Bridging the Gap: Remediating Mathematics Competencies of College Entrants

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Abstract: This study aims to provide empirical evidence on the performance of low performing students in mathematics if they undergo remediation classes before taking the regular courses. The experiment used Randomized Control Trial (RCT) design particularly the Randomized Posttest Only Control Group with matched subjects. Involved in the study are low performing students in mathematics matched according to their performance in the diagnostic test and randomly assigned to the control and experimental groups.

Results show that students who took remediation classes have significantly higher performance in the mid and final term exams than those who proceeded taking the regular course without remediation. Consequently, a significantly higher proportion of students in the experimental group passed the mid and final terms than those in the control group, with about 55% of the low performing students in the experimental passed the term exams compared to the 21% in the comparison group. There is a positive and moderately strong relationship between posttest and performance in the final term of regular math classes. This means that students who improve their basic competencies in mathematics perform better in the regular math courses. The coefficient of determination indicates that 29% of the variation in students' scores during the final term can be attributed to the remediation program. Results support positive effect of remediation on students' performance in mathematics and it is recommended that low performing college students take

preparatory mathematics programs before they enroll regular courses.

Keywords: Randomized Control Trial (RCT) design; Randomized Posttest Only Control Group; remediation classes; mathematics education; student performance

Introduction

The University of Southern Mindanao (USM), with its mission to provide equal opportunity to education among students with different ethnolinguistic and academic backgrounds, has not set a minimum standard as to the achievement level of students admitted to some of its colleges. USM indeed is quite unique in this aspect. While other universities limit its enrolment to top performing high school graduates, it opens its gates not only to the gifted but also to the disadvantaged ones who might not have the opportunity to learn necessary competencies in their basic education with a number of its college entrants coming from remote high schools and war-torn and conflict areas. Data however show that as high as 40% of these students fail at 50% cut-off mark in mathematics classes.

Failing a subject is stressful and results to poor self-esteem, especially among freshmen who are still struggling to adjust and cope with university work. In relation to this, it is the responsibility of the university to help out these students gain higher capacities so that students may have the chance to achieve their goals. Remediation or bridging programs in universities, if shown to work effectively, is cost efficient compared to taking regular mathematics twice or even more. Potentially not successful students will be helped out first to increase their probability of passing before enrolling to regular courses. At the same time, the university will not be putting

them in situations where they might experience failure, adding up to their anxiety and negative attitude towards mathematics.

The main objective of this study is to determine if low performing students will improve their performance and chances of passing when provided remediation before taking the regular classes in college. It aims to provide basis for college/university policy that would entail mathematically challenged students to take preparatory mathematics program before taking regular courses.

Specific Objectives

1. To determine if there is a significant difference in performance of students in the control and experimental classes after the remediation program;
2. To determine if there is a significant difference in the proportion of students who passed regular mathematics classes after taking remediation classes.

Research Design

This study is a cause-effect and experimental or the randomized control trial (RCT) is the best research design for such purpose, particularly the Randomized Posttest Only Control Group with Matched subjects. Pretest was not administered to avoid test-treatment interaction and to simulate the actual practice in the university where students do not take pretest of their midterm and final exams. Students were matched primarily according to their scores on a 50-item diagnostic test before random assignment to the control and experimental groups.

Local and Sampling Procedure

This study was conducted at the University of Southern Mindanao, Kabacan, Cotabato during the second semester SY 2010-2011. The respondents were first year Bachelor of Secondary Education students from two randomly selected Math 124 (Contemporary Mathematics) classes. The bottom 30 students (in a class of 51 and 54 students) based on the diagnostic test result were matched and randomly assigned to the control and experimental groups. However, the 30 suitable match needing enhancement was not possible in one section therefore more samples were taken from the other section. All subjects obtained scores below 50% in the diagnostic test. Originally, a total of 60 matched students participated in the study: 30 in the control and 30 in the experimental group. Two students incurred unreasonable number of absences and were dropped from the list together with their matched pair.

Table 1. Composition of the control and experimental group

Group	Original Sample			Final Sample		
	SectionB	SectionD	Total	SectionB	SectionD	Total
Experimental	17	13	30	16	12	28
Control	17	13	30	16	12	28
Total	34	26	60	32	24	56

Data Collection Procedure

After the groups were constituted, their regular Math 124 classes were delayed for about 1 ½ months. Students who constituted the experimental group from each class were fused and took remediation sessions as one class under the researcher. They were required to attend remediation one hour a day for three days in a week.

After the remediation sessions, students returned to their respective classes and regular Math 124 classes began.

Classes were conducted separately for the two sections, each was composed of students who belonged to the control group, the experimental group and high performing students who were not part of the study. Since the control and experimental groups mixed in one class, extraneous variables to include the teacher factor, time, and classroom environment were highly controlled.   Special classes at 1 ½ hours per week were scheduled for each section during their free time to make up for the time used up for the remedial classes.   Classes proceeded in regular manner, with workbooks used by all students.   Midterm and final exams were administered following the university schedule and used the test developed by the mathematics department. The diagnostic posttest was also administered as part of the final exam for the experimental group.

Result of the Study

Since matching of subjects was carefully done before random assignment to the groups, a negligible mean difference of 0.07 was obtained (t-value = 0.03 p = .98, see Table 2). On the average, students in both groups were able to answer about 16 (31%) of the 50 items correctly.

