



# **Colorado Community College System**



**Success of Remedial Math Students in the  
Colorado Community College System:  
A Longitudinal Study**

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## Executive Summary

A major stumbling block for many students entering postsecondary education is inadequate academic preparation. This challenge is even more pronounced for community college students, with math readiness the most frequent and deepest area of deficiency. Community college remedial<sup>1</sup> or developmental education programs are structured to remediate the skills of students who assess at pre-college levels; however, there is mounting evidence that a majority of students who enroll in developmental courses will either never complete their remedial education or will fail to pass the initial college-level discipline course that follows the remedial sequence. Once again, math emerges as the most serious challenge.

This report tracks different cohorts of Colorado Community College System (CCCS) remedial math students over a period of four years. It addresses the success of students in different cohorts as they progress through the remedial math sequence and the subsequent college-level math course that follows. Of particular interest is their overall success, the average time to completion of the developmental sequence and college-level math, and the identification of those points in the remedial sequence where students are most likely to drop out. Understanding the course-taking patterns of developmental math students provides insights into the policies and practices that will promote

stronger math outcomes, as well as stronger certificate and degree completion.

CCCS employs mandatory assessment and placement with standardized cut-off scores across thirteen member colleges. Students who assess below the “cut scores” for college-level math are placed into one of three remedial math levels. This study follows three cohorts of new students beginning in three levels of remedial math for four years, from Fall 2003 through Fall 2007. Of the almost 7,000 new remedial math students beginning in CCCS in Fall 2003, 44% of them successfully completed their remedial math sequence, with 18% completing college-level math during the course of the four-year period of observation. Students in these cohorts tended overall to be younger, female, and overrepresented by ethnic minorities than students in the overall CCCS new student cohort.

The following are some of the key findings of the report:

- Students who began at the lower two levels of remedial math and progressed through the remedial sequence were as successful in the sequence of remedial courses as students who began in the highest level; however, students who began in the lower levels had significantly higher attrition.

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<sup>1</sup> For the purposes of this paper, “remedial education” is used interchangeably with “developmental education” and is defined as a prescribed course or set of courses designed to prepare students with weak academic skills in a particular subject to succeed in college-level coursework of the same subject area.

- The greatest percentage of attrition was due to non-completion (withdrawal or failure), but a significant percentage of students who successfully completed a remedial course did not attempt the next course. This pattern was more pronounced in the progression from completion of the remedial sequence to enrollment into college-level math.
- Students tended to complete the remedial sequence in somewhat consecutive semesters, but the average time between completion of the remedial sequence and enrollment in college-level math was longer than the time between the other courses in the remedial sequence.
- Finally, increased attrition over the course of the remedial sequence appeared to correlate with an increased number of required courses. Each additional course that lower-level remedial students were required to take reduced the college-level math completion and graduation rate by as much as half.

The primary finding of the report is that the majority of students who exit the remedial sequence do so by failing or withdrawing from a remedial math course. This may point to the need for a more concentrated focus on the quality of math instruction, including more full-time faculty involvement; more student supports; and a re-evaluation of

assessment and placement policies for remedial coursework.

A major, but expected finding is the negative impact of time on completion of the developmental math sequence. Based on this finding, it is recommended that the colleges consider different ways to accelerate students' progression through the developmental sequence. These include maximizing the accuracy of the initial assessment and placement processes, including offering math refresher courses for students who have been out of school for a while; flexible delivery of instruction that promotes acceleration, such as accelerated developmental education learning communities offered in conjunction with self-paced and late start classes; and ongoing advising that stresses the importance of taking remedial and college-level math courses consecutively (one course per semester until completion).

Additional strategies to promote persistence include learning communities that link student success courses with developmental math courses, dual enrollment in developmental and college-level courses, more interactive instruction and greater use of relevant content through contextualization. Lastly, colleges and high schools should continue to work on the alignment of high school and college-level mathematics competencies.

# Introduction

## Colorado's Economic Reality

In recent years, Colorado has experienced a divergence in the state economy and the skill level of the various occupations which support it. Many of the higher paying, low skill jobs have disappeared, leaving many Coloradans with a choice of working in low wage, low skill jobs in the service sector and other industries, or obtaining the higher level skills and education necessary to compete in the new "knowledge economy". Colorado Governor Bill Ritter has identified four main industries as key drivers in Colorado's economic future – aerospace, bioscience, energy, and information technology – STEM (science, technology, engineering, and math) industries that, for the most part, require postsecondary education. However, more than a third of Colorado's adult population lacks any postsecondary education, with 13% of adults lacking any form of high school credential<sup>2</sup>. Further, more than a third of the gains in baccalaureate degrees in Colorado from 1990-2000 were a result of in-migration from other states and countries<sup>3</sup> (NCHEMS, 2008), translating into lost opportunities for Coloradans. Colorado imports a significant population with postsecondary education while failing to successfully transition the state's own citizens at an acceptable rate through the educational pipeline – ranking 20<sup>th</sup> in the country (NCHEMS, 2006).

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<sup>2</sup> Calculated based on Profile of Selected Social Characteristics, Colorado, 2000, US Census Bureau

<sup>3</sup> 106,000 out of a 301,000 increase

## A Leak in the Education Pipeline

There are many leaks along the educational pipeline and many risk factors associated with various student groups. As open access institutions that serve a high proportion of at-risk students, community colleges are charged with providing effective remedial coursework for students who enter with pre-college skills. Despite this mission, the current and emerging research on remedial students indicates that remedial students are failing at high rates, with too many students dropping out of college before completing the remedial sequence or the initial college-level work that follows, effectively curtailing their college aspirations.

The numbers of students needing remediation are daunting. Nationally, more than 60% of first-time community college students take at least one remedial course (Levin and Calcagno, 2008). In Colorado, approximately 60% of new students enrolling in public two-year colleges require at least one remedial course. For these students, success or failure in remedial courses will either facilitate their transition into college-level work or signal the end of their college career.

## Colorado Remedial Structure

Since the early 1990s, the state of Colorado has required mandatory assessment and placement in math, English, and reading based on ACT, SAT, or ACCUPLACER test scores. Only institutions with a two-year statutory role are eligible to receive Colorado State funding to provide remedial education. The Colorado Community College System employs standard "cut scores" in determining

course placement and has instituted a common course numbering system across colleges (Appendix 1). New students entering the Colorado Community College System who are assessed below college-level performance are placed into one of three remedial course levels based on their scores.

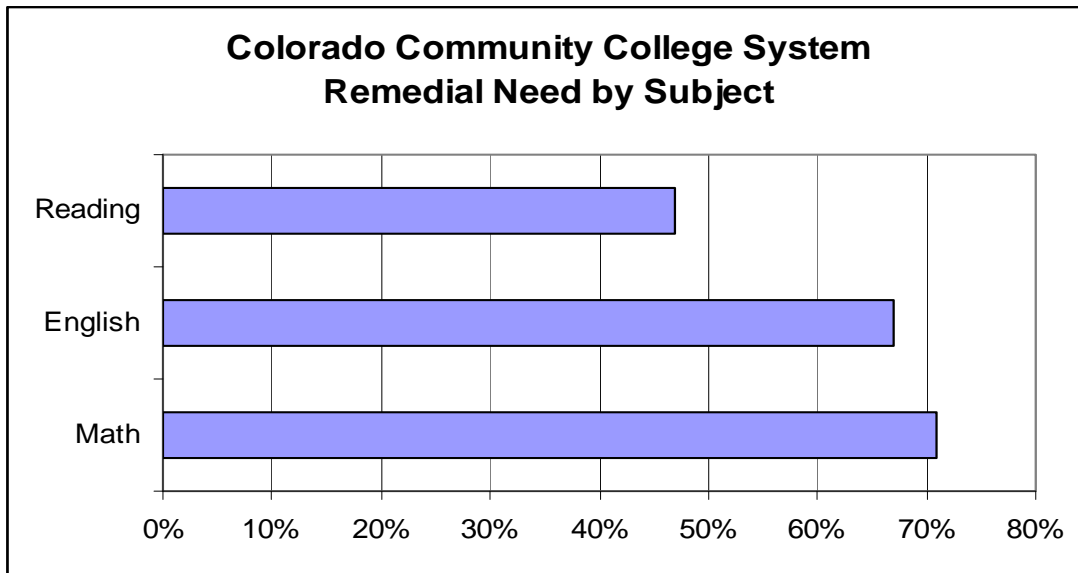
**Remedial Math: Greatest Need and Lowest Success**

