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The Analysis of Two Teaching Programs: Massed and Distributed

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ABSTRACT

In Mathematics, many innovations were introduced to achieve a fruitful learning environment. The study examined the consequence and the effectiveness of two differently structured programs, massed teaching and distributed teaching, for equipping the performance of the students in learning mathematics, specifically in some topics in Algebra. The study used a teacher-made pretest and posttest with a reliability coefficient of 0.76. Two sections were accounted. In section A, 35 students were exposed to a long- term session which is the massed teaching program and in section B, 41 students were exposed to a short-term session with an interval break session which is the distributed teaching program. This study employed a quasi-experimental design, the experimental group and control group was section A and section B, respectively. The data were analyzed using both descriptive and inferential statistics. Using the ANCOVA, the result shows that there was a significant difference between massed and distributed teaching program as to the mathematics achievement

of the students with different mathematical ability as above average, average, and below average. Analysis revealed that distributed teaching program is more effective and beneficial for below average students and the massed teaching program is efficient for average and above average students.

KEYWORDS

Mathematics, massed teaching, distributed teaching, teaching programs, quasi-experimental design, Philippines

INTRODUCTION

In a classroom setting, learning mathematics is not simple for those who hate mathematics. Teachers make assumptions all day long on what is the appropriate strategy for a specific concept so that the students best comprehend and remember their lessons especially in mathematics. This problem arises because most of the students hate mathematics and they are anxious towards the subject. It takes time for them to love and appreciate the essence and beauty of mathematics. This situation alarms the educators on how it could be resolved. There are a number of different educational innovations that have been investigated by different educators. The central goal for each of their researches is to identify the most effective way of achieving knowledge or mastering skills. There are several factors that come into the picture in the process of learning, one of it is the teaching program or class schedule used by the school. Subjects in Basic Education including Mathematics are taught in five sessions per week with 1 for private school and 45 min for public schools respectively. A three-unit Math course in college is taught in three sessions. For each session, the teacher checks attendance, does follow-up statements and other routines which consume time. Why not lump all topics/activities for a week in one session?

Distributed Teaching Program means spacing short rest intervals of work apart with longer periods of rest (Schmidt, 1991). Massed Teaching Program means "running work periods very close together with either no rest at all or very short rest intervals in between"(Schmidt, 1991). Which one is more effective?

Donovan and Radosevich, (1999) conducted a meta-analysis of spacing-effect studies performed on adults. A meta-analysis is a statistical technique that reveals trends across many studies. It was noted that spacing has the biggest effect for learning simple motor skills (such as typing), but is also present when subjects learn new facts. Only few experiments have investigated highly complex skills (e.g., running an air traffic control simulator), but in those studies, the spacing effect has

disappeared altogether. Thus, this meta-analysis supports the idea that the spacing effect applies to some (but probably not all) of the sorts of things that children learn in school. Unfortunately, there are little laboratory data to suggest at what point along the continuum, from learning facts to learning complex material, the spacing effect loses its potency. Increased amounts of massing did have a deleterious effect on performance, but did not reduce the amount learned (Carron, 2013).

Some research reported that the students who had learned the words by distributed practice did substantially better 35% than the massed-practice students (Bloom, et al., 1981). The distributed practice would appear to have considerable potential for improving classroom learning, yet there is no evidence of its widespread application (Dempster, 1988). But based on the results reported about collaborative and non-collaborative groups, it can be concluded that there are no substantial differences between massed and distributed (Zarei & Tavakkol , 2012).

In this study, the researchers determined the best possible style in teaching mathematics. It is observed that distributed teaching is practiced nowadays yet students are still not performing so well in mathematics. It seems that nobody noticed that this type of teaching style may interrupt the students' interest towards the subject. For example, in times when the student shows interest in the subject but the bell rings because it is already time. So the teacher cannot do anything but to dismiss the class and leave the momentum that will ignite the interest of the students. Thus, it is aimed that massed teaching would have possibly be effective to solve the problem. Because of this style of teaching, it allows the teacher to allocate time for more activities and drills to motivate and ignite the interest of their students in mathematics. The teacher can also manage his time to inject more effective strategies and methods so that the students will not be bored during the discussion.

FRAMEWORK

This study was based on the concept that teachers can best promote students acquisition and fluency in a newly taught mathematics skill by transitioning from massed to distributed teaching practice. Massed and distributed teaching practice then play unique individual roles in effecting learning among the students.

The study was anchored on the concept that most of the studies suggested that distributed teaching program is better than massed teaching program yet the performance of students in Mathematics is still not good enough. Thus, there is a possibility that the findings of these studies are not anymore applicable to the recent times. The availability of sophisticated technologies may have affected the focus of the students in their studies. There is a tendency then that few topics discussed in

the classroom by distributed teaching are disregarded by the students for they would not feel much value on it. An object or idea is more interesting and memorable if the whole picture, essence, or meaning of it is seen than when it is understood in pieces.

