

The Effects of Remedial Mathematics in Learning College Algebra

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Abstract

Remedial program is composed primarily of sequence of activities designed to bring underprepared students to the level of skill competency expected of new college freshmen. There were 438 student respondents with complete grades in College Algebra classified according to their exposure to Remedial Mathematics. The main purpose of this study is to assess the effects of remedial mathematics instruction on students' performance in College Algebra. This study used the causal comparative research design which is appropriate when two groups differ on an independent variable and want to test hypotheses about differences on one or more dependent variables. A non-parametric statistical test, particularly the Wilcoxon Rank-Sum test, was used to test the difference in the level of performance in College Algebra between the takers and the non-takers of the remedial program in Mathematics. On the other hand, the Fisher's Exact Probability Test was used to find the difference in the proportion of passers in College Algebra between the takers and the non-takers of the remedial program in Mathematics. The results obtained in this study may lend itself to some weaknesses of the remedial mathematics program which need to be identified and addressed in order to have a positive impact on the academic work of the students in the university. There is a need to establish the skills and competencies where the students are weak and address these weaknesses in the implementation of the Remedial Program in Mathematics.

Keywords: Remedial Mathematics, College Algebra

1. Introduction

Inadequate academic preparation is no longer a barrier to college access. Remedial or developmental courses can help bridge this gap. The University serves as a catalyst to prepare the underprepared students to the level of skill competency expected of new college freshmen using experimented variety of ameliorative strategies developing abilities and remedial programs.

Parallel to its desire to help or facilitate the underprepared students to the level of skill competency expected of new college freshmen and to be at par with their non-remedial counterparts in more advanced math classes, the university offers remedial courses including Remedial Mathematics.

College Admission Test scores were used to determine whether students must first be placed in a remedial Math before they are allowed to advance in any university-level required mathematics courses. Albeit a very large percentage of entering freshmen were placed in these courses, there had been no comprehensive evaluation of the effectiveness of these courses since their inception. The researchers were motivated to conduct the study to find out the effectiveness of remedial mathematics in terms of learning college algebra, and thus highlight the significance of the roles of the teachers and administrators in improving the quality of Remedial Mathematics program of the university.

1.1 Purpose of the Study

The main purpose of this study is to assess the effects of Remedial Mathematics instruction on students' performance in College Algebra. Specifically, this research sought to answer the following questions:

1. What is the level of performance in College Algebra of students who attended the remedial program in Mathematics and those who did not attend the said program?
2. Is there a significant difference in the level of performance in College Algebra between the takers and the non-takers of the remedial program in Mathematics?
3. Is there a significant difference in the proportion of passers in College Algebra between the takers and the non-takers of the remedial program in Mathematics?

2. Methods

2.1 Design and Procedure

This study used the causal comparative research design which is appropriate when two groups differ on an independent variable and want to test hypotheses of differences on one or more dependent variables². It is prospective in the sense that it starts with a cause which is exposure to Remedial Mathematics program and attempts to assess its effect on the students' performance in College Algebra.

The scores of the students in College Algebra were culled from the Grade sheets during the Second Trimester. To identify students who attended the remedial math program, the class lists for Remedial Mathematics during the First Trimester were generated. The names of the students in these class lists were matched with the names of the students that appeared on the grade sheets in College Algebra. When a match occurred, the student was classified to belong to the group who were exposed to the Remedial Program in Mathematics. Hence, names of students in the College Algebra grade sheets that were left unmatched were classified to belong to the group who were not exposed to the Remedial Program in Mathematics.

2.2 Respondents of the Study

The respondents of the study were first year students who took Remedial Mathematics during the First trimester and who took College Algebra during the Second trimester of the same school year. At the same time, students who were not required to take Remedial Mathematics but enrolled in College Algebra during the same trimester were also identified using the same grade sheets. Only the students with ratings in the Prelim, Midterm, and Final examination were included as samples of this study. The total number of respondents with complete grades in College Algebra classified according to their exposure to Remedial Mathematics is presented in Table 1, (note 1).

2.3 Statistical Tools

Descriptive statistics such as the mean and standard deviation were used to describe the level of performance of the respondents in College Algebra. Due to discrepancy in sample size, a non-parametric statistical test particularly the Wilcoxon Rank-Sum test was used to test the difference in the level of performance in College Algebra between the takers and the non-takers of the remedial program in Mathematics.

On the other hand, the Fisher's Exact Probability Test was used to find the difference in the proportion of passers in College Algebra between the takers and the non-takers of the remedial program in Mathematics. This test is appropriate for two independent samples where the data are nominally casted in a 2x2 table. The null hypotheses were tested at the 0.05 level of significance.

