

Fragmentary Cohorts, Full Cohorts, and the Placement/Course Level
Match in Remedial Mathematics Courses among
Urban Community College Students

Annual Meetings of the American Educational Research Association
San Diego, 2004

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According to NCES (1996), in 1995 29% of entering freshmen took at least one remedial course. Despite these large numbers, many baccalaureate institutions are attempting to shift almost all remediation to community colleges. Community college transfer rates are generally very low, and from urban community colleges in California less than 5% of the students transfer to a four-year college. Failures to move beyond remedial math courses and to master college level math courses are a central part of this low transfer rate. Discussions and policy controversies have been frequent, but research about the patterns and effectiveness of remedial efforts have been limited (Hodges, 1998; Merisotis & Phipps, 2000; Weissman, Bulakowski & Jumisco, 1997).

This paper is an exploratory description of remedial coursetaking over several semesters. In attempting to characterize the introductory course classrooms of urban community colleges, it proposes a distinction between fragmentary and full cohorts. Also proposed is a concept little examined in community colleges, the placement/course level match, the match between placement testing and the level of subsequent remedial course-taking. Despite whatever assessment is stipulated by placement testing, community college students are somewhat free to exercise their choices as to whether they enter a remedial course at the assessed level, or enter another course at a higher or lower level. This paper is a longitudinal study of the coursetaking paths taken in remedial mathematics courses after placement testing of students.

PERSPECTIVES:

After a century of testing, in recent decades placement exams have been again gaining high respect. From testing in early childhood to high school exit exams, and continuing to college placement exams, educational institutions are relying on tests to assess academic preparation. The community colleges have a strong tradition of placement exams, and in the 1980s reform programs focused on testing and matriculation processes were adopted in many states throughout the nation. The open access mission of these institutions invites a population of students from all academic levels to enroll. The variation in preparation leads many community colleges to rely on devices such as placement exams for advising incoming students regarding course-taking decisions (Hadden, 2000; Merisotis & Phipps, 2000). The area deemed most frequently as requiring remediation is mathematics (Cantone, 2001; NCES, 1996).

To analyze remedial course-taking scholars have relied primarily on two perspectives, functional theory and critical concepts of tracking.

Functional. Many community college leaders conceive academic success to be based on the efficient allocation of students, based on their level of expertise, to a position in a hierarchy of courses. From this perspective students from various non-traditional origins in the social structure are viewed as often likely to have inadequate prior training (Ignash, 1997). Placement tests have been viewed both as useful or questionable in effectiveness (Armstrong, 1999; Kingan & Alfred, 1993). Enrollment patterns and consecutive enrollment at the level of courses suggested by entry testing have been found to be associated with student success (Burly, Cejda & Butner, 2001; Waycaster, 2001).

Tracking. A critical view has held that several kinds of tracking occur within the colleges (Brint and Karabel, 1989; Pincus, 1980). From this perspective, placement tests and remedial courses operate as barriers, pushing students into lower level curricula and limiting potential future educational and job opportunities. Community colleges are gateway institutions for many underrepresented minorities, the poor, and women who may be unfairly tracked into remedial education based on the outcome of a placement test. Questions regarding the validity, reliability, and cultural bias of placement tests have been used to support the claims that entry testing may be tracking students unjustly (Kingan & Alfred, 1993).

Directionless. There are various hints that the actual placement/course match behavior of the students may be less tidy than suggested by the foregoing comments. Both of the above theories assume that the colleges have considerable control over college students, when in fact some students enter courses free of restraint by any testing and placement regulations. Many students enter the colleges without a definite sense of direction (Grubb, 1991). It is not clear to what extent and in what ways students comply with placement assignments. Moreover, the outcomes of various modes of the placement/course match have not been investigated in the community colleges.

Exploratory. While mindful of the foregoing ideas, this paper takes an exploratory tack and does not attempt to test these ideas as hypotheses. Our purpose is descriptive rather than explanatory. We note that the community college has departed in recent decades from the model of traditional higher education to now enroll students in a variety of ways that are not well understood. Students may enroll for only one or two courses repeatedly over a sequence of many semesters, and even stop out repeatedly. They may withdraw from and re-enter the same, similar, or even lower levels of, math courses several times over many several semesters. At introductory math course levels in urban colleges, there is a withdrawal or failure rate of 30 percent or much higher.