When discussing various practice styles, it is often the case that learning is used to evaluate and judge which style is more efficient and thus better. So, a definition of learning is paramount.Schmidt (1975)defined learning as "a change as a result of practice (experience), in a relatively stable internal state." In addition, he believed that learning is best defined "in terms of the gain in the underlying capability for skilled performance developed during practice, with the improved capability leading to improved performance (Schmidt, 1991).

Students tend to disregard the lessons discussed if they do not see the meaning as a whole. If a single topic is distributed in different sessions, then students will not be able to grasp the connection of the subtopics at one setting.

The low achievement level of students with learning disabilities has multiple causes. One is the mismatch between the students' learning characteristics and the design of instructional materials and practices (Carnine, 1997). Learning in behavior-disordered, brain-damaged, and normal children was investigated under conditions of massed and spaced practice using auditory and visual paired-associates tasks. The results confirmed the superiority of spaced-practice over massed-practice learning for normal, brain-damaged, and behavior-disordered groups (Grassi, 1971) . Also, distributed practice is ever the best practice for high school mathematics (DuBois, 2012) and the spacing effect is applicable for middle-school-aged children (Sobel, 2011). However, massing is the preferred strategy, particularly in young children (Son, et.al., 2012) and (Crow, 2013) concluded that mathematics achievement for fifth grade economically disadvantages students favored the schools with massed learning.

It is generally believed among physical educators that, when working with young or beginning learners, distributed practice tends to provide better results in learning new skills. And, when teaching advanced and more highly skilled learners, massed practice should be the schedule of choice (Rider and Abdulahad, 1991). This supports the results of Donovan and Radosevich (1999), found that the effect of distributed practice declined as task complexity increased.

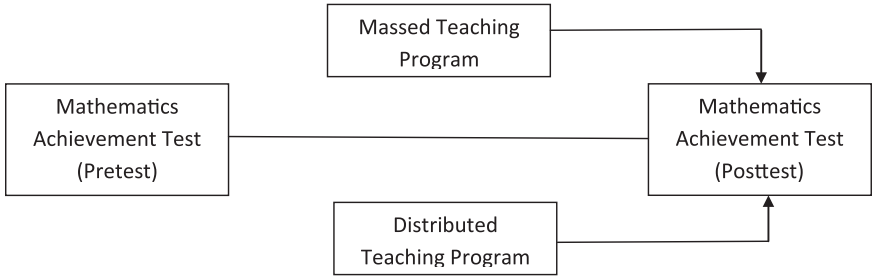

Figure 1. Conceptual Paradigm

Figure 1 presents two variables that are considered in this investigation that could cause significant influences on students' performance in Algebra: first, the independent variable which consists of styles of teaching identified as massed and distributed teaching; and second, the dependent variable which includes the achievement scores in Algebra during the first semester classes.

OBJECTIVES OF THE STUDY

The main objective of the study was to find out a more effective teaching program for the students best comprehend mathematics. Is it massed teaching or distributed teaching program? It also measures the mathematics achievement of the students to identify what teaching program is applicable for above average, average, and below average students.

METHODOLOGY

Ethical Issues

Prior to the conduct of the study, researchers seek permission to the head of the institution through a request letter. After the request has been granted, all research participants were informed about the groupings (the massed teaching group and the distributed teaching group) to avoid anxiety towards the subject. To avoid conflict, we allow the participants to choose and decide what teaching program is applicable for them and considering the availability of their schedule. But we assured that both groups received equal learning materials and strategies. Through the consent and participation of everybody, no untoward incident happened during and after the study.

Research Design

A pretest- posttest quasi- experimental design was utilized in this study. It was used to determine the more effective teaching program, - massed teaching or distributed teaching program.

Participants

This study was conducted at Surigao State College of Technology, Surigao City Campus. All of the participants were enrolled in College Algebra during the 1stSemester,SY 2010- 2012.Two sections were involved; section A comprised of 37 students while section B 40 students. One of the researchers is also the teacher in this study.

Measures

The instrument of the study was a researcher-made questionnaire to measure the students' achievement in mathematics. The validated 45-item multiple-choice with four options, each correct answer is worth 1 point, were analyzed and yielded a reliability coefficient of 0.76 using Cronbach alpha.

Procedure

Prior to the treatment, a pretest was given to both sections (massed and distributed). In the massed teaching section the classes were conducted once a week every Friday for 3 hr without breaks. While the distributed teaching section, the classes were conducted thrice a week every Monday, Tuesday, and Wednesday for 1 hr every session. Both sections received the same teaching strategies; they only differ in time schedule. After the discussion of some topic in Algebra, and series of exercises a posttest was given in both sections to determine if there is a significant difference between their mathematics achievement and to identify what teaching program is appropriate for above average, average, and below average students.