Of those students requiring remediation, the majority require coursework in remedial math. The National Study of Community College Remedial Education<sup>4</sup> found that more than 60% of remedial students required remedial math, versus 45% and 38% in writing and reading, respectively (McCabe, 2000). In the Colorado Community

College System, 40% of new students in Fall 2007 required remedial math – but of those students requiring remediation in any subject, just over 70% required math remediation, compared to 67% in English and 47% in reading (Figure 1). In addition to the greater need for remedial math education, remedial math students also experience the lowest pass rate, both nationally and in Colorado (Attewell, et. al., 2006; Colorado Department of Higher Education, 2008).

McCabe’s study found that 43% of community college remedial students successfully complete their remedial sequence. However, as this figure includes all three subject areas, the lower math completion rate is masked. Another study involving traditional-aged students who attended both two- and

Figure 1. Of those CCCS students assigned to remediation in Fall 2007, percent by subject.



<sup>4</sup> Study based on 25 community colleges in various regions and settings consisting of a random selection of 1,520 remedial students. Student transcript records and interviews form the basis for the analysis.

four-year institutions found the remedial *math* sequence completion rate was closer to 30%, versus more than two-thirds for both reading and writing (Attewell, 2006).

According to McCabe, students who are able to successfully complete the remedial series perform equally well in the initial college-level courses in the related subject area (often called “gatekeeper” courses) as those who didn’t require remedial education. Subsequent research also indicates a positive relationship between completing a remedial sequence and entering a gatekeeper course with degree completion (Roueche, 2001). If this premise is accurate, the challenge that emerges is how to successfully move under-prepared students through the remedial sequence and into the subsequent college-level course.

This report focuses on math remediation for several reasons: the critical relationship of math literacy to success in the “knowledge economy”; the requisite that most certificate students and all degree students complete college math; and the low rate of student success in the remedial math sequence, as well as in college-level math<sup>5</sup>. To meet the challenge of moving students successfully through the remedial math sequence and into college math, we begin with an analysis of the CCCS remedial math sequence.

## **Remedial Math Sequence Analysis**

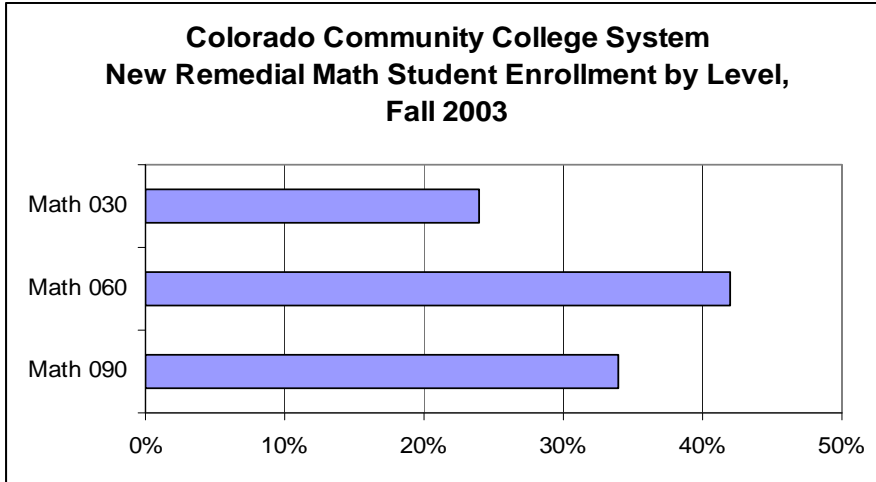
For the CCCS analysis, we started with three initial cohorts of remedial math students, all beginning in Fall 2003 and followed through Fall 2007, for a total of thirteen terms including summer terms. The three cohorts were comprised of new students enrolled in each of the three remedial math levels (030, 060, and 090). The lowest level developmental math course is Math 030 – Fundamentals of Math, followed by Math 060 – Pre-Algebra, and ending with Math 090 – Introductory Algebra. While CCCS currently maintains assessment and placement data, such data are not available for the Fall 2003 cohorts, so an assumption was made that new students enrolled in these remedial math courses actually placed into these courses, which is an assumption made in another published study (Leinbach & Jenkins, 2008). For the new students enrolled in remedial math in Fall 2003, just under a quarter were enrolled in Math 030, 42% in Math 060, and slightly more than one-third in Math 090 (Figure 2).

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<sup>5</sup> For this study, college-level math was defined as the first required course necessary to obtain a certificate or a degree. College-level math was defined to include Math 106 only for career and technical education majors (Appendix 1).



Figure 2. New CCCS remedial math students enrolled in Fall 2003, by remedial math level.



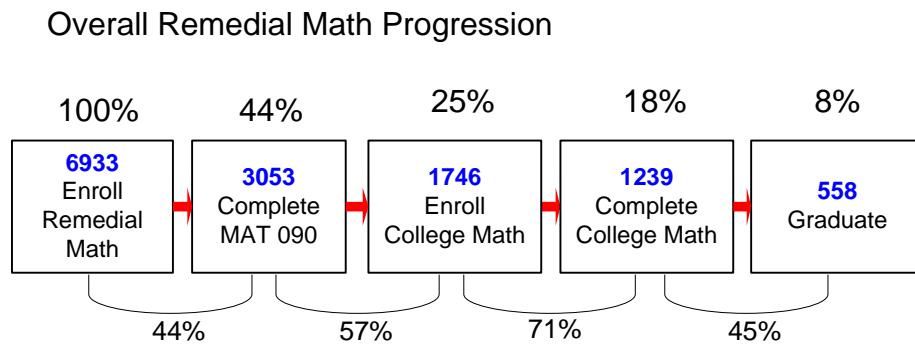
## Results & Discussion

### Critical Points in the Sequence

In addressing all three math cohorts combined, we found 44% of the students in the initial cohorts completed their remedial sequence (Figure 3). Of those who completed the sequence, more than forty percent did not enroll in college-level math. From the group of students who did enroll in college-level math, almost another 30% did not complete<sup>6</sup>

college-level math, and of the completers, more than half did not graduate within the four-year time frame of observation, resulting in an 8% graduation rate of the initial cohorts. (Given the part-time nature of the CCCS student body, it is likely this figure would increase significantly with a longer observation period).

Figure 3. Flowchart showing the overall progress of the three remedial math combined cohorts at critical points in the academic sequence. Percentages above each flowchart reflect progression of initial cohort over the four-year period, while percentages below indicate enrollment or completion rates of those remaining in the cohort at that point. For example, 18% of the initial combined cohorts completed college-level math, but of those who attempted college math, 71% completed.



<sup>6</sup> Successful completion of a course throughout this paper is defined as a grade earned of “C” or better.