Community college research and theory does not yet have a set of conceptual images, a vocabulary, for these coursetaking gyrations. In general, coursetaking patterns have not been analyzed in their complex varieties (Burley, Cejda, & Butner, 2001; Hagedorn, et. al., 2003; Maxwell, et. al., 2003). There is much literature that extols the benefits of matriculation processes such as placement testing, some research showing benefits, but there is little research showing the coursetaking routes actually followed by students subsequent to placement services (Spurling, 2000).

We propose in this study to simply explore and discover some of the patterns of remedial coursetaking and in relation to the placement test/course level match, and to describe some of the associations with student characteristics.

Thus, this study seeks to explore the following questions:

1. In what ways is successful academic achievement related to patterns of coursetaking in remedial studies?
2. What are the patterns of match between levels of placement test assessment and subsequent routes among remedial math courses?

3. What is the relationship between various patterns of match in placement/course levels selected by the students and the social characteristics of the students?

METHODS:

Longitudinal analysis with large samples is necessary for providing a full picture of coursetaking processes in remedial courses.

The full sample for this study consists of 4,976 students who participated in the Transfer and Retention of Urban Community College Students (TRUCCS) project. TRUCCS is a three-year, longitudinal study of community college students at nine campuses in a large metropolitan district.

Students responded to a classroom questionnaire survey during spring 2001. Classrooms were identified through a stratified sampling method that focused on three levels of English courses (2 levels below transfer, 1 level below transfer, and transfer level), as well as occupational programs, stratified by age, gender and ethnicity. The resulting sample reflected the district's distributions of age, gender and ethnicity.

The main sources of longitudinal data for this proposal are student transcripts. Although the initial data collection occurred in Spring 2001, the transcript data went back as far as 1974. Thus far we have obtained and analyzed transcripts from the initial point of a student's entrance into any of the nine colleges plus 5 semesters since the year 2000, plus summer and winter terms. Placement test assessment scores were also obtained.

The variable of success in each course was defined in accord with a standard approach taken by the California Community College Chancellor's Office. It is a dichotomous variable that defines course success as completing a course with a grade of C or better. The category of non-success is applied to lower grades than a C, or withdrawal from the course before completion.

Three levels of remedial courses were identified in terms of content knowledge, difficulty and relationship to four-year colleges as follows:

Level 0: There exist no pre-requisites to enter the course and the course is designed to teach the students the necessary skills to be successful in level 1 courses and beyond.

Level 1: There may be a pre-requisite to join the course and the course is designed at a basic skills level aiding the student to master the basic skills needed to be successful in the advanced level courses

Level 2: There exists a pre-requisite to enroll in the course and the course is beyond the basic understanding of the core concepts. Usually the course itself is indicated with the title of intermediate. However, the course does not provide transfer credit to either the University of California or California State University systems, so is not at the advanced transfer level.

FINDINGS:

Variety of Routes. The rates for various categories of the placement/course match are displayed in Table 1. These rates indicate that the

large majority of the students, 77%, entered a remedial math course at the level that was indicated by their placement test assessment. We will label these students in this paper as the “middle-routers.” A small portion of the students, 5%, entered a remedial math course at a level lower than their placement test scores: here we label them as “low-routers.” Almost four times that fraction of the students, 18%, elected to enter a math course that was at a level higher than their assessment score: these we label as “high-routers.”

Routes & Success: the Total Group. Students who entered their first remedial math course at a level equal to their placement test score, the middle-routers, are reported in Chart 2 as having a higher rate of achieving a “successful” grade (of C or higher) in that first math course than did students who selected a course at a lower or higher level. Sixty-five percent of the middle-routers achieved a grade of C or higher. Slightly fewer of the students in a math course lower than their placement score, the low-routers, achieved a grade of C or higher. Of the students taking math courses at lower or higher levels than their assessment scores, the rate of achieving a C or higher grade was 58%.

