost: unclear

Recommendation 2012F.1 (Student Learning Outcome Assessments – Improve the Quality of Assessment Cycles) Create more comprehensive assessment instruments, involve more voices throughout the assessment process, and have more thorough follow-up on each assessment cycle.

Estimated cost: none

Prioritization of Recommendations:

Expanding the professional development opportunities and better managing the entire developmental mathematics program are our two greatest concerns (Recommendations A.1, A.2, B.1, B.2 and F.1). The next level (Recommendations D.3, C.1, D.1, D.2, C.3, E.1 and E.2) addressess our desire to provide effective placement services and equitable student access to curriculum that better serves the majority of our student. The remaining two recommendations would enhance the program overall.

1. **Recommendation 2012A.1** (Professional Development – Training Opportunities for BAM and GEA Instructors)
2. **Recommendation 2012A.2** (Professional Development – Future Training Opportunities)
3. **Recommendation 2012B.1** (Management – Developmental Mathematics Program Coordinator)
4. **Recommendation 2012B.2** (Management – Course Coordinators)
5. **Recommendation 2012F.1** (Student Learning Outcome Assessments – Improve the Quality of Assessment Cycles)
6. **Recommendation 2012D.3** (Instructional Support Services – Equitable Student Access to Instructors)
7. **Recommendation 2012C.1** (Staffing and Course Offerings – Growth and Study of BAM and GEA)
8. **Recommendation 2012D.1** (Instructional Support Services – Expand Supplemental Instruction Program)
9. **Recommendation 2012D.2** (Instructional Support Services – Expand Counselor Intervention)
10. **Recommendation 2012C.3** (Staffing and Course Offerings – Faculty Course Cohorts)
11. **Recommendation 2012E.1** (Placement and College Readiness – Expand the Summer Math Academies)
12. **Recommendation 2012E.2** (Placement and College Readiness – MyMathTest Preparation for Placement)
13. **Recommendation 2012C.2** (Staffing and Course Offerings – Fulltime and Adjunct Instructor Recruitment)
14. **Recommendation 2012D.4** (Instructional Support Services –Technological upgrade: Tablet PC or iPad)

X. Appendix

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