Questions about College Algebra

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Abstract

To begin assessing their College Algebra course at a small, rural community college in north-central Kansas, the authors investigated two questions. The first question was about the best format for the course, while the second concerned the effectiveness of the preceding course in the algebra sequence, Intermediate Algebra, in preparing students for College Algebra.

Background and Goals

Cloud County Community College is a small rural two-year college in north-central Kansas. The college serves a twelve county service area of over 8000 square miles on two widely separated campuses, and is an open enrollment college. Over the years we have seen a shift in our enrollments, as more and more of our students come to the college requiring one or more developmental courses. In fact, the vast majority of our enrollments, roughly 92% during the 2001-02 school year, are for classes at or below the level of College Algebra.

We naturally felt that our focus should be on these classes. We wanted to learn more about how our students fared when they moved from their developmental courses to College Algebra. In order to start small, we decided to limit this investigation to students who had taken the previous course in the sequence, Intermediate Algebra. We also wanted to investigate the best format for College Algebra itself.

Historically, Cloud County Community College has had the same problems as the rest of the nation in terms of student success in College Algebra. Thus, several years ago, a one-credit course, Explorations in College Algebra, was instituted as an attempt at intervention. This course was required of all students who took College Algebra at our Concordia campus. It was designed and implemented as a series of activities in which the students used graphing calculators and other technology, often in groups, to examine certain topics in more detail. These topics included basic regression analysis, the laws of gravity and light intensity, and a deeper investigation of exponential functions through applications to finance.

We wanted to determine whether the course fulfilled one of its primary goals: to increase performance in College Algebra. That data had never been gathered. We also received complaints on a regular basis from students because they were required to take a course with little or no perceived benefit to them. We were concerned that this requirement may have led to decreases in enrollment in main campus daytime College Algebra classes. Thus one issue we decided to examine was trying to find the best format for our College Algebra classes.

This effort formed the largest part of our project, but was not our original idea. As mentioned above, we were interested in whether our developmental classes provided a good preparation for College Algebra, and this was the idea we presented in our initial meeting in San Diego. Being new to the world of assessment, we had trouble deciding how we were going to measure this, and even what we were going to measure. We were asked to refine this idea. We decided that the examination of the best format for College Algebra would be our first project. This was particularly attractive since one member of our team (Warkentin) was teaching the three daytime sections of College Algebra in the spring semester. Thus we wouldn't have to worry about the effect of different instructors on any results.

Details of the assessment program

Since we were interested in finding the best format for the class, each section was delivered in a different format. Section A met three days a week, with an Explorations laboratory that met once a week for one and a half hours. Section B met each day of the week, with the Tuesday and Thursday sections meeting for 45 minutes each, without any lab activities. This time was instead used mainly to slow the pace of lecturing down, so that students had more time to process and practice. The last section, Section C, met three days a week, without any additional time or intervention.

Because enrollments for the Spring semester had already taken place, there was little we could do to group students in any way. At the time of the project, students had to satisfy at least one of two prerequisites: two years of high school algebra with a C or better *and* appropriate test scores, or a grade of C or better in Intermediate Algebra, the previous class in our algebra sequence. Thus these classes had a fairly wide range of abilities and preparations. Admittedly this makes any conclusions from this study less reliable, but this was our starting point.

In each of these sections, we used questions on multiple-choice tests to measure student performance. Since these test questions were tied to objectives from the text, we used those as outcomes. We also tracked which section performed best on each chapter test, as well as the final examination.

While Warkentin investigated formats for College Algebra, the other member of the team (Whisler) looked into how well our developmental courses prepared students for College Algebra. With the help of our advisement office, we looked at the grades that students who took Intermediate Algebra received in College Algebra. This search went back through the past two years only, since we had a significant faculty turnover at that time.

Findings.

The results of the investigation into the best format for College Algebra are partially summarized in the tables in Appendix A. We found that the section that met each day (Section B) performed the best on 6 of 7 chapter exams. This result, though, did not carry over to the final exam, and in fact this section had the worst performance on the

final exam. The next best performance during the semester came from the section that met three times per week (Section C), while the the section with the Explorations lab (Section A) did worst on chapter exams. This section performed best on the final, however.

Below in Table 1 is what we found about success rates in College Algebra of students who took Intermediate Algebra from us and earned a grade of C or better. *For the purposes of this study, we defined success to mean that the student earned a grade of C or better in the class the first time they took the class*. That is, if a student had taken Intermediate Algebra, subsequently withdrawn from College Algebra, but then later succeeded in earning a grade of C or better, that was not considered a success. This is perhaps too stringent a criterion, since it doesn't take into account other life factors which may have had a significant impact on the student in a given semester.

TABLE 1: Success in College Algebra of successful Intermediate Algebra students

	% of developmental students in class				Success rate (%)
Fall 2000					
Section A		28.6 (5/21)			20.0.(1/5)
Section B		27.3 (6/22)			100 (6/6)
Section C		36.0 (9/25)			55.6 (5/9)
Overall		36.8 (20/68)			60.0 (12/20)
Spring 2001					
Section A		50.0 (11/22)			81.8 (9/11)
Section B		63.6 (14/22)			78.6 (11/14)
Section C		66.7 (8/12)			75.0 (6/8)
Overall		58.9 (33/56)			78.8 (26/33)
Fall 2001					
Section A		22.2 (6/27)			66.7 (4/6)
Section B		21.4 (3/14)			33.3 (1/3)
Section C		17.6 (3/17)			100.0 (3/3)
Overall		20.7 (12/58)			66.7 (8/12)

One message here seems to be that developmental students who take College Algebra in the fall are somewhat more at risk. It seems likely that many students did not keep up their studies or use what they had learned over the summer, and so they simply forgot a good portion of what they had learned. It is also the case that they are competing against incoming freshmen who are more talented mathematically. There are other factors that come into play; there are probably multiple reasons for this situation. On the positive side, the success rate was significantly higher in the spring. This may indicate that we do a good job in our developmental courses overall preparing our students for College Algebra.