Thus, there was a relationship between the placement/course match and the success rates in the first remedial math course. The middle-routers achieved success at a higher rate and the high-routers were less likely to be successful, and the low-routers fell in between. The differences between these three categories of the match, however, were slight.

A different way to see Chart 2 is in terms of the large numbers of students failing to achieve a grade of C or higher in their first remedial math course. A familiar, but yet distressing, amount of more than a third of the students withdrew from the remedial math course or got a grade of D or F. This was the case for all three levels of the placement/course match.

Returning to the relationship between the placement/course match, we next asked whether the placement/course match was related to success in all of a student’s courses? Would the more challenging math course taken by the high-routers, for example, lower the likelihood of success in their other courses? Or would they receive higher grades than the other students? Chart 2 indicates that there was some relationship, but only slightly so. On average, both the low-routers and middle-routers achieved success in 69% of all of their courses. The high-routers were about 5% more likely to have achieved success, that is, a grade of C or higher, in all of their courses. Moreover 2% more of the high-routers, compared with the other students, were successful in any subsequent math courses.

So, high-routers were a little less likely to be successful in their first math course, but in both their subsequent math and other courses the high-routers were a little more frequently successful than were the middle or low-routers. The appearance of effectiveness of the placement/course match depends in part, then, on the point in the coursetaking sequence which is examined.

These small differences can be seen in contrast to the fact that for all three kinds of the match, the rate of failure in courses is large (ranging from about 25-40% for the various types of courses).

Disentangling Success by Levels of Remedial Courses. We will continue the foregoing analysis of the total sample of students in the next section below.

Here we will focus on disentangling the coursetaking routes and success of students in three remedial course levels which differ in knowledge and difficulty.

We found in Charts 3 – 5 that success in math courses and in all courses differed substantially between students who tested at the lowest or higher levels on the math placement test. There was also an interaction between the relationship of the placement/course match to academic success and the three levels of remedial courses.

In Chart 3 success rates are presented for the students who scored at level 0 on the math placement test. A little over half of the students scored in this bottom category and were expected to enroll in the most elementary of the remedial math courses. Here the success differences between high-routers and middle-routers for the first post-placement math course is twice the difference observed for the total group in Chart 2. Thus, for the high-routers the amount of students who succeeded was very low, about 55%. In the measure for all of their courses the results were similar to what we have seen for the total group: over the several semesters these high-routers, who had tested at the bottom category on the math placement test, achieved results in their overall set of courses and in the remainder of their math courses that were a little better than those of the middle-routers.

The success rates for the students who scored on the placement test at the intermediate remedial category, level 1 (about a third of the remedial math enrollments), are presented in Chart 4. For most of the students, the middle and low-routers, the success rates are a little better but yet similar to the course successes of the students who tested at level 0: their overall math success rates are close to 60% and their total course success rates are close to 70%. The departure from Chart 3 is for the high-routers: it is the high-routers at this level who do much better. Here their first math course rates are about 10% higher than was the case for the level 0 high-routers (in Chart 3), and as good as those of the middle and low-routers. Their overall course success rates approach 80%.

In Chart 5, for the students who tested at level 2 (the top of the remedial ladder), the results were generally similar with a slight edging up over the success rates for level 1 students in Chart 4. (The exception was a lower rate on the first math course for the low-routers.) These success rates again manifest a pattern of better success rates for the high-routers, this time on all of the 3 variables of first math course, all math courses, and all courses. The high-routers, who were successful in this first math course, had satisfactorily performed at the regular college (non-remedial and transferable) level. Thus, they had moved beyond further requirements for remedial math courses.

Success in Subsequent Math Courses: Total Group. Mindful of these variations that occur among the three remedial course levels, we return now to analysis of the total group of students who enrolled in at least one remedial math course. Tables 6 to 8 examine the various routes and success rates of the students in subsequent math courses. [Note re. the tables: The data in Table 1

and Chart 2 concerning first math course enrollments, and Tables 6 and 7 concerning the second math course are all summarized in Chart 8 which contains enrollment and success rates for all of the first three math courses. Tables 1, 2, 6 and 7 were initially presented separately, however, for ease of reading.]