Table 2. Test of difference in the diagnostic test scores of the experimental and control group

Group	N	Mean	Std. Deviation	Mean Difference	t	df	p value
Experimental	28	15.61(31.2%)	8.12	0.07	0.03^{ns}	54	.98
Control	28	15.68(31.4%)	8.76				

ns – not significant at .05 level

Effect of Remediation on Students' Performance

In a 90-item midterm examination, the highest scorers in both groups were those who obtained highest scores in the diagnostic test. However, the highest performer who underwent remediation outperformed the one in the control group by about 21%. Figure 2 further shows the median score of students in the experimental group is above the 50% reference line indicating more than half of them passed the midterm test while most in the control group failed.
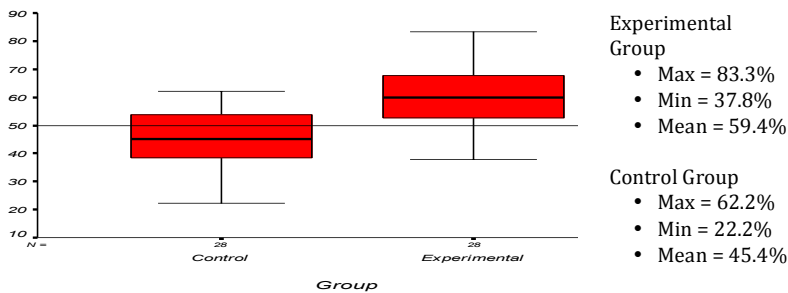

Figure 1. Performance of the control and experimental groups in the midterm exam

The obtained scores of the experimental group yielded a mean higher than the control group by 13.9% significant at .01 level (t-value = 4.31, p value = .00). The group performance of students revealed that remediation helped students perform better in regular mathematics courses.

Table 3. Test of difference in midterm scores of the experimental and control groups

Group	N	Mean	Std. Deviation	Mean Difference	t	df	p value
Experimental	28	53.1(59.3%)	12.6	13.9%	4.31**	54	.00
Control	28	40.6(45.4%)	11.5				

** - significant at .01 level

The contingency table below shows that majority (64.3%) of students who joined the remediation passed the midterm even though most of them were just a bit higher the passing mark. On the contrary, only 25% of those in the control group beat the 50% cut-off score. The higher proportion of students experimental than the control group who passed the midterm exam was significant at .01 level (χ^2 = 7.226, p value = .01)

Table 4. Midterm performance of control and experimental groups

Group	Midterm Percent Score			
	50% above (Passed)		below 50% (Failed)	
	f	%	f	%
Experimental	18	64.3	10	35.7
Control	7	25.0	21	75.0
Total	25	44.6	31	55.4

Corrected Chi-square value = 7.226**   df = 1
   p value = .01
 ** - significant at .01 level

Figure 2 shows statistics of both groups for the final test scores and similar trend as in midterms can be observed, though finals came out to be more difficult for both groups. Experimental group likewise showed better performance with more than half passing the final exam though scores were concentrated at lower values and variation was high.

Experimental Group
- Max = 81.4%
- Min = 17.1%
- Mean = 54.9%

Control Group
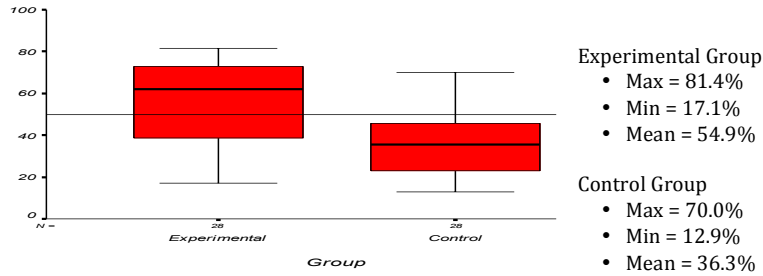- Max = 70.0%
- Min = 12.9%
- Mean = 36.3%

Figure 2. Performance of the control and experimental groups in the final exam

The obtained final exam mean score for the control group was 38.4 or 54.8%, sd = 14.1 was higher by 18.5% than the control group (mean = 25.4 0r 36.3%, sd = 11.5). The difference was found to be significant at .01 level (t-value = 3.77, p = .00) which proves that students who were given remediation were helped out pass the course until the end of term.

Table 4. Test of difference in final term scores of the experimental and control groups

Group	N	Mean	Std. Deviation	Mean Difference	t	df	p value
Experimental	28	38.4 (54.8%)	14.1	12.96	3.77**	54	.00
Control	28	25.4 (36.3%)	11.5	(18.5%)			

** - significant at .01 level

The proportion of students in the experimental group who surpassed the passing mark was 57.1% while only 21.4% did the same among students in the control group.

Table 5. Final term performance of control and experimental groups

| Group | Final term Percent Score | | | |
| | 50% above (Pass) | | Below 50% (Fail) | |
	f	%	f	%
Experimental	16	57.1	12	42.9
Control	6	21.4	22	78.6
Total	23	41.1	33	58.9

Corrected Chi-square value = 4.72*
p value = .03   ** - significant at .01 level

Students' performance in the posttest was also found to be positively correlated with students scores in the final term ($r = 0.54$, p value = .01) with 29.4% of the performance in the final exam that can be attributed to the remediation program ($r^2 = .294$) providing sufficient evidence that remediation positively aided students in regular math courses.

Summary and Conclusion

Students who took remediation classes performed significantly higher in the midterm and final exams than those who proceeded taking the regular course without remediation. A significantly higher proportion of these students also passed in the regular math courses. Results support the positive effect of remediation on the performance of mathematically challenged students and taking it before the regular mathematics courses increases students' chances of passing the subject. This means that loose admission policy can be compensated by bridging programs for those whose competencies are lower than the university work requirement. It is therefore recommended that a comprehensive remedial or bridging program to be given to low performing students before they may be allowed to enroll regular university courses.