It is important to note that the loss of students between completion of the remedial sequence and enrollment into college math may be related to transfer behavior. A preliminary analysis of transfer data obtained from the National Student Clearinghouse shows that more than 2,000 of the almost 7,000 students from the initial remedial math cohorts were either co-enrolled or transferred to another institution during the four-year period, and 84% of this number were enrolled at a four-year institution<sup>7</sup>. Although an analysis of the points in the sequence at which these students transferred has not yet been completed, this may serve to explain the large number of students who exited after completing the remedial sequence but before enrolling in college math.

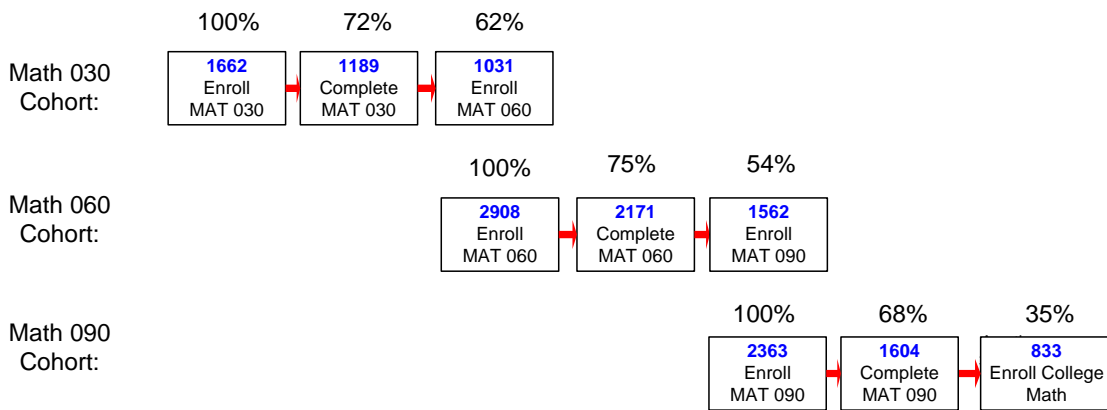
Transfer behavior may also impact the low percentage of remedial math students who graduate with an associate degree. Because Colorado

policy does not equate completion of an associate degree with junior status in a four-year institution, many students transfer after completing their remedial sequence or their initial college-level math course rather than completing their associate's degree.

### Progression in Initial Stages

The initial course completion rate was similar among the cohorts, ranging from a low of 68 percent for the 090 cohort to a high of 75 percent for the 060 cohort (Figure 4). **Among the three cohorts, the greatest numbers of students exited early in the sequence.** More than one-third of the initial 030 and 060 cohorts exited prior to enrollment in the second course in the sequence (Math 060 and 090, respectively).

Figure 4. Flowchart depicting completion rate in initial course and subsequent enrollment in second course for each remedial math cohort.



<sup>7</sup> The three initial remedial math cohorts were submitted to the National Student Clearinghouse (NSC) searching for enrollment at other institutions from January 2004 through December 2007. Matching is based on name and date of birth and resulted in a 79% match rate. Not all institutions are represented in the NSC data.

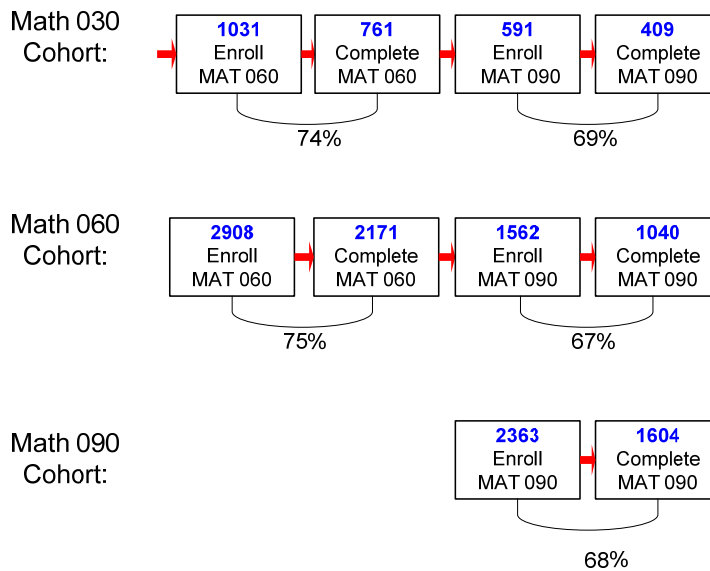
This high rate of attrition in the first remedial math course may also be related to the high attrition rate of first-time college students within the first semester of study. A second high-risk juncture is the progression from Math 090 to enrollment in college-level math. More than 60 percent of the 090 cohort had exited by this point in the sequence (Figure 4). As mentioned earlier, this may be due in part to transfer behavior.

### Course Completion Rates

Students who enrolled directly into the mid-level and upper-level remedial math

courses succeeded at the same rate as students who enrolled in the same course after completion of a lower-level remedial course. For example, 74% of the students who began in Math 030 and continued to 060 completed 060, which is comparable to the 75% Math 060 completion rate of those who began in Math 060 (Figure 5). Similarly, in terms of Math 090, the completion rates were 69% for the cohort who began in Math 030, 67% for the cohort who began in 060, and 68% for the cohort who began in 090.

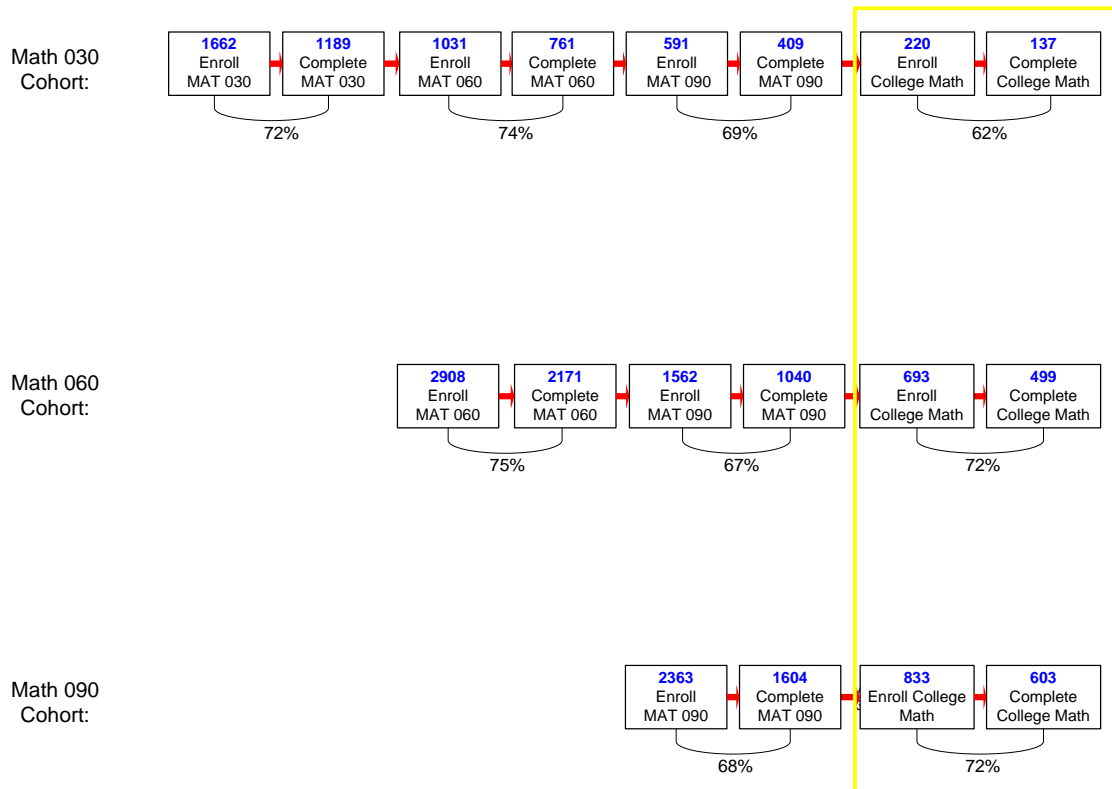
Figure 5. Flowchart indicating similar completion rates for the same remedial course regardless of the remedial level of origin.