Table 6 indicates that the low-routers and middle-routers were the most likely to enter a second math course, and high-routers were the most likely to not attempt additional math courses. The difference between the two groups is modest, about 10%. The lower rate of enrollment in a second course by the high-routers could possibly be explained in part by the number of level 2 high-routers (see Chart 5) who successfully completed their first math course not at a remedial level 2 but instead at the regular college level and were thus not required to take further lower division work in mathematics.

Given that a substantial minority of the high-routers were not successful in their first math course, 8% dropped down in their second math course to a lower level remedial course and 44% continued at the same level.

For the total group Table 7 reports a complex array of rates of achieving a “successful” grade (of C or higher) in the second math course. The success rates in the second math course are similar to those in the first math course, typically about 60%. Only a few of the rates differ as much as 10% above or below 60%. The corresponding rates of failure to complete the course or attain a grade of C or better are again very large, usually about 40% and as much as half of the low-routers whose second course was at the same level as their first math course. Taking a higher level course than the first course is associated with moderately better rates of success.

Table 8 represents an attempt to portray for the total group the complexity of the numbers of students moving, and succeeding or failing, along one of the initial three routes from the first math course through the third math course. (Where the numbers of cases fall below 30 in some of the cells in the table, we are reluctant to place any confidence in the estimates of course success rates.)

In the cells of Table 8 where there are sufficient cases, the rates of success, as in earlier courses, continue to hover in the third courses at around 60%, plus or minus about 10%. Thus, the rates of non-completion or low grades continue to be about 40% or higher. These continuing high rates of unsuccessful performances in subsequent math courses appear to be associated with the multiple re-entries of students who were not successful in earlier courses. For example, of the 1,691 students who selected a middle-route for their first math course, only 1099 completed the course and achieved a grade of C or better. Despite this small proportion of successful experiences, 1,374 (81%) of the students attempted a second math course. Of the students who were not successful in the first course, 76% enrolled for a second math course, and of the latter 44% were successful in completing the second course with a grade of C or better. There were clearly a substantial number of students embracing our American adage of “try, try, again.”

This persistence did not stop with the second course. Of the initial 1,691 middle-routers, a little over a thousand (1,013) persisted into attempting a third

math course, most of them continuing to labor even at this point at a remedial level. Some of them climbed above remedial studies and became eligible for “traditional” college level math. For example, 13% of the initial middle-routers began their climb at the bottom in what we have labeled level 0, and successfully passed through all three remedial levels within a sequence of three courses. However, another 12% of the middle routers took at least three or more courses at the same remedial level at which they began, and of this group 52% did not succeed in their third remedial course.

Given that this paper is attempting to give an overview of many different lens for viewing remedial math coursetaking, we move to other analyses, but note in passing that the alternative coursetaking paths in Table 8 are more complex and varied than space has permitted us to describe here.

Fragmentary Cohorts and Descriptive Analysis. Even though the foregoing analyses may be very useful as descriptions of the kinds of students in remedial and regular introductory academic college courses, and are based on a large sample of longitudinal data, such a sample is not likely to accurately estimate the proportions of an entire cohort of students entering and succeeding over time in successive courses.

This limitation is associated with the tendency for a sample of this type (introductory course classrooms) to over-select survivors in the community colleges. Given the relatively low proportion in introductory classes of students enrolled in their first semester, the large majority of students in most of the classrooms sampled were persons who had persisted for several semesters. The coursetaking trajectories of these students are obviously much different from those of their now absent peers with whom they initially entered the colleges as first semester cohorts, which peers have since departed from the colleges. If these departed cohort peers had more difficulty with the courses than did the survivors we have examined, then the previous analyses may have overestimated the course re-enrollment and success rates that would have characterized a given cohort in an earlier semester. Or if the departed peers had had an easier time with the courses before they went off early to, say, a four-year college, then the foregoing analyses might have underestimated course success rates.

We might call this a fragmentary cohort sample design, because only a fragment of the students remains from each of the full cohorts that entered in each of preceding semesters. The preceding analyses have been useful for estimating the composition of introductory course classrooms which are comprised of a set of fragmentary cohorts. Such introductory courses enroll a very large proportion of the total numbers of students in the community colleges. However, the estimation of the sequence of coursetaking rates and success for a full cohort sample (which retains all of its cases, including the dropouts) is not to be found with such a design.

