EFFECTIVENESS OF EXPLICIT TIME-DRILLS ON THE SPEED AND ACCURACY OF GRADE 10 STUDENTS IN SOLVING PROBLEMS IN PLANE COORDINATE GEOMETRY

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Abstract

The Grade 10 students manifested slow speed and inaccuracy in problem solving as evidenced in their summative test and solution papers. This study is focused on improving the speed of grade 10 students in solving mathematics problem while maintaining high level of accuracy through explicit timed- drills. The researcher employed a quasi-experimental design specifically the pretest-posttest design. The data gathered from explicit timed-drill worksheets, pre and post-intervention test were analyzed through frequency counts, percentages, and means. This project involved 101grade 10 students. The results showed that 71% of the students who were taught using explicit time- drills have moved to higher speed level while 29% of students have maintained their speed level. Also, the posttest accuracy mean scores showed a significant difference between the students in the explicit timed-drills against the students in the traditional classroom. Overall, the result indicated that the students in the experimental group solved faster with high level of accuracy than the control group. The researcher concluded that explicit timed drill was found to be effective in improving the speed and accuracy of the students in solving math problems. This drill strategy should be incorporated to other learning areas and in other grade level.

Keywords: Effectiveness, Explicit timed-drills, Speed and Accuracy, Percentage Increase

1. Introduction

In mathematics, slow speed and low level of accuracy in problem solving is one cause of lack of self-confidence among students (Benjamin, Foy, Konowitch, & Mauprivez, 2013). Hence, the teaching efforts of mathematics teachers should be directed to the root problem – the slow speed and low level of accuracy. The researcher realized the necessity of preparing educational researches to boost speed and accuracy so that students would gain self-confidence in answering mathematics test then eventually increase the performance of students in mathematics.

Generally, the Level of mastery of students could be determined by calculating the Mean Percentage Scores. And it is someway affected by the performance of students in the written assessment test or examination. However, according to Rasul and Bukhsh (2011), there are factors which create obstacles to measure the real performance of the student in examination. These factors are in the following categories: the extrinsic factors, Intrinsic factors, Personal factors, and miscellaneous factors. The lack of self-confidence is one of the personal factors affecting their performance in a written summative test. Thus, student's poor working rate with low level of accuracy that cause lack of self-confidence needs to be improved so that the test performance score would go high and then in the end the real level of mastery of the students would be achieved.

Over the past years, the researcher observed that most students can solve mathematics problems during the written formative test but in the quarterly summative test, the MPS had remained very low with the descriptive equivalent of low mastery. It was noticed that some students were very fast in solving math problems with less accuracy and others were very slow with moderate accuracy level. In answering written math test, it is important that students must be very fast in solving math problems while they maintain high level of accuracy because Haring & Eaton (as cited in Rhymer et al.,1999) pointed out that skill mastery requires students to be both accurate and rapid.

Some Mathematics Teachers in Dagupan City National High School were informally interviewed regarding this problem. They confirmed that the low mastery level of students in mathematics is not solely affected by mastering the skill itself but also the slow working rate of students in solving Mathematics problems. They even claimed that though the students have acquired the

knowledge and skills many of them were still in the Average Mastery Level or Low Mastery level of competence during summative written test. The problem was also observed during mathematics written test contest in the school level wherein the researcher is always a trainer/ coach.

The main purpose of this research project is to improve or boost the speed of Grade 10 students in solving mathematics problem while maintaining a high level of accuracy by using Explicit Timed Drills. So that the students would gain self-confidence in solving mathematics written test and eventually their level of mastery in mathematics would increase.

2. Method

2.1. *Research Design*

The researcher used quasi-experimental research design specifically the two groups' pretests-posttest design. In this research, a quasi-experimental design was used because the researcher lacks control over the assignment to conditions and/or does not manipulate the causal variable of interest. It was used to find the effectiveness of explicit-timed drill on the speed and accuracy of students.