Students beginning in the lowest level of math succeeded at the same rate in the equivalent remedial course as those who began in the higher levels of remedial math until they reached college-level math. Data

from college-level math indicate that students who began in Math 030 experienced a lower completion rate than students who began in Math 060 or Math 090, 62%, 72% and 72%, respectively (Figure 6).

Figure 6. Flowchart comparing college math completion rates among the cohorts.

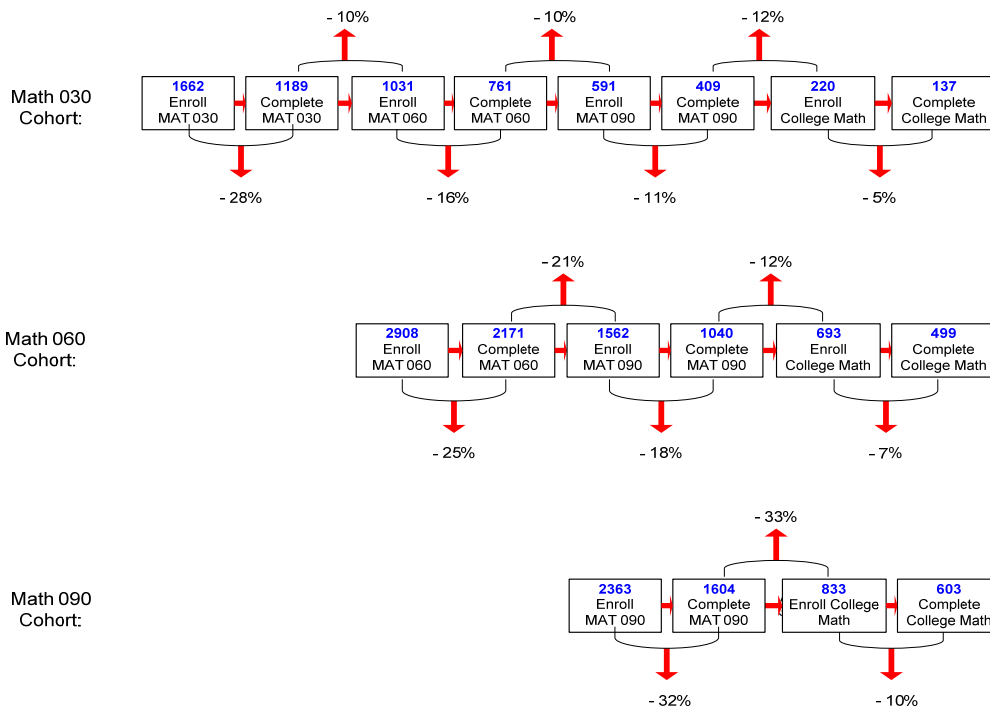


## Student Attrition

Up to 87% of students exited during the remedial sequence before enrolling in college-level math. **The majority, accounting for as much as 55% of the attrition, was due to non-completion (withdrawal or failure) of a course.** Although the primary reason that students left the remedial sequence was failure to complete a remedial course, a significant percentage of students completed a remedial course but did not enroll in the next course in the

sequence. **This loss of students between completion of one course and enrollment in the next course** accounted for more than a 30% loss of each initial cohort (Figure 7). For example, 10% of the Math 030 cohort exited between completion of Math 030 and enrollment in Math 060, another 10% between Math 060 completion and 090 enrollment, and another 12% between 090 completion and college-level math enrollment.

Figure 7. Flowcharts demonstrating the percentage loss of the initial cohorts. Figures below flowcharts indicate loss due to non-completion of a course, while the figures above reflect loss as a result of failure to enroll in the next course in the sequence.



This phenomenon seems to be especially pronounced between completion of the remedial sequence and enrollment in college-level math, where more than 40% of the remedial sequence completers in all three cohorts did not attempt college-level math (Figure 3). The pattern of high attrition

between courses is analogous to outcomes found in a comprehensive study of community college remedial students recently released by the Community College Research Center, although, unlike CCCS, that study found that more students actually were lost between courses rather than non-

completion of a course<sup>8</sup> (Bailey, et. al., 2008).

### **The Impact of Co-Enrollment and Transfer**

Since Colorado community colleges serve a large transfer population, it is likely that a significant portion of students successfully completed their remedial math sequence and subsequently transferred into college-level math at a four-year institution rather than enrolling in college math at the community college. As described earlier in this paper, more than 84% of the initial remedial math cohorts were co-enrolled in, or transferred to, a four-year institution. Anecdotal evidence suggests many four-year students who enroll in Math 090 at a community college will return to their four-year institution after completing the course. Therefore, what appears to be a lack of persistence into college-level math may in actuality be evidence of a successful transfer function.

### **Importance of Consecutive Course-Taking**

Although most students who did persist completed the remedial sequence in somewhat consecutive terms, this pattern did not continue as students transitioned into college-level math.

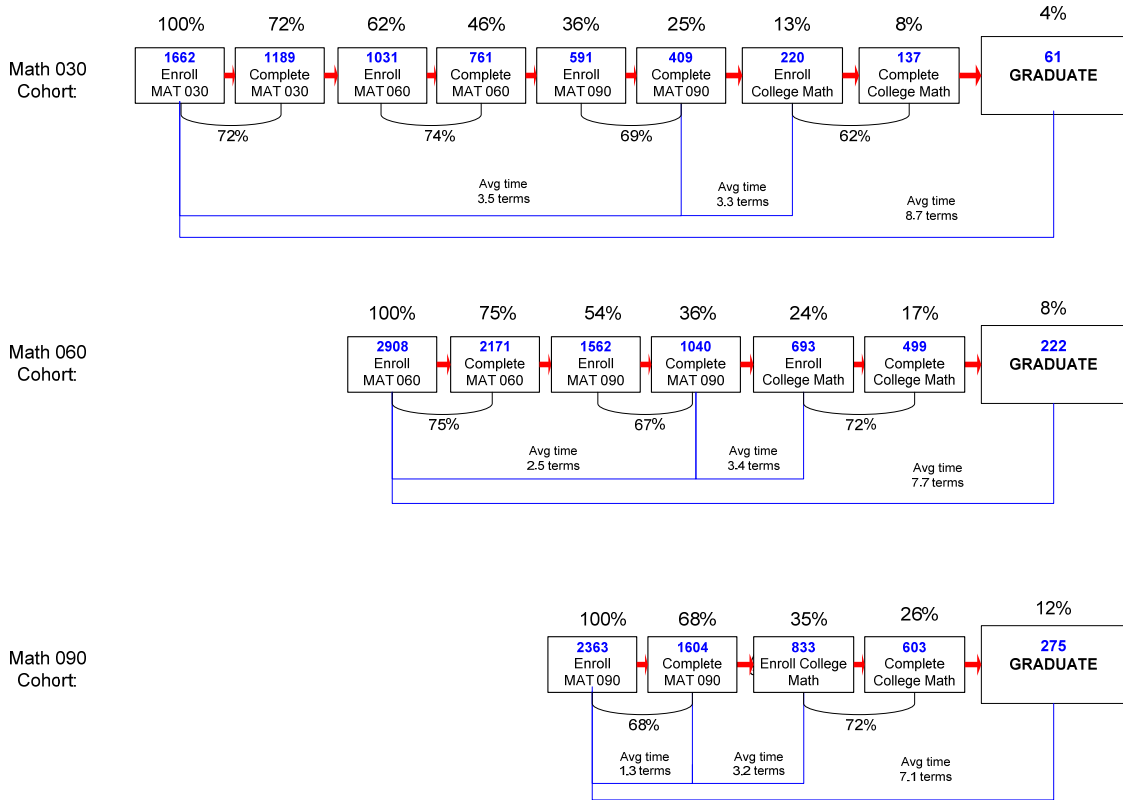
#### **The average time between completion of the remedial sequence and enrollment into college-level math was more than three terms**