Success in Subsequent Math Courses: First Time Freshmen Cohort

To describe the actual rates of enrollment and success over the several semesters for a full cohort, we identified within the larger sample a smaller group of students in the first semester in which they began college for the first time. We

then followed the math coursetaking of all of these students over five semesters (that is, for any courses they attempted within the nine colleges; courses they may have entered elsewhere were not examined).

In this full cohort sample of 609 students we found that 294 had taken the math placement exam. Of these 184 enrolled in at least one math course at some point during the five semesters. The distribution of the cohort over the categories of the placement/course match is portrayed in Chart 9: middle-routers 86% (N=158), low-routers 4% (N=7), and high-routers 10% (N=19). For the latter two categories the number of cases was too low for the estimates to be reliable, yet it is clear that the proportions of students taking a different route than the middle path was less than had been estimated in the earlier analyses. There are at least two reasons why the full cohort displays lower estimates of high-routers than found in our preceding analyses of the fragmentary cohorts. First, the colleges in recent years have attempted to impose computer registration controls against high-routers who attempt to slip past the matriculation regulations, and these lower figures may be an indication of the success of these controls. Probably a larger part of the difference in the percentage of high-routers can be attributed to the method here of following all students within a cohort sample for several semesters, rather than only the students who persisted in attending these colleges.

In comparing the full cohort with the previous analyses of fragmentary cohorts, we see smaller estimates of the proportion of students who attempted second and third math courses. For example, of the 158 middle-routers whose first class was equal in level to their placement test, only 78 (53%) attempted a second math class. This proportion is much less than the estimate of 81% observed in the analysis of the fragmentary cohorts. This lower estimate may be due in part to the shorter enrollment sequence of only 5 semesters for the full cohort, yet 5 semesters is probably a long enough time period in which to capture most of the second math course enrollments. The main explanation for a lower rate of course entry for the full cohort is probably that this analysis accounts for all of the sample, many of whom departed from the college during the first or early semesters.

Chart 10 portrays the success of these students in their first math course, all math courses, and all courses in relation to the 3 categories of the placement/course match. As would be expected, the rates of course success for the full cohort are lower than for the seasoned survivors in the fragmentary cohorts, by about 5 – 10% or more. For the mid-routers, 56% were successful in all of their math courses. (Again, because the sub-sample numbers of cases are so low for two of the match categories, it is not meaningful to compare rates between these categories.)

Social Structure and the Placement/Course Match. Exploring possible sources of the foregoing nontraditional coursetaking patterns in the nontraditional social origins of the students, we examined relationships for the match with gender, age, ethnicity, and first language. We found some relationships, all of them modest in strength of association.

There were no statistically significant differences between women and men in their placement/course match scores. About 4% more of the younger students were more likely to enter a math course at a higher level than recommended. By about 15%, Asian American students were more likely to enter a math course at a higher level than their placement score, compared with students from other ethnic groups. Students whose native language was English were about 6% less likely to enter a math course at a higher level than their placement score, compared with students whose first language was another.

Educational Attitudes and the Placement/Course Match. We have explored various educational attitudes and goals, but have found few relationships with the placement/course match.

An example of such attitudes concerns the degree of priority the students placed on their role as a student. Adelman (1999) found that this sense of the priority of the student role was substantially correlated with some coursetaking behaviors. Table 12 displays the students' conceptions of their roles in their current social context (as indicated by a closed category survey item). Those conceiving of themselves as only or primarily students were a little more likely than those who identified primarily with their work or their parenting, but by no more than 5%, to enter a math course at a higher level than indicated by the placement tests.

CONCLUSIONS:

Functional. This study found some evidence of the functional success of the system of assessment and remedial courses, including high rates of participation in placement testing among those entering the academic track, a high rate of entry by students into remedial math courses at the level indicated by placement tests, and for the latter students slightly better rates of success in their first remedial math course. The middle-routers and low-routers were also more likely to enroll for a second math course (though it is not clear that this is a sign of the remedial system's success).