3. Results and Discussion

3.1 Level of Performance in College Algebra

It can be observed from Table 2 that the mean grades in College Algebra exhibited by both group of students on all indicators of the dependent variable were generally below average. Considering that College Algebra was taken by all students admitted in the university, the results indicated that the students admitted to the university were generally below average in terms of mathematical skills and competencies in the said subject. The same table shows that the non-remedial group exhibited better mean grades in College Algebra from the prelim up to the final grading period than the remedial group, (note 2).

3.1.1 Discussion on the level of performance in College Algebra

The results of the data analysis revealed that the performance of the students in College Algebra, whether they took Remedial Mathematics or did not take Remedial Mathematics, was below average and this was consistently shown by their prelim grades up to their final grades. These results were not surprising and can be attributed largely by their attitude towards mathematics. It was generally observed that most students depended only on the materials provided them by their teachers. In spite of the encouragement for them to use the library to supplement their learning by reading other references, students could not do so because most of them were working students.

3.2 Difference in the level of performance in College Algebra

The test of significance conducted and which compared the mean ranks of the grades of the students in College Algebra, as shown in Table 3, yielded p-values which were all smaller than $\alpha = .05$ (two tailed). This means that non-remedial group performed significantly better than the remedial group of students. This pattern is observable on all three indicators of the dependent variable. Hence the null hypothesis which states that there is no significant difference in the performance in college algebra between students who took Remedial Mathematics and students who did not take Remedial Mathematics is rejected, (note 3).

3.2.1 Discussion on the significant difference in the level of performance in College Algebra

The test of significance conducted revealed that those who did not take Remedial Mathematics performed significantly better than those who took Remedial Mathematics and this was also observed on all three indicators of the dependent variable. This result tends to show that the Remedial Math Program failed to rehabilitate the

² http://wiki.answers.com/Q/What_is_ex-post-facto_design#ixzz1I6g2UHcn

mathematics skills of the remedial students on par with the non-remedial students and the same result seemed to be consistent with the results obtained by Johnson and Kuennen (2002). A closer look at the mean scores suggests that the remedial program did not even close the gap of the discrepancies in the performance of the students in college algebra.

3.3 Difference in the proportion of passers in College Algebra

A validation of the data analysis was conducted by classifying the grades in all grading periods into pass or fail criterion. Operationally, a transmuted grade of 75% or better is considered a passing grade while less than 75% is considered a failure. The student respondents in each group were then classified based on this criterion. The objective of the analysis is to compare the proportion of students in each group who obtained passing grades on all the three grading periods. Because the data generated resulted into a 2x2 table and the data were nominal, the Fisher's Exact Probability test was used. The results of the data analysis are presented in Table 4, (note 4).

It can be gleaned from Table 4 that the proportion of passers in College Algebra is higher for students who did not take Math 0 than students who took Remedial Mathematics. This pattern is also observable on all indicators of the dependent variable. However, the Fisher's Exact Test yielded significantly different proportions only for the passers in the prelim Grades ($p < 0.05$, two-tailed). The proportion of passers in the Midterm and Final grades for both groups did not turn out to be significantly different as evidenced by p-values which are greater than the 0.05 level of significance criterion, (note 4).

Be that as it may, the results are seemingly consistent with the previous analysis reinforcing the impression that the taking of Remedial Mathematics does not significantly enhance the students' skills and competences comparable with that of students who were not recommended to take the said remedial course in mathematics.

3.3.1 Discussion on the significant difference in the proportion of passers in College Algebra

The validation of the data analysis conducted and which compared the number of passers in College Algebra between the two groups of students also yielded consistent results that a greater proportion of students who did not take Remedial Mathematics passed College Algebra than those who took Remedial Mathematics. The result is also alarming in the sense that the number of students who passed college algebra is roughly 50% in both groups.

Overall, the data gathered in this study suggested improvements to the remedial mathematics offered in the university. Ideally, a functional remedial program in a particular academic area ought to develop the skills and competencies of the students to prepare them for a formal course in the same subject area. The results obtained in this study may lend itself to some weaknesses of the remedial program in Remedial Mathematics which need to be identified and addressed in order to have a positive impact on the academic work of the students in the university.

4. Recommendations

The weaknesses of the Remedial Program can be assessed by first reviewing the Mathematics Component of the College Admission Test (CAT). The nature of the test questions must be assessed and students must be identified based on their performance in CAT. There is a need to establish the skills and competencies where the students are weak and address these weaknesses in the implementation of the Remedial Program in Mathematics. The resource materials must likewise be adjusted to address the problems that may arise based on the performance of the students in the College Admission Test.