Data Analysis

The data were analyzed using both descriptive and inferential statistics. Descriptive statistics were computed using excel software for measures of central tendency, dispersion, frequency tables and charts. The ANCOVA in SPSS software was used

for inferential statistics to test the significant difference of massed and distributed teaching program as to the mathematics achievement of the students with different mathematical ability as above average, average, and below average.

RESULTS AND DISCUSSION

Students' Achievement towards Mathematics

Table 1 shows the achievement level of the students in mathematics. Mean and standard deviation of the pretest and posttest scores are depicted to describe the achievement level.

Table 1. Distribution of Achievement Scores

Teaching Programs	Pretest Mean Scores	SD	Posttest Mean Scores	SD
Massed Teaching Program (MTP)	9.61	4.49	17.08	10.12
Distributed Teaching Program (DTP)	9.68	3.41	13.44	3.38

22.6- 45.0 Above Average 12.6- 22.5 Average Below 12.5 Below Average

The data shown in Table 1 indicated that students in all the two groups exhibited slight difference in pretest scores which is below average. On the other hand, students under MTP have variability higher than DTP. Foregoing results imply that the students had poor background in comprehending some topics in Algebra prior to the conduct of the study proper.

Further, Table 1 reveals that the posttest mean scores of the students exposed to the two teaching programs and its SD increased remarkably. Both programs showed average achievement and the standard deviation of the posttest scores exposed to MTP was more variable than DTP. The foregoing results imply that MTP is effective in increasing mean score but DTP is efficient in reducing variance.

Effect of MTP and DTP on the Posttest Results with Covariate

Results on the analysis of this section compare the achievement level of the students exposed in MTP and DTP.

Corresponding to this problem are the null hypothesis tested at 5% level of significance, to wit, Ho(1): There is no significant difference in the students mathematics achievements as influenced by the MTP and DTP with corresponding mathematical ability as above average, average, and below average. Priori test on the assumption of homogeneity of regression was conducted based on the hypothesis:

Ho(1,a): The interaction effect between the teaching program and pretest score does not account for some of the variation in the posttest score.

The model that was designed to test Ho(1,a), which dealt with the students' achievement, contained three independent variables. The students' posttest score served as the dependent variable for this model. One of the independent variables included in this model was consisted the students' pretest score labeled as X. The second independent variable included in this model was the teaching program intervention. This variable consisted of the values one and two indicating the student was in the MTP and DTP, respectively. The third variable included in this model was formed by multiplying the pretest score, X by the teaching program intervention. The inclusion of this variable, labeled program * pretest allowed the researchers to use the regression model to calculate the difference between the slopes of the MTP and DTP groups' regression lines.

The t- value of the regression coefficient for the program * pretestvariable was used to test Ho(1,a). Since this study involved one dependent variable, that is, the achievement level the alpha level for the t-test of this regression coefficient value is equal to 0.05. The chance of committing a type I error was reduced by using this alpha value (Newman & Fry, 1972). Resultson the test on homogeneity of regression ($F= 24.906$, $P<0.01$) indicated that the difference between the slopes of the regression lines of the MTP and DTP groups was statistically significant at the 0.05 level; thus, reject Ho(1,a). Hence, differences in the posttest scores were not constant across the range of pretest scores.

Statistical test of the interaction, step 1 in the three- step analytic JN procedure was implemented for the achievement data by statistically testing multiple linear regression models that were designed to measure the linear interaction effects. The results obtained from the analysis of the regression model contained in Table 2.

Table 2. Regression Results on Estimating Achievement Score from Teaching Program and Pretest and their Interaction

Variable	B	t	P- value
Intercept	9.044	3.408	0.001
Massed Teaching Program (MTP)	-11.066	-3.549	0.001
Distributed Teaching Program (DTP)	0a	.	.
Pretest score (X)	0.454	1.706	0.092
MTP * X	1.536	4.991	0.000
DTP * X	0a		

aThis parameter is set to zero because it is redundant.

Table 2 shows parameter estimates needed to obtain the regression equations for each of the treatment group. Using the values of B for each parameter, the regression equations of posttest score Yt are obtained as follow:

YMTP = (9.044 – 11.066) + (0.454 + 1.536)x = -2.022 + 1.99x for the treatment t= MTP,

YDTP= (9.044 + 0) + (0.454 + 0)x = 9.044 + 0.454xfor the treatment t= DTP.

The pair of the regression lines were set equal yielded the pretest score at 7.20 where the group or treatment regression lines YMTP and YDTP intersect. The interaction effect between pretest score and method of instruction is diagramed in Figure 1. The vertical broken lines point to the pretest value where group regressions intersect; that is, the range of pretest scores where interaction effect of the method and pretest.