2.2 Participants

The main participants of this action research study were the Grade 10 students of Dagupan City National High School in sections 1 and 2 in the regular class during school year 2016-2017. The researcher used none - probability sampling method specifically the selective or purposive sampling. The researcher selected two groups or sections that are similar as possible so he can fairly compare the treated one with the other. (Loman, 2003).The researcher had determined that two sections are practically equivalent or homogeneous groups based on academic performance because the descriptive statistics of the General Average of Grade 10 section 1 and section 2 was computed. These potential research participants now are assigned to either an experimental group or to a control group. Since, each of these group participants has an equal probability of ending up in either group. Randomness of assignment of each group participant is done by flipping of a coin. In this study, the students in grade 10 section 1 was used as experimental group while students in grade 10 section 2 was used as the control group

2.3. Instrumentation

The researcher designed an Explicit Time –Drill Worksheets as one of the data collection instrument for this study. Each worksheet has timings so that the student will know the time to work with the problems on the sheet. Timings will enhance the students' skills in time management. Timings for each worksheet were determined by getting the average speed of 5 non-sample students who belong to very slow, slow, average, fast and very fast. Each worksheet covers only the topics prepared for the day. It is administered only to the experimental group during practice activity. They were given to monitor the speed and accuracy of the students every after the lesson was taught.

Two summative timed-tests were given during intervention to assess student's examination performance to determine whether the speed and accuracy is improving. The researcher used the 30-item test prepared, validated and published by the department of Education in the Mathematics Grade 10 Teacher's Guide page 207 and page 231 which was designed to measure the mastery level of grade 10 students in public high schools as well as to determine the effect of explicit timed- drill (Callanta,2015).

2.4. Data Analysis

The researcher used both the descriptive and inferential statistical analysis; descriptive analysis was used particularly in determining the change in the speed level of the students, and in the test completion rate of both groups; and the independent t-test was used to test the significance of the mean difference between pretest and posttest scores of the experimental and control group at 5% level of significance. The test completion rate of the students was analyzed by comparing the average test completion rates in the pretest against the average test completion rates in the posttest of each group, The effect of explicit time-drills on the speed level of students was interpreted in two ways: (1) By comparing the differences of the speed of each group in the pretest and the differences of the speed of each group in the posttest, and (2). By the descriptive statistics of the students' pretest and posttest scores by group membership. The significant effect of explicit time-drills on the accuracy of students was determined by comparing the mean gain in the posttest accuracy scores of the experimental group against the control group.

3. Results

Table 1.The Average Speed of Grade 10 Students before and after the Intervention.

	Control Group		Experimental Group	
Pretest	0.37(pwc/min)	Fast	0.21(pwc/min)	Moderately Slow
Posttest	0.24 (pwc/min)	Moderately Slow	0.40(pwc/min)	Fast

The speed of students shown in table 1 was measured by getting the number of problems worked correctly per minute (pwc/min). This speed measure was adopted from the research report of Houten, R. and Thompson, C. (1976). The result showed that the average speed of the experimental group in solving math problems was improved from moderately slow to faster speed. The result in the posttest showed the average speed in the posttest of treatment group had substantially increased over their pretest while the group in the traditional classroom had worked even slower.

Table 2.The Differences of the Speed of the Grade 10 Students in the Pretest and Posttest.

Speed (PWC/min)		Control Group	Experimental Group
Slow	(0.02-0.12)	4.0%	-4.0%
Moderately Slow	(0.13-0.24)	41.0%	-67.0%
Average	(0.25-0.36)	2.0%	25.0%
Fast	(0.37 - 0.48)	-23.0%	29.0%
Very Fast	(0.49 - above)	-24.0%	17.0%

Table 2 was a summary of data presented in Annex H. The result showed a total of 47 % or 23 out of 49 students who were taught in the traditional classroom have decreased their speed level from very fast to a lower speed level and the other 53% or 26 students have maintained their speed level. On the other hand, a total of 71% or 37 students out of 52 students who were taught using explicit time-drills have moved to a higher speed level while the other 29% or 15 out of 52 students have maintained their speed level.

Table 3. Descriptive Statistics for Students' Pretest and Posttest Scores by Group Membership.

Group	N	Average Completion Rate	Pretest, Posttest, Gain	Mean	Standard Deviation
Control (No Treatment)	49	64%	Pretest	6.92	2.27
		96%	Posttest	10.76	2.91
			Gain	3.84	3.91
Experimental (Explicit Timed Drill)	52	73%	Pretest	8.35	2.86
		99%	Posttest	17.58	4.47
			Gain	9.23	5.37

In Table 3, the posttest completion rate of the experimental group (99%) is a little higher than the control group (96%) which means that the experimental group had finished the test a little bit faster than the control group.