References

- Bettinger, E., & Long, B. (2007). Institutional responses to reduce inequalities in college outcomes: Remedial and developmental courses in higher education. In S. Dickert-Conlin & R. Rubenstein, (Eds.) *Economic Inequality and Higher Education: Access, Persistence and Success* (pp. 69-100). New York: Russell Sage Foundation.
- Bogardus, A. Elena, (2007). Quasi-Experimental Retrospective Study: Effects of Formal Math Study Skills Instruction on Remedial College Math Achievement. University of Phoenix.
- Breneman, D., & Haarlow, W. (1998). *Remedial education: Costs and consequences*. Paper presented at Remediation in Higher Education: A Symposium, Washington, DC.
- Johnson, M., & Kuennen, E. (2004) Delaying development mathematics: the characteristics and costs, *Journal of Development Education*, Vol. 28(2).
- Calcagno, Juan Carlos & Long, Bridget (2008). The Impact of Postsecondary Remediation Using a Regression Discontinuity Approach: Addressing Endogenous Sorting and Noncompliance. Community College Florida.
- Garies, Ruth S. & Larsen, John C. (1997). Forging the Bridge Between High School and College. Paper presented at the annual AIR conference.
- Hoyt, Jeff E. Level of Math Preparation in High School and Its Impact on Remedial Placement at Utah Valley State College

Justiz, Manuel J. (1997) Collaborating for Success: Case History of a School-College Partnership. *Educational Record* 78, 31-37.

Lee, Valerie E., Croninger, Robert G. & Smith, Julia B. (1997). Course-Taking, Equity, and Mathematics Learning: Testing the Constrained Curriculum Hypothesis in U.S.

Merisotis, J., & Phipps, R. (2000). Remedial education in colleges and universities: What's really going on? *Review of Higher Education*, 24(1), 67-85.

Office of Institutional Development. (1994). W.M.S.H. Union High School District Students at College of the Canyons. Valencia, California: Office of Institutional Development.

Office of Program Policy and Government Accountability [OPPAGA]. (2006). *Steps can be taken to reduce remediation rates* (Report 06-40). Tallahassee: Florida Legislature.

Ramzi N. Nasser (2007). The effectiveness of remedial mathematics courses in light of student decision to enroll at a private university in Lebanon.

Rebecca. (1986). Mathematics and Science Test Scores As Related to Courses Taken in High School and Other Factors. *Journal of Educational Measurement* 23, 197-208.

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Notes

Note 1.

Table 1. Frequency and Percentage of First Year Students Enrolled in College Algebra Grouped According to their Exposure to Remedial Mathematics

GROUP	N	N	%
Remedial	154	140	90.9
Non-Remedial	380	298	78.4
TOTAL	534	438	82.0

The table presents the total number of respondents with complete grades in College Algebra classified according to their exposure to Remedial Mathematics.

Note 2

Table 2. Mean Grades in College Algebra between the Remedial and Non-Remedial Groups

DEPENDENT MEASURE	Remedial Group (n = 140)		Non-Remedial Group (n = 298)	
	MEAN	S.D.	MEAN	S.D.
Prelim Grade	73.51	9.432	76.67	10.021
Midterm Grade	74.72	9.935	77.54	11.262
Final Grade	75.55	10.750	78.39	11.991

The table presents the data on the level of performance of the two groups of respondents in College Algebra. Despite the difference in sample size, the distribution of the two sets of data in all grading periods were generally

comparable as indicated by the small discrepancies between the standard deviations.
 Note 3.

Table 3. Grade Comparison between the Remedial and Non-Remedial Groups

Dependent Measure (Performance in College Algebra)	Remedial Group (n = 140)	Non-remedial Group (n = 298)	Computed Z-value ^a	p-value
	<i>Mean Rank</i>	<i>Mean Rank</i>		
Prelim Grade	192.89	232.00	3.017	0.003**
Midterm Grade	199.78	228.77	2.237	0.025*
Final Grade	198.16	229.53	2.420	0.016*

^a Wilcoxon Rank Sum Test

A non-parametric statistical test particularly the Wilcoxon Rank-Sum test was used to test the grade comparison between the remedial and non-remedial groups. The table shows the test of significance conducted and which compared the mean ranks of the grades of the students in College Algebra.

Note 4.

Table 4. Proportion of Students Who Passed College Algebra in the Remedial and Non-Remedial Groups

Dependent Measure (Performance in College Algebra)	Remedial Group (n = 140)		Non-Remedial Group (n = 298)		Fishers Exact Test (2-tailed)
	Passed	%	Passed	%	
Prelim Grade	60	42.9	166	55.7	0.014*
Midterm Grade	74	52.9	176	59.1	0.132 ^(ns)
Final Grade	72	51.4	182	61.1	0.062 ^(ns)

The Fisher's Exact Probability test was used to test the proportion of passers in College Algebra between the takers and the non-takers of the remedial program.