The Impact of Redesigned College Algebra

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Abstract. An important component of undergraduate education is the understanding of basic mathematics. To help students enhance their basic mathematical knowledge necessary for their academic success, in Fall 2011 Georgia College begun offering a redesigned College Algebra course based on the Emporium Model and, using the latest technology and learner-centered pedagogy. Various adjustments and modifications were made since then. This paper will give an overview of how the redesigned course was implemented, the changes made and the results for the first four years. We will also discuss the performance of the students who took College Algebra in Year 1 and who then went on to take either Precalculus or Probability and Statistics.

1. Introduction

Georgia College (GC), the public liberal arts college of Georgia, has approximately 5,900 undergraduate students and about 850 graduate students. The Department of Mathematics offers a BS degree in mathematics with an optional teaching concentration. It has about 80-100 major students, who are guided by 18 full-time faculty. Mathematics, a cornerstone in a liberal arts education, is an essential area for students. At Georgia College each student must complete 3 hours in Area A2. Among the courses that meet this requirement is College Algebra. This course was introduced in Fall 2011 following the Emporium Model [2]. In this paper we will give an overview of how the redesigned course was implemented, the changes made and the results for the first four years. We will discuss the performance of the students who took College Algebra in Year 1 and who then went on to take either Precalculus or Probability and Statistics. In Section 2 we are going to describe the educational framework for our work, we will follow with section 3, where we describe our design. The results after our first four years of implementations, and the performance of our students in the follow-up courses will be presented in section 4.

2. Educational Framework

Over the last decade it has been a big shift from teacher-centered to student-centered learning. Student-centered learning theorist Carl Rogers wrote that: "the only learning which significantly influences behavior [and education] is self-discovered" [4]. Students are now engaged in the discovery of information, the role of the instructor is that of a facilitator of learning. Active learning has great benefits, students not only improve learning but also gain lifetime learning skills. As Carl Rogers stated, “significant learning is acquired through being active and doing things” [4]. Following the model of learning by doing, the Emporium Model is one of the five models of instructions advocated by the National Center for Academic Transformation (NCAT). This model is based on three main principles: learning by doing, provide immediate personalized help, and

mandatory student participation [1]. Many variations of this model have been adopted by many institutions. The main characteristics are [2]:

- The lectures are replaced with a learning resource center model featuring interactive software and on-demand personalized assistance.
- Depends on instructional software, including interactive tutorials, practice exercises, and online quizzes and tests.
- Allow students to choose what types of learning materials to use depending on their needs.
- Uses a staffing model that combines faculty, peer tutors and others who respond directly to students' specific needs and direct them to specific resources.

The underline principle is that students are required to do their work, spend most of their course time doing math getting immediate feedback, and spend more time on concepts they do not understand.

3. Emporium Model at Georgia College

One of the goals of College Algebra has always been to "bridge the gap between the ideas emphasized in the high school and in the college by treating topics of secondary algebra in the college course more in the light of higher mathematics, and with greater stress on logical considerations than is, in general, feasible in the high school"[3]. It is one of courses that is taken by most of the students to fulfill general education requirements at many colleges.

In Fall 2011, in consultations with many Georgia College's departments and with the administrative support, the Department of Mathematics has started to offer a redesigned College Algebra. One of the purposes of implementing College Algebra is to enhance the algebraic skills and knowledge of our students necessary for upper-level math courses and for courses in many other disciplines.

Before deciding on the key elements for GC's Emporium, the leading instructors of this course, attended several workshops. The most intensive ones focused on how to design a hybrid course, how to organize an emporium model and what are the best software for delivering the course content online. Some were organized by Georgia College and some by NCAT. Following these workshops, the instructors decided on the characteristics of the redesign and then prepared all the materials for the course.

For fall 2011, we decided that our College Algebra's students would spend 50 minutes per week at a fixed time with their instructor, and a minimum of three flexible hours per week in the Georgia College Emporium Lab, which is staffed with instructors and undergraduate learning assistants (ULA's). During the class meeting, instructors guide the students through their responsibilities, connect concepts, work examples, and point out common student misconceptions. Overall the main goal of these meetings is to give students the big picture of the content. In the Emporium Lab, instructors and ULA's offer immediate and personalized help with mathematical concepts 44 hours per week, Monday through Friday. All course materials created (syllabus, daily schedules, videos, tutorials and guides) were integrated within the web-based software MyMathLab, which comes bundled with the e-textbook. Every week, students navigate through the assigned sections that include the e-textbook, video lectures and examples, animations, tutorial exercises, homework and quizzes. The homework has an unlimited number of attempts and the quizzes have up to three attempts before the due date, and they can be accessed from home as well. The password-protected tests are only taken in the lab under the instructor's supervision. The instructors grade the test work presented by students on paper, to correct the possible

computer's errors, to give partial credit, and to better evaluate students' performance and improvement.
This course redesign is not about putting the course online. It is about creating a new teaching strategy in the light of the possibilities that technology offers with strong considerations being given to the individual needs of students.