We also looked at success rates of students in College Algebra organized by the grade they earned in Intermediate Algebra. This information is contained in Table 2.

TABLE 2: Success rates in College Algebra sorted by Grade earned in Intermediate Algebra

	C	B	A
Fall 2000	0% (0/8)	50% (5/10)	100% (2/2)
Spring 2001	61.5% (8/13)	93.7% (15/16)	75% (3/4)
Fall 2001	0% (0/2)	83.3% (4/6)	100% (4/4)
Overall	34.8% (8/23)	75.0% (24/32)	90% (9/10)

We can see from this table that, for instance, of the 20 developmental students who took College Algebra in the Fall 2000 semester, 8 of them earned a C in Intermediate Algebra. Of those 8 students, none of them succeeded, according to the definition of success given above. Overall, 23 students taking College Algebra over these three semesters earned a grade of C in Intermediate Algebra, and of those 23, 8 of them succeeded. Similar interpretations should be made for the other entries.

It seems clear that students who received a C in Intermediate Algebra typically struggled in College Algebra. In fact, just under 35% of those students earned a grade of C or better in College Algebra, which is how we defined success in the class. None of them earned an A, and only two earned a B. It should be no surprise that students who were allowed into the class despite not fulfilling one of the prerequisites fared even worse. For this reason we decided not to track this group of students. Some of these students simply slipped through the cracks in the advising process, but some of them were highly motivated, typically non-traditional students. They provided the only successes in this category. Overall, roughly 63% of our students who took Intermediate Algebra in this two-year period earned a C or better in College Algebra.

Use of Findings and Next Steps

The change with the greatest impact is likely to be the change in format that we instituted in the fall of 2002 in College Algebra. We are offering all of our daytime sections of College Algebra as classes that, along with its companion class, College Algebra Explorations, meet every day. We plan to continue our evaluation of this format with a smaller set of outcomes, to see if it nets any gains in student performance.

We had already raised the level of performance necessary in Intermediate Algebra to move on to College Algebra to a grade of B or better, and we intend to hold to that standard, despite pressure. One consequence of this policy is that we have received requests for alternatives to Intermediate Algebra if a student has earned a C in that course. We also are looking for ways to implement early intervention for developmental students who take College Algebra in the fall in order to improve their likelihood of success.

Even though one of us (Warkentin) is a veteran teacher, we were both new to the process of using assessment techniques for our program. We both feel that this experience has been a valuable one, but we believe that it would be difficult to sustain at the level of this case study. We are continuing, so far, the study of how students who take Intermediate

Algebra perform in College Algebra. The challenge, as always with a small school, is to keep up our attention level to assessment and make it part of our departmental culture.

Appendix A: Comparison of success of College Algebra sections taught in different formats

Each chapter's data consists of two tables. The first shows the number of times each section ranked first, second or third for a particular objective, as measured by the number of students who got questions correct for each objective that was tested. The second averages each section's performance on all the common objectives. The sections of College Algebra are labeled as follows:
Section A: Met 3 days per week and had an Explorations Laboratory.
Section B: Met 5 days per week.
Section C: Met 3 days per week.

A "first" for a section indicates that that section performed best on a given question, e.g. they had the highest percentage of correct answers. A "second" indicates that a section had the second highest percentage of correct answers for a question, and so on.

Chapter 1

Section/Rank	Firsts	Seconds	Thirds
Section A	2	7	9
Section B	12	2	4
Section C	4	10	4

Section	Average Percent Correct
Section A	44
Section B	56
Section C	49
All Sections	50

Chapter 2

Section/Rank	Firsts	Seconds	Thirds
Section A	2	8	3
Section B	8	1	4
Section C	5	2	6

Section	Average Percent Correct
Section A	62
Section B	68
Section C	65
All Sections	65

Chapter 3

Section/Rank	Firsts	Seconds	Thirds
Section A	1	10	2
Section B	9	2	2
Section C	5	0	8

Section	Average Percent Correct
Section A	53
Section B	65
Section C	53
All Sections	57

Chapter 4

Section/Rank	Firsts	Seconds	Thirds
Section A	5	4	0
Section B	1	3	5
Section C	2	2	5

Section	Average Percent Correct
Section A	51
Section B	37
Section C	40
All Sections	43

Chapter 5

Section/Rank	Firsts	Seconds	Thirds
Section A	1	4	5
Section B	6	3	1
Section C	3	4	3

Section	Average Percent Correct
Section A	58
Section B	67
Section C	61
All Sections	62

Chapter 6

Section/Rank	Firsts	Seconds	Thirds
Section A	1	5	4
Section B	5	4	1
Section C	4	2	4

Section	Average Percent Correct
Section A	65
Section B	72
Section C	71
All Sections	69

Chapter 7

Section/Rank	Firsts	Seconds	Thirds
Section A	0	4	6
Section B	7	1	2
Section C	4	5	1

Section	Average Percent Correct
Section A	69
Section B	79
Section C	78
All Sections	75

Note that the final exam was a 40 question, multiple-choice exam. We see that Section A had the highest percentage of correct answers on 22 of 40 questions.

Final Exam

Section/Rank	Firsts	Seconds	Thirds
Section A	22	12	6
Section B	13	13	14
Section C	16	16	8

Section	Average Percent Correct
Section A	54
Section B	49
Section C	53
All Sections	52