(Figure 8). Despite the fact that more than 70% of the students who attempted college-level math among the three cohorts completed, attrition lowered the percentage of students enrolling in college math, from 13% for the 030 cohort to 35% for the 090 cohort. Even within the category of college math completers, less than half of the students graduated within the four-year period (13 terms) of measurement. Not surprisingly, the average time to award increased by approximately a term for each additional remedial math course required. The average time to award from initial remedial math enrollment ranges from 7 terms for the 090 cohort to more than 8 terms for the 030 cohort.

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<sup>8</sup> Study used Achieving the Dream database consisting of more than 200,000 new students enrolled in community colleges in several states from Fall 2003 to Fall 2004, as well as transcript information from more than 3000 students obtained from National Education Longitudinal Study of 1988.

Figure 8. Complete math pipeline illustration for each remedial math cohort beginning in Fall 2003. Percentages above each flowchart reflect progression of initial cohort over the four-year period, while percentages below indicate completion rates of those that enroll in each course. For example, 8% of the initial Math 030 cohort completed college-level math, but of those who attempted college math, 62% completed. The time figures indicate the average time required: a) from initial enrollment in remedial math to completion of Math 090, b) from completion of Math 090 to enrollment in first college-level math course, and c) from initial enrollment in remedial math to graduation. Term count includes summer terms.





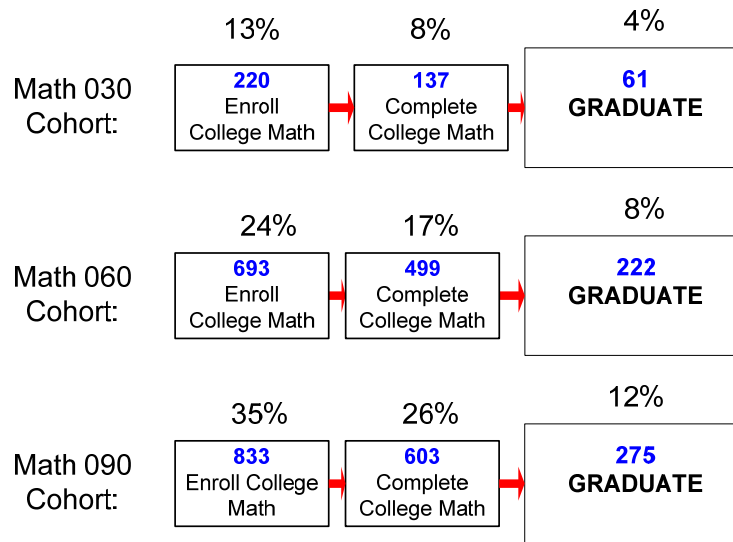
### Additional Sequence Requirements and Graduation Rates

Approximately 45% of the college math completers graduated in the four-year period. However, when comparing the graduation rates among the cohorts, the 030 cohort graduation rate was half of the 060 rate, and the 060 rate was three-quarters of the 090 cohort graduation rate (Figure 9). This pattern would suggest that subsequent cohort reduction correlates directly with the

number of courses required. **By adding an additional course to the sequence, the college-level math completion rate and graduation rate of the initial cohort dropped by as much as half.**

The more courses that individuals required, the less likely they were to complete the remedial sequence. This pattern is consistent with other research that concludes that the longer students spend in remediation, the less likely they are to persist (Adleman, 1999).

Figure 9. College-level math enrollment, completion, and graduation rates of each initial cohort.



### Putting Results in Context

The 030 cohort in Colorado experienced a 25 percent remedial sequence completion rate after earning the required ten credits (Math 030, 060, and 090), and just 4 percent of the initial cohort graduated within the four-year time frame. Similarly, in his 1998 report on remedial education, Norton Grubb noted that, of students who require nine or more credits in remedial courses, only about 25 percent will complete all of their remedial courses and only about 4 percent will complete a degree within five years of initial enrollment (Grubb, 1998).

Concern with the issue of time and completion of the remedial sequence appears also in the Lumina Foundation for Education’s research on community college remedial students. In their study of six states involved in the “Achieving the Dream” initiative, the tracking time was extended to six years rather than the standard three years (the generally accepted tracking period for community college students is three years) to determine if given enough time, additional students would graduate (Jobs for the Future, 2008). Knowing the part-time tendency of CCCS students, it is likely that continued

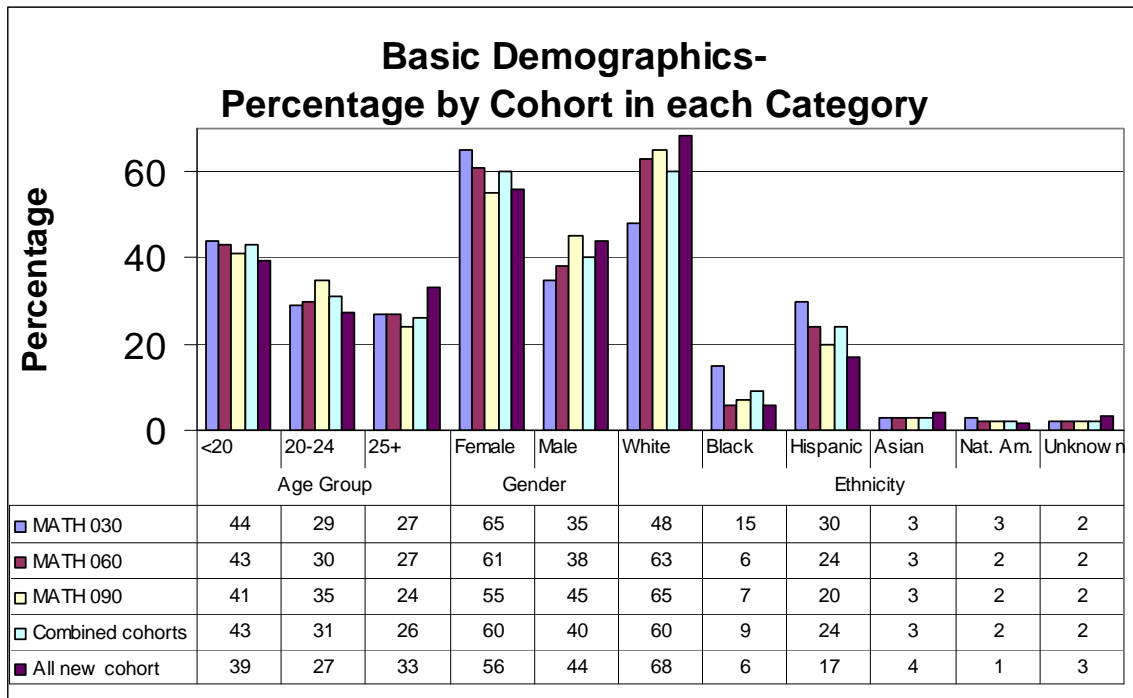
tracking for an additional two years would reveal higher completion and graduation rates.

