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The Effect of Daily-Time Pressured Test with Scaffoldings on Students' Achievement and Problem Solving Test Scores as a Mark of Fluid Intelligence

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Abstract: ***This paper reports the influence of daily time-pressured test with scaffoldings on the students' achievement and problem solving test scores as an indication of the development of fluid intelligence. In this research, the data were gathered using pretest-posttest quasi-experimental control grouped design among the general section of Grade 10 students in mathematics. Results of the analysis revealed that those students who underwent daily-time pressured test with journal writing and enforced note-taking as scaffoldings did better in their achievement and problem solving test compared to those students who were subjected with weekly quiz, unforced note-taking and journal writing. The students in the experimental group were enthusiastic and participative in the class discussions and activities than those students in the control group. The researchers recommend that daily-time pressured test with journal writing and forced note-taking be practiced in the classroom to develop students' focus and concentration thereby establish their fluid intelligence.***

Keywords: fluid intelligence, scaffolding, achievement

1. Introduction

Written test is the most common method to determine the students' performance in various subjects taken in the school. In the Philippines, public elementary and secondary schools have an annual assessment called the National Achievement Test (NAT). This assessment is conducted by the Bureau of Education Assessment (BEA) in the Department of Education (DepEd) to evaluate students' performance as mark of the quality of service delivery of education among schools in the country in all subjects like mathematics. The results will then show the effectiveness of the teachers in delivering instruction in the class. This serves as gauge of the teacher's success to carry-out the noble task (Wilkinson, 1998). This further implies that the teacher has a great influence in molding the future lives of the youth by giving them the worthwhile experiences and realizations in different academic disciplines particularly in mathematics.

In the international scene, the Philippines lags behind in terms of mathematics performance. The Philippines consistently rank third place from the bottom among the 43 participating countries in the 1998 and 2003 Trends in International Mathematics and Science Study (TIMSS). For almost a decade now, many of the elementary schools have NAT results above 75 percent, the national standard. However, it has been observed a phenomenon that these elementary NAT takers have dwindled their performance below the national standard once they reached in high school. In Region 10 alone in Northern Mindanao, Philippines most of the secondary schools in the fourteen (14) divisions have mean percentage scores in NAT below the national standard. These results concurred with the study of Lee-Chua (1999) that high school students master less than fifty percent (50) of what they were supposed to learn in the basic mathematics. This low performance in mathematics has alarmed the Philippine government. Hence, the Department of Science and Technology (DOST) and DepEd launched interventions to address the very low performance in mathematics by Filipino students. The DOST instituted the Project RISE (Rescue Initiative in Science Education) which aimed to train science and mathematics teachers to become proficient in teaching the content. However, the low performance persisted and had not shown any change to improve towards and beyond the national standard. Being aware of this situation, the researchers conducted a study that would eventually address the gap of the students' performance in mathematics. The study aimed to determine the effect of developing the fluid intelligence of the students through daily-time-pressured test with scaffoldings in terms of the achievement and problem solving test scores.

2. Review of Related Theories and Literatures

Intelligence is believed to influence achievement and psychologist also believed that intelligence is hereditary. However, this belief has been refuted by recent researches that training of the mind through daily test would significantly improve the intelligence of a person (Siadat, 2011). Nieser, et al (1996) agreed that genetic alone does not absolutely influence the intelligence of an individual. They theorized that the actual ability of an individual depends also on the proper motivation and interaction with the environmental and physical world. In addition, Catell (1963) had conceptualized that general intelligence is subdivided into two forms, the fluid and crystallized intelligences. According to him, the capacity of a person to think logically and solve problems in new situations independent of acquired knowledge called fluid intelligence. This can be seen in test inference and reasoning in which the materials are relatively

free of cultural or informational content, while the ability to use skills, knowledge, and experience is referred to as crystallized intelligence. Jaeggi, Buschkuehl, Jonides, and Perrig (2008) reported in their studies that training on the working memory can improve the fluid intelligence of the students. Siadat (2011) also suggested that fluid intelligence can be developed through frequent and time-pressured tests, a good exercise of the mind to develop focus and concentrate for logical and critical thinking. This idea supports the theories of Pavlov (1927), Skinner (1938) and Thorndike (1911) on classical conditioning and operant conditioning, respectively. These social learning theories clearly stated that people can have mental associations between events and stimuli which are knitted together over time and those changes occur as a result of the positive or negative stimuli. Similarly, it can be deduced that when a student is always given a test as stimulus, the mind will be conditioned to do critical thinking. As a result, the students consider seriously the benefits and importance of getting when good scores are experienced. These social learning theories therefore suggest that training and conditioning of the mind can improve the academic performance of the students; its applicability in the pursuit to advance the achievement test scores of the students in the study.