4. Results

After the first term's implementation of the redesign College Algebra we obtained encouraging results. Compared to all 1000-level math courses offered in Fall 2011 and prior to this, the DFW-rate dropped and the AB-rate rose.

All 1000-level math courses		
	AB-rate	DFW-rate
Fall 2009	45.4%	30%
Fall 2010	50.7%	28%
Fall 2011	55.6%	24.2%

MATH 1111 College Algebra		
	AB-rate	DFW-rate
Fall 2011	57.1%	22.6%

All 1000-level math courses		
	AB-rate	DFW-rate
AY 2009-10	47%	29%
AY 2010-11	53%	26%
AY 2011-12	53%	26%

MATH 1111 College Algebra		
	AB-rate	DFW-rate
AY 2011-12	57.1%	22.6%

Based on the experience from our first year of offering, to increase the students' success, we made some changes to the course in the next term. We increased the class time from 50 to 75 minutes, this allowed us to engage students in more hands-on activities, and allowed for more testing time. In addition to this, we made adjustments to students' assignments based on their performance, we designed class notes with gaps, when needed, to increase time class participation and discussions, and we extended the number of hours of the lab from 44 to 52 hours per week. These changes reflected positively on our results for the following year compared to our first year:

MATH 1111 COLLEGE ALGEBRA			
	AB-rate	DFW-rate	W-rate
AY 2011-12	55	24	13
AY 2012-13	67	20	9

For the next two years, we did not do major changes, we only adjusted assignments, tweaked the class notes and class activities. The results after four years of implementation of the redesigned College Algebra are:

Academic Year	**Enrolled Students**	**AB-rate**	**DFW-rate**	**W-rate**
2011-12	511	55%	24%	13%
2012-13	535	67%	20%	9%
2013-14	593	71%	16%	7%
2014-15	616	66%	18%	7%

The purpose of offering the redesigned College Algebra is to help the students learn the basic college level mathematics, essential foundation for many courses. After the first three years of offering it, the two leading instructors analyzed some data to see if the course serve its main purpose. The results found are positive and very encouraging.

	MATH 2600 ABC-rate	MATH 1113 ABC-rate	MATH 2600 DFW-rate	MATH 1113 DFW-rate
MATH 1111 ABC-rate	89.9%	**79.5%**	10.1%	20.5%
MATH 1101 ABC-rate	83.8%	57.7%	16.2%	42.3%

Of the students who received ABC in College Algebra in Year 1 and who went on to take upper level math courses, 89.9% received ABC in MATH 2600 Probability and Statistics and 79.5% received ABC in MATH 1113 Precalculus. When we look at the analogous data for students who took MATH 1101 Intro to Math Modeling instead of MATH 1111, the data suggest that the redesigned College Algebra provides better preparation for MATH 2600 and MATH 1113 than does MATH 1101. What is very interesting and somehow expected is that students who take MATH 1113 after they took MATH 1111 performed better than the ones who took MATH 1101 instead.

At the end of Spring 2014, we decided to administered a survey regarding various aspects of the lab and the ULA's. The survey were taken by 184 students out of 256 attending the class. The results of the survey reflected that students in general find the model beneficial.

Few of the survey results were:

1. I found the Emporium Lab's services useful:

Agree	Disagree	Total
160	17	177

2. The Emporium Lab is open sufficient/appropriate hours:

Agree	Disagree	Total
148	35	183

3. The ULA's made sure all my questions were addressed:

Agree	Disagree	Total
148	17	165

4. I would recommend the Emporium Lab to other students:

Agree	Disagree	Total
165	19	184

5. Conclusion

After four years of offering, we believe that the Emporium Model at Georgia College is set up for success. The students not only enhance their algebraic skills but also develop good math study skills and learn time management skills. We require students to take control of their own learning, which is critical for college success.

References

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3. Rietz, H.L. (1910), The Teaching of College Algebra. The American Mathematical Monthly, Vol. 17, No. 3 (Mar., 1910), pp 51-55.
4. Rogers, C. (1969). *Freedom to Learn: A View of What Education Might Become*. (1st ed.) Columbus, Ohio: Charles Merill.

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