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ABSTRACT

A section of College Algebra was redesigned to consist of best practices in instruction and assessment, a lower enrollment, and a required lab component in an effort to improve student performance. This pilot course consisted of instructional methods such as whole class instruction, small group instruction, and student presentations. Additional course revisions included a writing component using personal reflections, an additional lab component, a software package aligned with the adopted textbook, and bi-weekly progress reports. There was a statistically significant increase from pretest to posttest, as determined by a T-test. Other comparative analyses showed the course had the highest passing rate in the department. This class had the highest average on the departmental final exam. The faculty member teaching the course also had a higher passing rate when compared to courses she taught during previous semesters. According to these results based on student performance, this course was deemed successful.

Key Words: mathematics, college algebra, student achievement, course redesign, assessment

INTRODUCTION

At the college level, college algebra is the first required mathematics course for most students. Therefore, this course is taken primarily by freshman and those who were not successful as freshmen when they took it the first time. Currently, about 15 sections of college algebra are offered in the fall semesters and about 5 are offered in the spring semesters. Albany State University (ASU) is a public, historically black comprehensive university located in rural southwest Georgia, with an enrollment of approximately 3500 students. College algebra has one of the highest "non-passing" rates at ASU (Bynum, Heglar, Hill, Jones, Leggett, Okonkwo, Qawiy, Whitley, & Wooden, 2008). Thus, efforts were needed to make improvements to this course. Several efforts have been taken in the past, but no substantial changes in course delivery and presentation have taken place (Porter, 2009).

REVIEW OF LITERATURE

Barkley (2010) suggests that course structure is a key component to engaging students so that they will experience academic success. Another component is teacher/faculty quality. Faculty at all levels should be properly trained and prepared to teach their students. This comes with professional development to create and design courses that will facilitate student success. The course redesign is centered on the philosophical and pedagogical concepts of "differentiation," which is simply individualizing options for each student's needs. This redesign should be thoroughly planned. Each of the proposed changes in the course reflected best practices in the literature. These changes included a required supplemental instruction (Lazari & Simons, 2003), smaller class sizes (Hanushek, 1998), student presentations (Chivers & Schoolbred, 2007), writing component (Urquhart & McIver, 2005), whole group and small group direct instruction (Barkley, 2010), technology (Barkley, 2010), and varied assessment practices (Barkley, 2010).

RESEARCH QUESTION

The research question in this study includes the following.

1. Was the math course revision effective?

METHODOLOGY

As part of an externally funded grant, the ASU stakeholders made a recommendation to revise a college algebra section to determine if best practices would be effective at ASU. During spring, 2013, MATH 1111-08 was restructured, and data were collected to determine the effectiveness of the redesigned course. The instructional and assessment practices were restructured to include best-practices as stated in the literature. This course was redesigned to consist of best practices in instruction and assessment, a lower enrollment, and a lab component. Instructional methods employed were whole class instruction, small group instruction, and student presentations. Additional course revisions included a writing component using personal reflections, a required lab component, a software package aligned with the adopted textbook, and bi-weekly progress reports. An analysis of the results included determining the pass rate of the class and comparing this pass rate with other faculty teaching the same course. A comparison of this class with the current faculty's' previously taught courses was also performed. Additionally, there was a comparison of improvement between pretest scores and posttest scores of students. Finally, attendance at the mandatory lab was correlated to overall final performance (Patten, 2007).

Changes in the Redesigned Class. The redesigned College Algebra had a maximum capacity set at 25 students. Traditionally, College Algebra courses have a maximum of 40 students. The varied instructional practices included cooperative learning, student presentations, writing assignments, bonuses, and quizzes. The varied assessment practices included multiple choice and short answer tests, problem solving, presentations, writing assignments, and homework assignments.

Participants. The participants in this study included 23 students enrolled in a college algebra course during spring, 2015. There were 15 females, 8 males. Their majors were housed in the all colleges at the university—College of Arts & Humanities, College of Business, College of Sciences and Health Professions, & College of Education. The students' background or historical academic information consists of the following. The class had an average GPA of 2.015/4.000. The class had an average SAT (Math) of 416/800. The class had an average ACT(Math) 17/36.

RESULTS

Redesigned Course Data. The pass rate for the course was 94.1% for completers (those students who attended throughout the full course). The pass rate was 72.7% for entire class including completers and non-completers. Additionally, students made more positive remarks about their feelings towards math at the end of the course. At the beginning of the course, the students were asked to submit their feelings about mathematics via a written assignment. Seventeen students (about 74% of the students) reported negative or neutral feelings about mathematics. When asked at the end of the course, 15 of the 17 students made more positive statements. There was a highly significant increase in the math content post-test scores (μ=69.9, σ=11.6) compared to the pre-test scores (μ=22.4, σ=5.9, $t(15)$=-15.4, $p<.05$, two tailed (Figure 1). Only one of the course completers did not attend at least 12 of 14 labs. There were zero (0) F's earned by students who completed the course. With α = .05 and a sample of n = 22, the critical value for Pearson correlation (±.423) for a two-tailed test, there was a significant positive correlation (r=.90) between the number of days students attended lab and their grades using a 0 to 4.0 scale.