Mental exercise needs varied activities to avoid monotony. To strengthen better assimilation of concepts, scaffoldings are necessary to support the mind to absorb the theories and principles. Schunk (1996) advocated and believed that scaffoldings helped the students to strengthen their ways of learning the lessons. Like journal writing, Maxwell (1994) revealed that journal writing can help improve the achievement and problem solving test scores of the learners. Dechosa (2009) revealed that enforced note-taking as scaffolding made the learners alert during class discussion. Moreover, the studies of Santa and Havens (1989), and Sullano (1998) as cited by Visande (2004) revealed that doing a journal helped the students recall the lesson.

Conditioning and training the minds to focus, concentrate, think critically and logically through daily-time-pressured test as an approach with the scaffoldings, enforced note-taking and journal writing may offer a channel to develop the fluid intelligence which may be shown in high academic performance. To achieve this goal to determine the effect of the training of the mind on the students' achievement and problem solving scores, the quasi-experiment was done.

3. Methodology

This study used a pretest posttest quasi-experimental control group design. Two intact heterogeneous sections of the Grade 10 classes of Sagay National High School in Bonbon, Sagay, Camiguin were used as participants of the study. One of the two sections was randomly assigned as the experimental group and control group. Using a teacher-made validated 30-item multiple-choice test and two (2) worded problems in exponential and logarithmic functions, the pretest was given to the participants of the two sections. The experimental and control groups received the same lesson every day within the timeframe of the study with the researcher as teacher. Depending on the level of difficulty of the given problem after discussion of the lesson, at most three exercises or problems enough for ten minutes were given to the experimental group as seat work and board work followed by a daily-time pressured test. While the students were taking the test, the teacher checked the notes of the participants. After the test, students wrote their journal to state what they learned and what point they did not understand. Their note-taking was part of the routine activity in the class. A weekly test was given. While the control group had lecture-discussion in the class with the researcher, again, as teacher. The teacher gave also the exercises and problems, then followed by seat work and board work but the notes were not strictly checked. The journals were written after the seat work and board work. The weekly test given to the experimental group was also administered to the control group. The lessons for both groups were the same, but the method of assessment differ until the topic was finished. Observers were also employed to avoid bias on the conduct of the experiment.

In the 30-item multiple-choice test, every correct answer was given one point while the problem solving test had rubrics with 5 points for every item. These scores in the pretest and posttest of the topics exponential and logarithmic functions were used as the primary data of the study. Using analysis of covariance (ANCOVA), the data were analyzed to determine the effect of daily-time pressured test, the assessment, with the scaffoldings.

4. Results and Discussion

The tables below show the results of the analysis of the data gathered in the study.

Table 1: Mean and Standard Deviation of the pretest and posttest scores in the Achievement Test in Advanced Algebra

Participants	Experimental Group N= 33		Control Group N= 35	
	Pretest	Posttest	Pretest	Posttest
Mean	7.69	16.54	7.74	11.83
SD	2.83	4.46	2.54	2.99

Table 1 shows the means and standard deviations of the pretest and posttest scores of both groups of participants. It can be noted that the means are very close to each other, and so are the standard deviations. This suggests that both groups of participants are almost of the same level of performance at the start. However, the scores of the participants in the experimental group in the posttest had considerably increased compared to the control group's minimal increase. The standard deviations of the posttest scores suggested that many of the participants in the experimental group had varied effect on their scores while some of the participants in the control group got scores which are closer to each other. This result is an evidence that better assimilation of concept among the participants in the experimental group because of their active, responsive and cooperative response to the discussion during the treatment period. While in the control group, the score is verification that they lack assimilation, focus and concentration. The participants in the experimental group show that daily-time pressured test, together with the

scaffoldings, has developed their critical thinking skills and higher assimilation process of the mathematical concept. To verify the impact of the treatment, the analysis of covariance (ANCOVA) was used to determine the effect on achievement test scores of the participants.