### Remedial Student Demographics

The basic demographics of the CCCS cohorts of new remedial math students indicate an overrepresentation of ethnic minorities – especially blacks and Hispanics – compared to the cohort of all first-time students in Fall 2003 (Figure 10). Remedial math cohort students also tended to be overall

younger and female than the cohort of all new students. When making a comparison among the cohorts, the students enrolled in the lowest level remedial math course (030) were even more overrepresented in terms of minorities and females than the other two cohorts (Figure 10). **These demographics indicate that the remedial math need is not just a matter of lost skills of adult students over time, but that students, especially minority students, are leaving high school under-prepared.**

Figure 10. Demographic comparison among three remedial math cohorts and between the three combined cohorts and all new students in Fall 2003.



## Conclusions

- Among the three cohorts, the greatest numbers of students exited early in the sequence.
- Students beginning in lower-level math were just as successful in the same remedial course as those who began in higher levels. However, this pattern did not hold true for students beginning in the lowest math level once they attempted college math.
- Unlike national research findings, most CCCS remedial math students exited as a result of failing or withdrawing from their remedial math course.
- Although more students were lost due to non-completion of a course, a significant number of successful completers did not persist into the next course in the sequence – especially college-level math.
- Students who did persist progressed somewhat consecutively through the remedial sequence but delayed enrolling in college-level math – an average of an additional three terms after completion of the remedial sequence.
- By adding an additional course to the sequence, the college-level math completion rate and graduation rate of the initial cohort dropped by as much as half. As anticipated, the more courses individuals require, the less likely they are to complete the remedial sequence and graduate.
- Females, minorities, and traditional age students were overrepresented in remedial math courses as compared to the population of new students as a whole.

## Recommended Actions

**The primary report finding is the large percentage of remedial math students who failed to persist due to non-completion of a course.** Education research has long pointed to the critical role of quality instruction in student success. In addition, there is a growing body of research that points to other factors that impact student success, such as the level of student engagement and sense of belonging in the college community, students' perceptions of the relevance of college to their personal/vocational goals, and interactive instructional practices. The following recommendations target the strengthening of student engagement through program design, active learning strategies, and career exploration.

- Employ high quality instructors in remedial and gate-keeper math courses.
- Expand technical assistance to replicate learning community strategies. Several developmental education learning community models have been piloted at CCCS colleges and could be replicated with a combination of technical assistance and additional funding.
- Promote co-enrollment of developmental math and student success courses. Student success courses, which help students navigate the college process and become comfortable in the college community, are currently offered at several colleges.
- Increase the use of relevant contextualized curriculum in developmental math as a practical answer to the most frequently asked question, "Why do I have to learn this?"
- Make math more relevant to students' long term goals by linking the mastery of math competencies to high-paying jobs in the "knowledge economy".
- Provide enhanced advising for remedial math students.
- Promote the implementation of additional supports, such as tutors and learning labs, which are currently provided at many CCCS colleges.

**A second critical finding is the negative impact of time on completion of the developmental sequence.** Based on the finding that the main difference between the graduation rates of the 030 and 060 cohorts was the addition of another course in the remedial sequence, resulting in a 50% reduction, it is recommended that the colleges consider different ways to **accelerate students' progression through the developmental sequence.** The following strategies are targeted toward reducing the time spent in remediation and increasing student success.

- Pre-Assessment Advising: The first strategy is to help students understand the importance of preparing for the ACCUPLACER assessment test. This would boost preparation for the test and contribute to more accurate placement, saving time and money for students who would otherwise be required to spend a semester repeating material they could have mastered with a short review.
- Maximizing the accuracy of the initial math placement through the following:
  - ✓ Better Assessment: Additional assessments could be devised and implemented to better pinpoint the appropriate remedial course.
  - ✓ Faculty Evaluation: Because math recall decreases over time and may result in artificially lower placement scores, one way to correct for this would be for faculty to evaluate students after the first two weeks of classes with the goal of identifying those students who would be likely to succeed in a higher-level course. For this strategy to be effective, colleges would have to complement these secondary assessments with flexibility in delivery of instruction, such as extending the “add-drop” period for developmental math classes for an additional two weeks or putting self-paced or late start classes in place for students who were identified by their instructors as candidates for a higher level course.
- Linking and accelerating two levels of developmental math with a particular emphasis on Math 030 and Math 060. This option was piloted over the last three years through a grant from the Lumina Foundation for Education. Results of the acceleration option show that merging two levels of developmental courses increased success rates in both remedial sequence completion and college math completion. (It should be noted that the Lumina model is a cohort model that, in addition to the core principal of acceleration, also includes case management and career exploration.)

**The report also highlights the importance of students taking developmental math courses and college math in sequence instead of postponing college-level math until the end of their program.** The Colorado data points to students exiting the math sequence after successful completion of their prior courses, particularly between the completion of the remedial sequence and enrollment in college-level math.

- Include a focus on the importance of **consecutive math completion** into the syllabi of each developmental math course. Colleges may want to consider mandating course-taking patterns to ensure the highest chance of success.
- Provide students with incentives to enroll in math coursework in successive terms, especially into college math.

**The issue of under-prepared students is complex.** To address the issue, colleges should collaborate with high schools and college teacher preparation programs to improve math education. Prominent in this work is the alignment of high school mathematics exit competencies with college-level competencies, including the alignment of ACCUPLACER competencies with high school math standards.

## Future Directions

The preliminary investigation of remedial math progress leads to additional areas for future research. Further analysis of transfer data might help us understand two critical points in the sequence – specifically the high number of students who exit between the completion of the remedial sequence and enrollment in college math, as well as between completion of college-level math and graduation. In addition, gathering data on overall retention, not just in the subject of math, would provide information on whether students are dropping out, or simply stopping out of the math sequence. Following the students for a longer period of time (six years) may also provide a better indication of true college math completion and graduation rates.

**Further research is also needed to understand why students beginning in the lowest-level remedial math course were not as successful in college-level math** as those beginning in higher levels. Some questions to consider include: If given more time to repeat the college-level course would the 030 students complete at a comparable rate to the 060 and 090 cohorts? Would a comparison of 030, 060, and 090 cohorts indicate a

difference in skills mastery prior to enrollment in college-level math?

Contrary to the study conducted by the Community College Research Center in which more students were lost between courses, our analysis indicated more students are lost **within** a course. An evaluation of placement testing may help us understand the lower course completion rates. Were some students dropping out because they were bored or frustrated by being placed in a class that was below their skill level? Would secondary assessments reduce the drop-out rate within classes?

Another topic for research would be a comparison of success in college math for students who started in remedial courses as compared with those who started directly in college-level math courses. This comparison would help to determine if the competencies defined in the remedial courses are indeed preparing students to succeed in college-level math.

Finally, colleges should be encouraged to collect data on student outcomes related to the implementation of innovative practices in remedial education as part of continuous improvement efforts within the Colorado Community College System.

## Policy Recommendations

The State Board for Community Colleges and Occupational Education is in a unique position to **incentivize and reward improved student success in remedial education.**

This report cites a number of challenges facing colleges and suggests several directions colleges can take to improve outcomes for remedial students. While these challenges are not new, what is perhaps new is the data that demonstrate the breadth and depth of the problem. Many of the practices and recommendations listed earlier are being implemented at different colleges in varying degrees. Ultimately, it is the colleges themselves who are in the best position to determine which strategies make the most sense for their populations, based on their own capacity and resources.