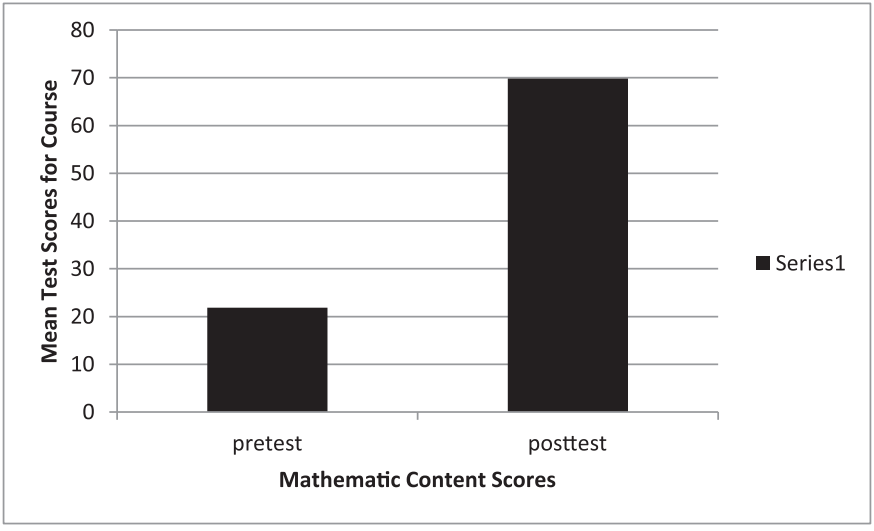

Figure 1. Comparison of pretest to posttest.

DEPARTMENTAL STATISTICS

Final Exam. The average score for the departmental standardized final exam was 58%. The average score for the standardized final exam for the revised course was 70%. See Table I.

Table I. Research and Departmental Faculty Average Final Exam Scores.

Faculty	Average Final Exam Score %
Research Faculty	70
Faculty 3	69
Faculty 3	60
Faculty 1	58
Faculty 1	54
Faculty 4	53
Faculty 5	52
Departmental Average	58

Course Pass Rate. The average department pass rate (A, B, C) for college algebra was 51.9%. The revised course had a pass rate of 72.7%, which is the highest in the department (Table II).

Table II. Research Faculty and Departmental Faculty Grade Results. Class Total represents total number of students enrolled. Total-W represents the Total in the class minus the number of students who withdrew from the class. This is the number used as the denominator for the passing rate percentage. The sum of the number of grades of A, B, and C is used as the numerator of the passing rate percentage. The last row entitled Department refers to the sum of all faculty members in the department, not including the Research Faculty.

	Grades						Class Total	Total-W	Passing Rate %
Faculty ID	A	B	C	D	F	W			
Research Faculty	4	7	5	1	5	1	23	22	72.7
Faculty 1	8	9	7	8	3	2	37	35	68.6
Faculty 2	7	3	5	1	7	1	24	23	65.2
Faculty 1	5	11	7	6	7	2	38	36	63.9
Faculty 3	2	3	14	5	10	6	40	34	55.9
Faculty 3	1	5	10	4	15	6	41	35	45.7
Faculty 4	2	6	4	1	18	9	40	31	38.7
Faculty 5	1	2	8	3	23	3	40	37	29.7
Department	26	39	55	28	83	29	260	231	51.9

Research Faculty Pass Rates. Additionally, the faculty member teaching the revised course also had the highest passing rate when compared to when she taught the same course during previous semesters (Table III).

Table III. Research Faculty Pass Rates.

Semester	Pass Rate (A, B, C) %
Spring 2013—Revised course	72.7
Spring 2009	58.3
Spring 2009	50.0
Fall 2012	42.2
Fall 2012	43.2
Fall 2011	62.2
Fall 2010	59.1
Fall 2010	62.2

DISCUSSION

The authors' quest to determine if this course was successful was based on answering four questions, viewed as subcomponents of the research question. The success and effectiveness of the College Algebra course was determined by answering the following questions.

1. Do the data indicate a significant difference in students' math content pre-test and post-test scores?

   There was a statistically significant increase in students' performance from pre-test to post-test scores in the revised College Algebra course. The authors realize that this is the natural flow and delved deeper to determine if the performance was indeed different from the natural flow at the university.

2. Is there a correlation between the number of days students attended lab and their final grades using a 0 to 4.0 scale?

   There was a statistically significant correlation between the number of days students attended lab and their GPA. There is not a causal claim, but the students who put forth effort and attended the labs tended to have higher final grades.

3. How did this class perform when compared to other College Algebra classes on the departmental final?

   According to the results, the students had the highest performance on the standardized departmental final. This test is developed by the coordinator of College Algebra (not the research faculty) with input from all faculty members in the department. The faculty members are not allowed to see the final exam prior to the final exam test date.

4. How did the class perform when compared to other College Algebra classes when determining pass rates?

   According to the results, the revised course had the highest passing rate (A, B, C) in the department when compared to other faculty members who taught College Algebra.

5. How did this class perform when compared to other College Algebra classes previously taught by the same professor?
   According to the results, the faculty who taught the revised course realized the highest passing rate in her own history of teaching College Algebra.

The authors viewed several aspects of this revised College Algebra course as effective. The results showed that the students in this section of college algebra performed better than the other students taking college algebra. There was also a personal gain for the instructor of the course. Not only did these students perform better than the other students, these students superseded other students taught previously by the same faculty member. Additionally, this class had the highest passing rate in the department for that semester. The results of this study show that best practices in instruction as well as assessment are effective in College Algebra course at an HBCU.

CONCLUSION

In conclusion, the authors report that with changes in the classroom structure and practice, student performance was improved. The data presented show that the students succeeded with varied instructional and assessment practices. Given the proper professional development of faculty members, proper time for planning and preparation of courses, smaller class sizes, and willing students, faculty can facilitate students to earn higher achievement scores in mathematics. This could possibly lead to better retention and graduation rates for the university and possibly increase the number of STEM majors at the university and required for the 21st century demands. The final conclusions of this research include the following. With smaller class sizes, varied instructional and assessment practices, prepared faculty, and required labs, students were able to realize successful, academic results in College Algebra. The students' performance showed to be a step in the right direction in College Algebra.

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