THIRD GENERATION REDESIGN OF A DEVELOPMENTAL MATHEMATICS COURSE: FINDING WHAT WORKS

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Abstract: Over the past five years the Department of Mathematics at West Virginia University (WVU) has experimented with a number of different formats for it's Pre-College Algebra Workshop. The program began with a standard lecture based course intended to prepare students who lack the necessary prerequisite algebra skills for mainstream credit bearing college mathematics courses. Subsequently the course was migrated to a self-paced hybrid format and has been recently redesigned. In this paper we will describe the evolution of the structure of the course and present data on success rates in the course during the various redesigns.

Student Placement at West Virginia University

West Virginia University (WVU) is a public, land-grant university with approximately 30,000 students. WVU general education course (GEC) requirements mandate that all students in undergraduate degree programs earn three credit hours of either collegiate mathematics or statistics. For many programs, College Algebra or a higher-level mathematics course is the mechanism by which students must meet that GEC requirement. Because of this, the WVU Department of Mathematics teaches over 12,000 students per academic year (not including summers). Unfortunately, many students arrive at WVU unprepared for college level mathematics. With no community colleges near WVU, it has been a long-standing responsibility of our department to address the lack of preparation in mathematics of incoming students through a remedial non credit-bearing mathematics course, the WVU Pre-College Algebra Mathematics Workshop (referred to as Workshop for the remainder of the paper).

Most students who do not have the SAT or ACT Math scores to place into College Algebra attempt to gain entry via the departmental placement exam. Those who are unable to place into College Algebra through any of the testing options but need at least College Algebra for their intended major are then placed into Workshop.

WVU has approximately 5000 new incoming freshmen and transfer students each year, many of whom take a placement test during the summer for mathematics placement if they do not come in with either transfer credit or sufficient ACT/SAT scores. Between the fall 2008 and spring 2014 semesters, the WVU Department of Mathematics tested 32,113 students, of which 28% ($N = 8975$) placed into Workshop (see Figure 1).

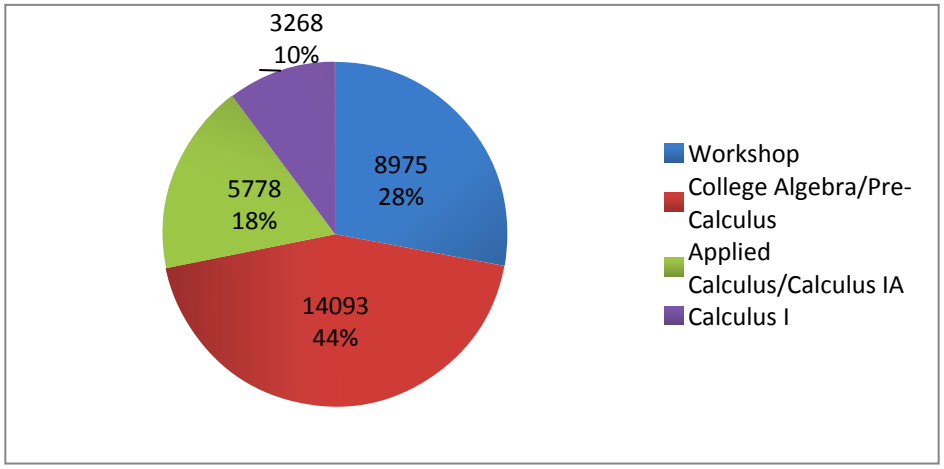

Figure 1 Student Placement fall 2008 - spring 2014

History and Evolution of Workshop

Given the history of a large number of students arriving at WVU unprepared for College Algebra, the university offered Intermediate Algebra for credit towards degree completion in the College of Arts & Sciences until the early 1980s. It was believed by the West Virginia Higher Education Policy Commission at the time that WVU should be using current instructional resources (e.g. faculty and graduate teaching assistants) for non-remedial, college level mathematics instruction. Therefore, Intermediate Algebra was removed from the WVU course catalog. The WVU Department of Mathematics then moved to a student-funded, departmentally offered, self-supporting model for Workshop to take the place of Intermediate Algebra. University-allocated resources were no longer consumed by remediation efforts. Students needing, but not prepared for, College Algebra must register (and pay) for Workshop through the Department of Mathematics (not the university). The funds collected through registration provide salary for the instructors hired as needed to teach the course.

The goal of Workshop is to assist at risk students by improving their chances for success in College Algebra. The early model of Workshop consisted of 10-15 sections of size 30, three hours of lecture, paper and pencil homework, and several multiple-choice exams graded electronically (scantron).