What is needed at this point is a clear message from state leadership that places the issue of remediation at the front and center of discussions and links the importance of successful remediation to the governor's goals of increasing student access and success. In addition to the message, there are specific actions the Board could take to promote improved outcomes including:

- Encourage accountability through system-wide annual tracking and reporting of remedial outcomes;
- Provide seed funding for colleges to engage in some of the above-mentioned recommended actions;
- Create a state position of Director of Remediation to work with a reconvened basic skills taskforce to coordinate efforts, facilitate the implementation of effective practice, and disseminate best practices;
- Support programs and legislation that improve transition between high school and community college and GED and community college in order to reduce the need for remedial education; and
- Reward improved outcomes.



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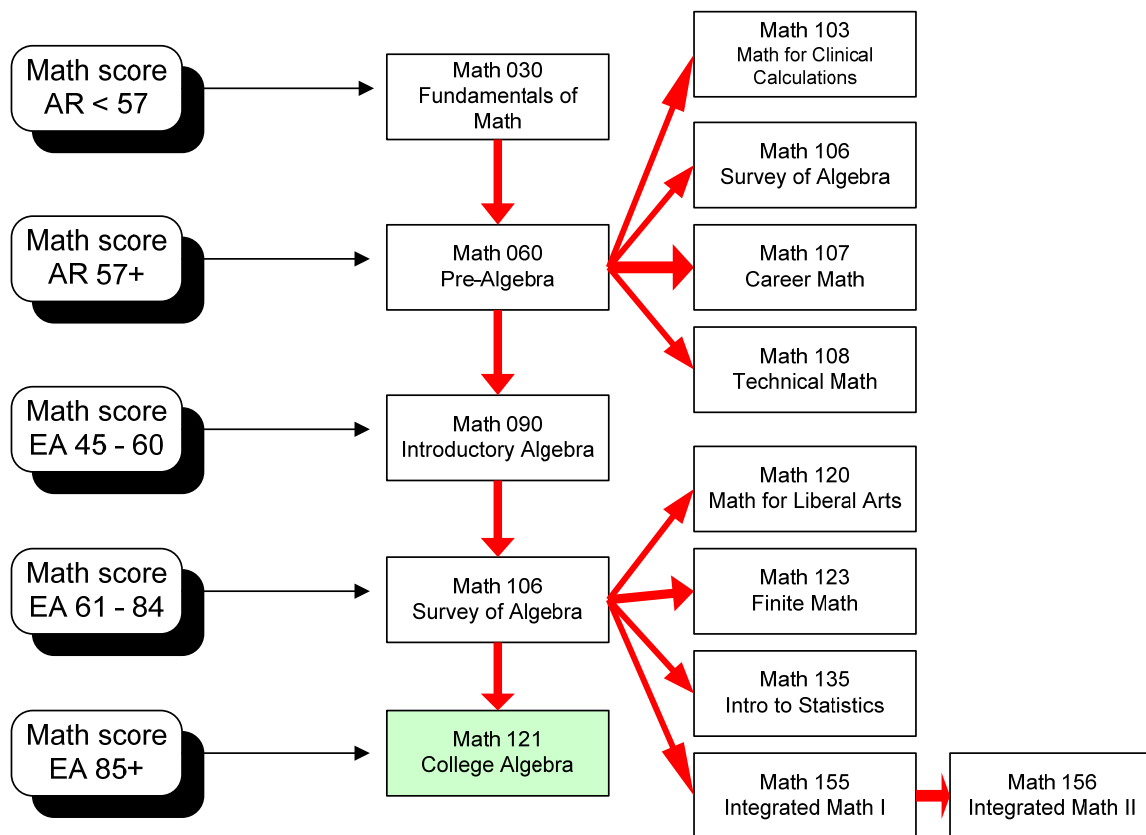
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## Appendix I: Math Assessment Placement Scores and Course Sequence

Students having successfully completed a college-level math course within the past five years or having earned an AA, AS or baccalaureate degree are exempt from assessment. In addition, students with a score of at least 19 on ACT Math or 460 on SAT Math are also exempted. The following diagram depicts the ACCUPLACER “cut scores” for each math course placement and the subsequent course sequence. College Algebra is considered the gatekeeper course for students in non-terminal community college programs and the course progression from there includes College Trigonometry and Calculus, but has been eliminated from this diagram for brevity. Math 106 functions as both the terminal course in certain career and technical, associate of applied science, and certificate programs and an intermediate course along the academic track sequence.



AR = ACCUPLACER Arithmetic Math Placement Test  
EA = ACCUPLACER Elementary Algebra Placement Test

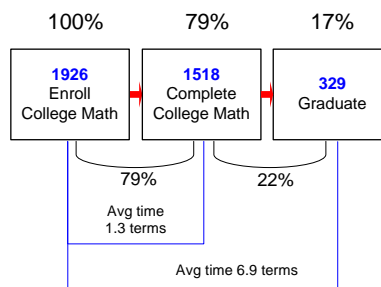
## College-Level Math Cohort Comparison Addendum:

One of the most important items listed in the Future Directions section of the report was to compare the success of the remedial math students enrolled in college math with the success of students enrolled in college math who did not require prior remedial math. National research has indicated that students who complete prescribed remedial math coursework are just as successful in college-level math courses as students who didn't require remedial math. To make a valid comparison, we followed a cohort of new students enrolled in CCCS college math in Fall 2003 through Fall 2007 (the same period for the remedial math students in this study). To better ensure the reliability of students marked as new with no prior remedial math, the cohort was sent to the National Student Clearinghouse and any students who had been enrolled in any of the participating institutions from Fall 2000 through Summer 2003 were eliminated from the cohort. For consistency, the definition of college math matched that used in the remedial math tracking study.

Out of the more than 1900 new students enrolled in college-level math in Fall 2003, just over 1500 students passed with a grade of C or better, taking on average 1.3 terms to successfully complete (Figure A1). This equates to a 79% pass rate, compared with the combined remedial math cohorts' college math pass rate of 71%. Fewer than 20% of the original college math cohort graduated within the four-year timeframe. Again, this low rate may be related to transfer behavior as a result of students who transferred to a four-year institution to complete a baccalaureate degree and would likely increase by following the cohort for a longer period of time due to the part-time status of most community college students.

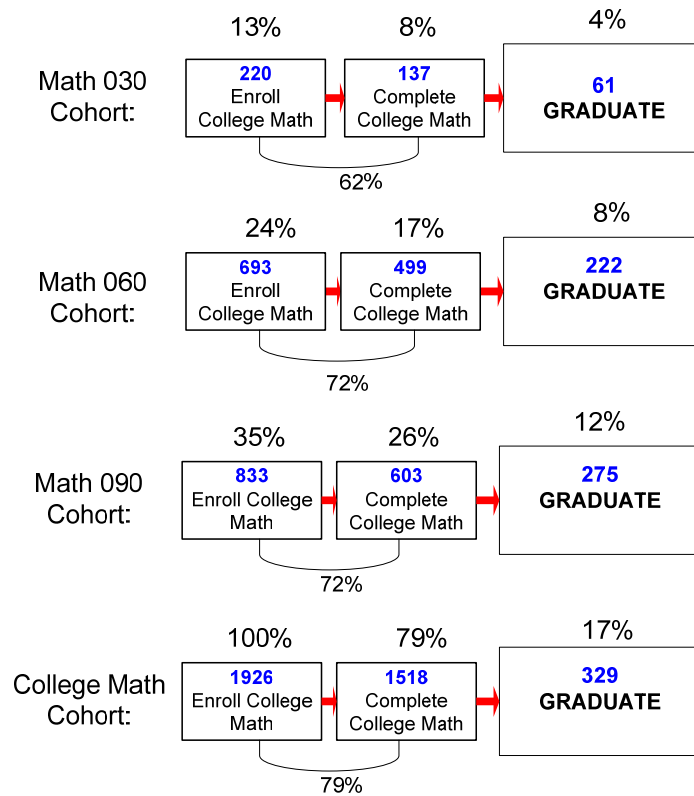
Figure A1. Flowchart of college-level math completion and graduation rate for new college-level math student cohort beginning in Fall 2003 followed through Fall 2007.