Since differences in the posttest scores were not constant across the range of pretest scores, pairwise analysis of regression equations was applied.

On the other hand, interaction effect of pretest with the groups of MTP and DTP exhibited dramatic shift in the posttest scores. The posttest scores of the students under DTP were higher than the posttest scores of the students under MTP when their pretest scores were less than 7.20 while MTP posttest scores became higher than the DTP scores when their pretest scores were greater than 7.20. A remarkable implication from these results suggests that those students who got a pretest more than 7.20, which are the above average and average students, tended to learn efficient with MTP than DTP. Pretest and posttest measures from 700 students revealed superior outcomes for the massed learning conditions (Collins, et al., 1999). The results suggest that subjects treat the massed repetition as a rest opportunity

that enables them to devote more attention, and thus more processing resources (Dempster, 1996).

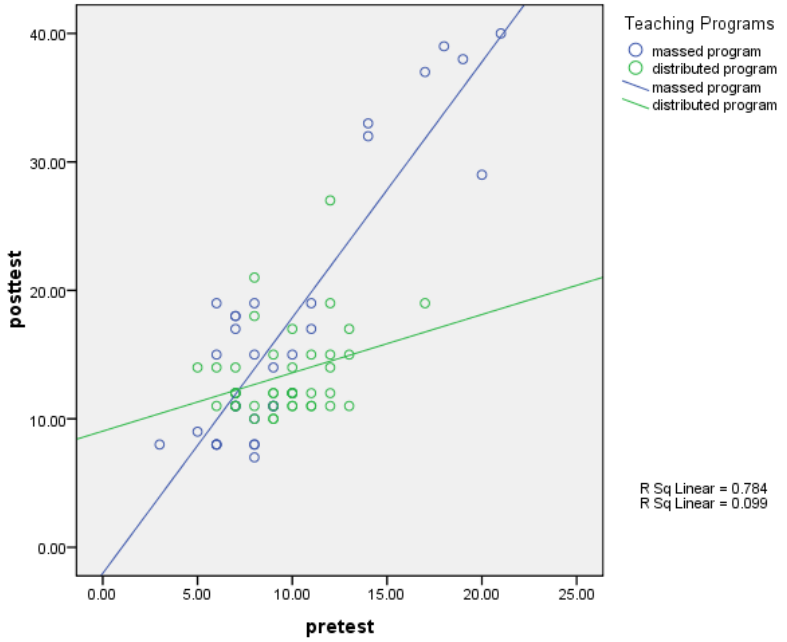

Figure 1. Scatter Plot Showing Heterogeneity of Regression Slopes of Teaching Program-Pretest Score and their Interaction

Thus, DTP is effective and beneficial to those students who got pretest less than 7.20 which are the below average students. Generally, under these conditions, studies investigating the influence of task variation on learning suggest that distributed practice produces superior levels of on-task responding and higher levels of child affect in children with low performance(Dunlap, 1984).

CONCLUSIONS

Massed teaching program (MTP) has shown to be more effective in improving performance of students in mathematics especially for above average and average students; that is, in achieving high posttest scores. This supports the idea of Rider and Abdulahad (1991), when teaching advanced and more highly skilled learners, massed

practice should be the schedule of choice. This group of students learns better in a long- term session because they have much time to utilize the manipulative materials that help them understand mathematical concepts and processes. Especially when the task complexity increased, massed teaching is more effective than distributed (Donovan and Radosevich, 1999). They appreciate an object or idea if the whole picture, essence, or meaning of it is seen than when it is understood in pieces. They will be able to grasp the connection of the subtopics at one setting.

The result suggests that massed teaching program is more effective to those students who appreciate the essence of mathematics and these are the mathematical inclined students. This style of teaching allows the teacher to allocate time for more activities and drills to motivate and ignite the interest of the students. However, the distributed teaching program is more beneficial for those students who are below average students and for beginners.It is generally believed among physical educators that, when working with young or beginning learners, distributed practice tends to provide better results in learning new skills (Rider and Abdulahad, 1991). Since this type of students is easily bored they need longer periods of rest to appreciate the beauty of mathematics.The results confirmed the superiority of distributed teaching over massed teaching for behavior-disordered groups (Grassi, 1971).

RECOMMENDATIONS

Implementation of MTP and DTP in classroom instruction must be handled properly; otherwise, desired outcomes will be marked or cancelled by some conditions or variables that can be actually controlled. Based on the findings and conclusions in the study, the following are recommendations in the use of MTP and DTP in teaching mathematics: A diagnostic test must be conducted prior to subjecting the students to teaching program such as MTP or DTP. Appropriate classification of teaching program must be done to maximize or optimize its effect on students' achievement.

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