In the fall 2006 semester, the course was redesigned but maintained three hours of lecture. We switched to using the Martin-Gay Intermediate Algebra text (Martin-Gay, 2005) and implemented the use of the online homework system MyMathLab. Exams were still given on paper, but were hand graded to allow for partial credit. Class size increased slightly to 35-40 students per section. In this model, students needed to earn a 70% average on the in-class exams and at least a 60% on the final to pass the course. Within both this and the previous models, students were able to fail a test and still pass the course by maintaining the necessary averages on the course components. This model

also left students with the possibility of failing the course by not meeting the in-class or final exam percentages needed.

Move to Self-Paced, Mastery Model

In the fall of 2009 we implemented perhaps the biggest change in the course – a move to a self-paced model of mastery that de-emphasized the traditional lecture format and instead let students control the pace and nature of their learning experience. In this format, instructors respond to individual student questions as students work through the seven chapters of material (35 sections of content). Students work through the material at their own pace and rely on more individualized instruction as they progress through the course. At the same time, we adopted the Beginning and Intermediate text by Martin-Gay (Martin-Gay, 2008) and revised course content to align with this book.

Because the course was now based on mastery, students could not move on to the next section in the content until they had passed the homework quiz for the previous section with at least a score of 80%. Homework quiz problems are algorithmically generated, free response and can be accessed from home or in class, so students could truly work at their own pace. Students had an unlimited number of attempts on homework quizzes. After reaching the end of a chapter, students took a chapter test and had to earn an 80% before moving on to the homework quiz for the first section of the next chapter. Tests were only accessible at specific times, on specific days on campus in the classrooms where students attended the class. If a student failed to earn the required 80% on a chapter test, they could retake the test up to three times before having to retake all homework quizzes from that chapter. The course ended with a cumulative final exam, on which students also had three attempts. In theory, upon failing to meet the required 70% on the final exam after two attempts, student would have to complete an exam review of 350 questions, though this has not occurred.

Class size was lowered to 25 allowing the instructor to interact with students one-on-one each day as they answered individual questions. Class time was kept at 3 hours of in-class meetings each week but students were also asked to spend one hour each week in a tutoring lab environment for additional help.

At the end of the semester, students could find themselves in one of three situations. If they had completed all homework quizzes and tests (including the final) at the required master levels they had successfully completed the course. In that case, their placement score was changed in the student database system to indicate eligibility to enroll in a College Algebra course but not in any higher-level course. If they had not finished the content, they could reenroll in Workshop the next semester and begin where they ended the first semester. In this case, students had to again pay for the course. Alternatively, if they had only taken the departmental placement test once before enrolling in Workshop and had made sufficient progress in the Workshop content they were encouraged to use their second try on the placement test to attempt to test into College Algebra.

Further Modifications to Course Structure

In fall of 2012 we made further modifications to the structure of Workshop. We felt the content and self-paced format were appropriate and students were benefitting from those aspects but believed students could benefit from additional changes.

When a student attempts a chapter test and is unsuccessful, he or she will usually seek out the assistance of an instructor to review problems they had trouble with during the next class meeting. Because of this practice of reviewing previous exams instructors can spend a great deal of time with a single student. In order to be able to do this and still help other students in the class, class size increased to 48, nearly double the previous size, but there were now two instructors in the room. Two instructors present allows one instructor to do exam reviews with individual students throughout the 50 minute meeting if necessary while the second instructor answers questions on the homework quizzes.

In addition, students now meet four days per week instead of three. With larger classes, we now offer fewer sections meaning there are more times during which our computer lab is not in use. This has provided more times for students to attempt chapter tests and progress through the course.

Preliminary Results & Discussion

A total of nearly 2,000 students enrolled in Workshop between fall 2006 and spring 2009, during the first redesign of the course. Slightly more students enrolled during the second redesign period when the course moved to self-paced and in three semesters in the newest format approximately 1,200 students have enrolled in Workshop. Success rates are presented in Table 1.

Time Period	Completed	Incomplete	Total	Success Rate
Fall 2006 through Spring 2009	928	1041	1969	47.31%
Fall 2009 through Summer 2012	785	1237	2022	38.82%
Fall 2012 through Fall 2013	595	590	1185	50.21%

Table 1 Success Rates for Three Redesigns of Workshop from Fall 2006 through Fall 2013

Success rates in the 2009-2012 period decreased and we believe this is a result of increasing the rigor and requiring a mastery of *all* units taught in the course preventing students from performing well early in the semester, performing poorly on later sections but still earning an average high enough to pass the course. However, the success rate increased again after the next redesign. We believe this to be due to an increase in contact time with instructors but still requiring the same level of mastery.

These results merely present the current pass rates for this course, but what we are more interested in is the performance of the students who are successful in Workshop in their subsequent classes. A preliminary analysis of Workshop student success in their subsequent mathematics courses has been completed (Fuller, Deshler, Kuhn & Squire, 2014) however, that work looked at the overall performance of all Workshop students, regardless of the format of the course at the time that they enrolled. Future plans include tracking students by format to determine the specific effectiveness of each redesign on performance of students in College Algebra and beyond.

References:

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