Table 2: Summary of the One Way ANCOVA of Unequal N of the Achievement Scores

Source of Variation	Adjustment Sum of Squares	df	Mean Square	F-ratio	Prob.
Treatment Between	389.97	1	389.97	26.86	0.001*
Error	973.16	67	14.52		
Total	1363.13	68			

** Significant at 0.05 level*

Table 2 shows the summary of the analysis of covariance (ANCOVA) of the pretest and posttest scores of the participants of the experimental and control groups in the achievement test in exponential and logarithmic functions. The analysis yielded a computed F-ratio of 26.86 with a probability value of 0.001 which is less than the critical value at 0.05 level of significance. This result leads to the rejection of the null hypothesis. This means that the mean score of the experimental group which is 16.62 is significantly higher than the mean score of the control group 11.89. This implies that the daily time-pressured test with enforced note-taking and journal writing as scaffoldings is effective in training the mind to focus, concentrate, think critically and logically. This implies further that daily time-pressured test with scaffoldings can develop fluid intelligence. These findings confirm that training of the mind to achieve desirable changes is actually a way of developing fluid intelligence (Cattell, 1963; Siadat, 2011). This study also corroborates the report that fluid intelligence can be improved by daily time-pressured test (Jaeggi, Buschkuehl, Jonides, and Perrig, 2008). The result also supports that note-taking can improve students' achievement while journal writing can enhance the flexibility and mathematical fluency of the students (Maxwell, 1994; Dechosa, 2009).

Table 3: Mean and Standard Deviation of the pretest and posttest scores in the problem solving test in Advanced Algebra

Participants	Experimental Group N=33		Control Group N=35	
	Pretest	Posttest	Pretest	Posttest
Mean	1.04	3.34	1.06	1.58
SD	0.76	3.19	0.80	1.07

**Perfect score:10*

Table 3 shows the means and standard deviations of the participants' pretest and posttest scores in the problem-solving test in Advanced Algebra. Before the treatment period of the study, the pretest mean of the experimental group is only 1.04 out of 10 points while the pretest mean of the control group is at 1.06. It can be observed that the control group has a little higher mean score than the experimental group by 0.02, but still very low. The standard deviation of the pretest scores of both the experimental and control groups is less than one which means that all of the students in both groups have very low score which is homogeneous.

In the posttest, the experimental group has increased the mean score by 2.23, but still very low because the score is only 30 percent of the 10 points, while the control group has a mean score increase at 0.52. The posttest mean score of the control group is only 16 percent of the total 10 points. These results imply that the students are very poor in problem solving. This is a clear indication and a confirmation of TIMSS (2003) result that Filipino students are very poor in problem solving. With regards to the standard deviation in the posttest, the scores of the experimental group became very dispersed after the experiment which means that the students' problem solving ability became widely varied. This means that there are students whose scores are very low, while some scores are high, but not widely scattered. The students' problem-solving score are more or less homogenous. Their scores are closer to each other which are very low. To determine which group performs better, ANCOVA is used for further analysis.

Table 4: Summary of the One Way ANCOVA of Unequal N of the problem-solving test scores

Source of Variation	Adjustment Sum of Squares	df	Mean Square	F-ratio	Prob.
Treatment Between	33.94	1	33.94	7.82	0.007*
Error Within	290.88	67	4.34		
Total	324.62	68			

** Significant at 0.05 level*

Table 4 shows the summary of the analysis of covariance (ANCOVA) of the problem-solving test scores in Advanced Algebra of the experimental and control groups. The analysis yielded a computed F-ratio of 7.82 with a probability value of 0.007 which is less than the critical value of 0.05 level of significance. This leads to the rejection of the null hypothesis. This implies that the posttest mean score of the experimental group at 3.34 is better than the posttest mean score of the control group at 1.58, even if the scores are low. This implies further that daily time-pressured test, with note-taking and journal writing as scaffoldings, has caused the significant increase of the problem solving test scores. These findings confirm the report that fluid intelligence can be improved by training the working memory through daily-time-pressured test (Siadat, 2011). This result also agrees to the claim that fluid intelligence is very important in achieving significant increase in test scores. This finding showed the importance of scaffoldings in the learning process. The improved problem solving performance of the participants in the experimental group can be also attributed in note-taking because this tool has benefited students learning (Dechosa, 2009) and also in journal writing because writing can enhance the learning process and can also develop confidence and competence in writing.