Table 4. The T-test results between the Accuracy Sores in the Pretest of Grade 10 Students using Explicit Time-Drill against the Students in the Traditional Classroom

Groups	Mean	T-value	df	T-critical
Experimental	38.40	0.83	98	1.98
Control	36.20			

It could be gleaned in table 4 that t (98) = 0.83. The t-value is less than the critical value of 1.98 which means that there was no significant difference in the accuracy scores of students who used the explicit timed-drills group against the students in the traditional classroom/no treatment group

Table 5. The T-test Results between the Accuracy Sores in the Posttest of grade 10 students in the Traditional Classroom against the Students using Explicit Time-Drills.

Groups	Mean	T-value	df	T-critical
Experimental	59.04	9.17	87	1.99
Control	36.9			

In table 5, the computed t-value is 9.17 with the degree freedom of 87. The result showed that the t-value is greater than the t-critical value of 1.99.It showed a significant difference between the posttest accuracy scores of students in the explicit timed-drills against the posttest accuracy scores of students in the traditional classroom/no treatment.

4. Discussions

The data in table 1 showed that the average speed of the experimental group in solving math problems was improved while the control group has shown slower speed. The reason why there was a downgrade in the average speed of the control group after intervention was because they became more focus on recalling steps by step formulas and concepts while answering the posttest .In table 2, although the changes in the speed level of students in the experimental group are not the same for all students, 71% was still a good indication of improvement which could be attributed to the use of explicit timed-drill. The researcher was very optimistic that the remaining students would also improve because Anderson (2008) said when students remember new concepts through practice and drill it would speed up solving math problems. Because practice greatly increases the likelihood that students will permanently remember new information.

The researcher computed the average completion rate, the pretest/posttest gain score and its standard deviation and the data was shown in table 3. Completion Rate was found unpredictable measure to determine the effectiveness of the intervention on the speed of the students. Since the completion rate between two groups did not show much difference because the students in the control group have tried to answer all the problems in the posttest inaccurately while in the pretest, they submitted the test paper with some unanswered test items.

The mean gain of the experimental group (M=9.23, SD=5.37) although more spread out than the control group (M=3.84, SD=4.47) remained higher than the control group. This means that the students in the experimental group have performed better than the students in control group. A gain score reflects the amount of growth or change in student performance over the duration of the treatment (Knowless, 2010).

The researcher utilized the independent t-test of two-Sample Assuming Unequal Variances to compare: (1) The pretest accuracy scores of students in the traditional classroom against the pretest accuracy scores of students in the explicit timed-drills, and (2) The posttest accuracy scores of students in the traditional classroom against the posttest accuracy scores of students in the explicit timed-drills. The result was shown in table 4 and 5.

Since the accuracy scores in the pretest between the two groups were found to be insignificant using the independent t-test of two sample means. It only means that the two groups have relatively equal accuracy level and have the same understanding of the lesson before the study began and this was a good start for a research study.

The result in table 5 also showed a significant difference between the posttest accuracy scores of students in the explicit timed-drills against the posttest accuracy scores of students in the traditional classroom/no treatment. It means that accuracy level of the experimental group is significantly higher than the control group. This result suggested that use of explicit timed-drills had an effect on the accuracy of students in solving math problems. These findings were consistent with the previous research (Miller, Hall, & Heward, 1995; Van Houten & Thompson, 1976; Woodward 2006; Rhymer & Henintong et al, 1999; Knowles,2010) that showed the explicit timing procedure increased problem completion rates without reducing computation accuracy levels.

This study finding strongly supports previous researches regarding the use of explicit time-drill in improving the speed of students in solving math problems while maintaining a high level of accuracy.

5. Conclusions

Based on these findings, the students in the explicit timed-drill showed significant improvement compared to the group in the traditional classroom drill. This improvement was attributed to the intervention used. Therefore, the researcher concluded that explicit timed-drill was found effective in improving the speed and accuracy of grade 10 students in solving problems in analytic geometry. The speed and accuracy of grade 10 students in solving mathematics problem was improved.

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