### New College Math Cohort Completion Rate



A further comparison broken down by remedial math cohort shows the Math 030 cohort college math completion rate was almost 17% lower than the college math cohort, and 7% lower for both the Math 060 and 090 cohorts (Figure A2). Consistent with the comparison between the Math 060 and 090 cohort graduation rates, the college math cohort graduation rate was nearly one and one half times that of the Math 090 cohort graduation rate.

Figure A2. Flowchart comparison of college-level math completion and graduation rates by each remedial cohort and the college math cohort.



## College Critical Sequence Points Comparison Addendum

The longitudinal study of new CCCS students enrolled in remedial math in Fall 2003 was an effort to examine the success of remedial math students at critical points in the sequence: remedial sequence completion, college-level math completion, and graduation. Three cohorts consisting of new students enrolled in each of three remedial math levels - Math 030, Math 060, and Math 090 - were followed over a period of four years. This addendum serves to highlight the highest CCCS completion rates at each critical point by system-wide, urban college, and rural college to serve as a benchmark for college attainment goals. In addition, a comparison of the levels of success by college, grouped by urban and rural colleges, is included.

With the exception of the Math 030 cohort, the highest sequence completion rates occurred at rural colleges (Figure 1). Alternatively, excluding the Math 090 cohort, the highest college-level math completion rates occurred at the urban colleges. Consistent with the sequence completion rate pattern, the highest graduation rates occurred at the rural colleges, with the exception of the Math 030 cohort. The highest sequence completion rates ranged from 32% for the Math 030 cohort to more than 80% for the Math 090 cohort, followed by a college-level math completion rate ranging from 18% to 42%. Finally, the highest graduation rates ranged from 8% for the 030 cohort to one-third for the 090 cohort.

Figure 1. Summary of highest remedial math cohort completion rates for 1) all CCCS colleges combined, 2) all rural colleges combined, and 3) all urban colleges combined.

### Colorado Community College System Highest Developmental Math Cohort Completion Rate

		030 Cohort		060 Cohort		090 Cohort	
All Colleges	Cohort size	Sequence Completion Rate	Cohort size	Sequence Completion Rate	Cohort size	Sequence Completion Rate	
		511	32%	23	52%	12	83%
	Cohort size	College-Level Math Completion Rate	Cohort size	College-Level Math Completion Rate	Cohort size	College-Level Math Completion Rate	
		73	18%	156	26%	24	42%
Cohort size	Graduation Rate	Cohort size	Graduation Rate	Cohort size	Graduation Rate		
	341	8%	23	13%	12	33%	

Rural Colleges	<b>030 Cohort</b>		<b>060 Cohort</b>		<b>090 Cohort</b>	
	<b>Cohort size</b>	<b>Sequence Completion Rate</b>	<b>Cohort size</b>	<b>Sequence Completion Rate</b>	<b>Cohort size</b>	<b>Sequence Completion Rate</b>
	62	27%	23	52%	12	83%
	<b>College-Level Math Completion Rate</b>		<b>College-Level Math Completion Rate</b>		<b>College-Level Math Completion Rate</b>	
	<b>Cohort size</b>	<b>Completion Rate</b>	<b>Cohort size</b>	<b>Completion Rate</b>	<b>Cohort size</b>	<b>Completion Rate</b>
	84	7%	23	22%	24	42%
<b>Cohort size</b>	<b>Graduation Rate</b>	<b>Cohort size</b>	<b>Graduation Rate</b>	<b>Cohort size</b>	<b>Graduation Rate</b>	
84	4%	38	13%	12	33%	
Urban Colleges	<b>030 Cohort</b>		<b>060 Cohort</b>		<b>090 Cohort</b>	
	<b>Cohort size</b>	<b>Sequence Completion Rate</b>	<b>Cohort size</b>	<b>Sequence Completion Rate</b>	<b>Cohort size</b>	<b>Sequence Completion Rate</b>
	511	32%	517	43%	510	80%
	<b>College-Level Math Completion Rate</b>		<b>College-Level Math Completion Rate</b>		<b>College-Level Math Completion Rate</b>	
	<b>Cohort size</b>	<b>Completion Rate</b>	<b>Cohort size</b>	<b>Completion Rate</b>	<b>Cohort size</b>	<b>Completion Rate</b>
	73	18%	156	26%	165	33%
<b>Cohort size</b>	<b>Graduation Rate</b>	<b>Cohort size</b>	<b>Graduation Rate</b>	<b>Cohort size</b>	<b>Graduation Rate</b>	
341	8%	456	11%	165	18%	

Figure 2 shows critical points in the sequence completion rates by college. Shaded cells indicate the highest completion rate at each critical point by cohort. Not surprisingly, due to smaller cohort sizes, the variability in completion rates among the rural colleges is greater than among the urban colleges. Since several of the rural colleges did not have any Math 030 students in Fall 2003 term, a meaningful comparison of the Math 030 cohorts is not possible.

Figure 2. Remedial math cohort sequence completion rate, college-level math (CLM) completion rate, and graduation rate by college, grouped by urban versus rural colleges. \*Seq comp rate = remedial sequence completion rate, in this case defined as completion of Math 090, CLM com rate = college-level math completion rate, and grad rate = graduation rate.

Urban Colleges												
	030				060				090			
	Cohort size	Seq Comp Rate*	CLM Comp Rate	Grad Rate	Cohort size	Seq Comp Rate*	CLM Comp Rate	Grad Rate	Cohort size	Seq Comp Rate*	CLM Comp Rate	Grad Rate
ACC	104	24%	8%	0%	135	36%	16%	4%	148	68%	19%	7%
CCA	196	12%	2%	2%	156	40%	26%	9%	160	70%	31%	12%
CCD	511	32%	6%	3%	517	43%	9%	3%	510	80%	11%	5%
FRCC	73	21%	18%	4%	805	30%	20%	8%	542	61%	30%	11%
PCC	341	27%	14%	8%	456	35%	19%	11%	165	65%	33%	18%
PPCC	157	10%	3%	2%	328	32%	12%	6%	274	62%	19%	11%
RRCC	119	22%	9%	5%	167	37%	20%	9%	230	63%	28%	10%
Rural Colleges												
	030				060				090			
	Cohort size	Seq Comp Rate*	CLM Comp Rate	Grad Rate	Cohort size	Seq Comp Rate*	CLM Comp Rate	Grad Rate	Cohort size	Seq Comp Rate*	CLM Comp Rate	Grad Rate
CNCC	9	11%	0%	0%	39	33%	8%	3%	24	75%	42%	17%
LCC	0	n/a	n/a	n/a	40	28%	10%	3%	34	71%	26%	15%
MCC	0	n/a	n/a	n/a	23	52%	22%	13%	12	83%	33%	33%
NJC	62	27%	3%	2%	108	47%	8%	6%	56	59%	16%	14%
OJC	0	n/a	n/a	n/a	80	16%	4%	4%	123	76%	36%	29%
TSJC	84	11%	7%	4%	38	26%	16%	13%	71	52%	28%	14%