5. Conclusion and Recommendation

Based on the analysis and findings of the study, the researchers conclude that daily time-pressured test with scaffoldings using journal writing and enforced note-taking can effectively help in developing student's fluid intelligence. Hence, the researchers recommend that school administrators may encourage their teachers to give daily time-pressured test with note-taking and journal writing to their students to

develop a habit, focus and concentration necessary for critical thinking, mathematical fluency, flexibility and creativity for high stake assessment, be it national or international in scope.

References

[1] Cattell, R. B. (1963). Theory of fluid and crystallized intelligence: A critical experiment. Journal of Educational Psychology, 54, 1-22.
[2] Lee-Chua, Q. N. (1999). The road to the International Math Olympiad: The Philippine experience. The Mathematical Intelligencer 21(4).
[3] Dechosa, R. A. (2009). Note-taking, Listening Skills and Mathematics Achievements of Grade Six Pupils. Thesis. Mindanao University of Science and Technology.
[4] Jaeggi, S. M., Buschkuehl, M., Jonides, J. and Perrig, W. J. (2008). Improving Fluid Intelligence with Training on Working Memory, Proceedings of the National Academy of Sciences (PNAS).
[5] Maxwell, M. (1994). Are the skills we are teaching obsolete? In S. Mioduski & G. Enright (Eds.), proceedings of the 13th and 14th Annual Institutes for Learning Assistance Professionals: 1992-1993(pp. 63-77). Tuczon, A.Z.: University Learning Center, University of Arizona.
[6] Neisser, U., Boodoo, G., Boucard, TJ., Boykin AW et al (1996) Intelligence: Knowns and Unknowns. American Psychologist 51 (2):77-101.
[7] Pavlov, I. P. (1927). Conditioned reflexes. London: Oxford University Press.
[8] Santa, C. M., & Havens, L. T. (1991). Learning through writing. In C. M. Santa & D. E. Alvermann (Eds.), Science learning: Processes and applications (pp. 122–133). Newark, DE: International Reading Association.
[9] Siadat, V. M. (2011). Using Mathematics to Improve Fluid Intelligence. Notices in the American Mathematics Society. Volume 58, Number 3 https://www.researchgate.net/publication/275220682
[10] Schunk, D. H. (1996). Learning theories. Englewood Cliffs, Prentice-Hall, Inc.
[11] Skinner, B. F. (1938). The Behavior of Organism. New York: Appleton-Century-Croffs.
[12] Sullano, E. Jr., P. (1995) Homework Feedback System: Its Implication on Achievement and Attitude Towards Mathematics of Third High School Students. Unpublished Master's Thesis, Mindanao Polytechnic State College, Cagayan de Oro City
[13] Thorndike, E. L. (1898). Animal intelligence: An experimental study of the associative processes in animals. Psychology Review Homograph
[14] Thorndike, E. L. (1911). Animal intelligence; experimental studies. New York: Macmillan Company. http://www.biodiversitylibrary.org/item/16001
[15] TIMSS (1998) Technical Report: Volume II: Implementation and Analysis, Primary and Middle School Years. Boston College, International Study Center. Chestnut Hill, MA. Martin, M.O., and Kelly, D.L. (Eds.)
[16] TIMSS (2003) International Mathematics Report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades: http://www.iea.nl/our-studies
[17] Visande, R. G. (2004) Rewrite-To-Improve: Its Impact on the Performance and Retention on the College Students in Problem Solving. Unpublished Master's Thesis, Mindanao Polytechnic State College, Cagayan de Oro City
[18] Wilkinson, I. (1998). Dealing with diversity: Achievement gaps in reading literacy among New Zealand students. Reading Research Quarterly, 33.

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