Difficulties faced by students who did not comply with the matriculation system, and who initially entered a remedial math course at a higher level than recommended by their placement test, may have been reflected in the slightly lower success rates in the initial math course.

There is also some suggestion that the matriculation system has become stronger, extending its reach over almost all students. The fraction of high-routers appears to be less in the more recent cohorts.

There are small numbers of students who persist in satisfactorily completing several remedial courses and entering the regular required college math studies.

Tracking. However, many findings were consistent with the perspective of a system of tracking that fails to assist students in their attempts to complete a program of studies. Success rates of 50 – 60% in the first and subsequent remedial math courses involve very low opportunities to learn and progress up the educational ladder. Moreover, the percentage of the students who did not attempt further math courses in subsequent semesters is large.

A disturbingly recurring pattern among the various coursetaking paths suggests a “two-thirds limits” hypothesis which asserts that usually not more than about two-thirds of any subgroup of students on any coursetaking route are likely to succeed in any particular remedial math course along that route. In too many remedial courses the success rate is closer to only half of the students. In any cells of our tables where we had a sufficient number of students for reliable estimates, say 30 or more, almost all of the success rates were about 60% or less. A remarkable continuity of success and failure rates characterizes the first three math courses taken by the students. The success rate was only about 60% (51-65%) at each point on the path regardless of whether it was the first, second, or third course. After each course a substantial minority, of those who were classified as unsuccessful, enrolled again in another math course. Why were the numbers of the successful so low, and why were they so consistently close to this fraction of 60%? Why isn't more learning occurring, and why is there so much repetition of failure?

As a result of these coursetaking routes of failure and repetition, the remedial math classrooms displayed a pattern of fragmentary cohorts comprised of the survivors of many different cohorts from earlier semesters. A high percentage of the participants in these classrooms have had more than one remedial course, and a high percentage have not succeeded in at least one course. The traditional notion of a full cohort of students who progress through an established sequence of courses did not apply to these settings. To understand the nature of the remedial classrooms, research can use the lens of many fragmentary cohorts to study the success of the different subgroups of students.

Analysis of a full cohort produced findings that suggested even lower rates of remedial math success and persistence in the colleges.

The comparisons of the placement/course level match could be interpreted as indicating that the high-routers in the upper level remedial courses, by evading the placement test assessments, had found a faster way out of the morass of the remedial courses. There was an interaction between the relationship of the placement/course match to academic success and the three levels of remedial courses. More in the upper levels, 1 and 2, than in level 0 of the remedial courses the high-routers had a little higher rate of success. We may speculate that these high-routers chose a higher level, than indicated by the placement test, because they felt that their previous accomplishments were greater than recognized by the placement tests. Or, they may have been unusually ambitious. Yet the high-routers still faced considerable risk in taking their path: in most instances over 30% of the high-routers did not succeed in these remedial math courses. The differences in success between the compliant middle-routers and the high-router risk-takers were not great: only about 5-10%.

In searching for social roles and characteristics associated with the placement/course match, we found no strong relationships. Students with Asian cultural backgrounds were a little more likely to be high-routers. In general, we have not found that coursetaking routes are closely connected to any of the roles we have examined.

FUTURE RESEARCH

At this point we feel that we are still not ready to begin testing hypotheses about remedial coursetaking. (For example, there are further possible analyses in the tables we have presented in this paper.)

We want to also pursue further the routes taken by the students after their third math courses. Among the fragmentary cohorts which populate the introductory course classrooms, how many remedial and regular math courses are attempted on which various kinds of coursetaking routes?

What are the ultimate educational outcomes in the community colleges for various kinds of the placement/course match?

Of course, we want to know what happened to these students after they completed or discontinued their remedial math studies. How many left college or move into regular college courses, transferred to four-year colleges, claimed the bachelor's degrees, and entered a satisfying productive job?

Finally, why is it that groups of students who are sufficiently motivated to persist through several remedial courses continue to fail the second and third of these courses at the rate of 40-50%? Having learned what are the paths taken by the students, the colleges must turn to address the learning processes that can promote more effective outcomes for many of the students.

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