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Engagement in Mathematical Thinking and the Proficiency Level of Secondary Students

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ABSTRACT

Engagement in Mathematics refers to the strategies to learn mathematics and confidence in the ability to succeed and emotional feelings about mathematics. It plays a vital role in the acquisition of mathematical skills and knowledge by being attracted to their work, persistent despite challenges and obstacles, and they take visible delight in work accomplishments. The purpose of the study was to determine the level of mathematical thinking and proficiency of secondary students of Davao del Norte, Philippines. The other intent of this undertaking was to find out the engagement of the students in mathematical thinking and the achievement of the fourth-year high school students. This study used the descriptive-correlation design. Pertinent data were gathered through the use of questionnaires in assessing the level of achievements of the 163 fourth-year students in Kapalong public secondary schools specifically Capungagan High School, Mabantao National High School and Sua-on National High School. This research employed statistical tools like Analysis of Variance (ANOVA), correlation, t – test and mean. The result revealed that the level of engagement of students in mathematical thinking was high that means that all the strategies are applied by the teachers in the class.

Keywords **-** Mathematics Education, mathematical thinking, proficiency level, secondary students, descriptive-correlation design, Tagum City, Philippines

INTRODUCTION

Many school improvement agenda focus on a new instructional strategy of the curriculum, but the work to bring all students to high achievement levels is more complex than that which involves establishing the right culture to nurture the minds of students and to enrich the involvement and innovation of school leaders and staff according to NCTM of 2002.

During the 89th Annual Meeting of the NCTM of Ball, 2002, emphasizes the need for student engagement in rigorous mathematical concept development beginning at an early age. American high school students have poorer mastery of basic math concepts than their counterparts in other leading industrialized nations. In the Organization of Economic Cooperation and Development comprises of nations pointed out United States as rank 24th out of 29 countries as richest country according to PISA study. Another study revealed that U.S. students were in the middle of the tract when it came to reading but insulated in math.

In the Philippines, during Arroyo's term, science and math competencies of Filipino students are also one of the lowest in the world because high school students ranked 41st out of 45 countries in math proficiency while Filipino grade-schoolers, ranked 23rd out of 25 countries in math and science proficiencies agreeing to Ramota of 2005.

In Davao del Norte, particularly in Capungagan High School, Sua-on National High School and Mabantao National High School have experienced problem regarding students' performance in Mathematics. Low performance was indicated in a recent national achievement test result. Unfortunately, Capungagan High School is ranked 34th out of 34, Sua-on National High School rank 33 and Mabantao National High School rank 25. It shows only that the proficiency level of the students in Mathematics is deteriorating.

It is in this premise that the researcher conducted a study to find out the engagement of students in mathematical thinking and the achievement of the fourth - year high school students.

FRAMEWORK

This study is based on the theory of Kunsch et al. (2007), Maccini, Mulchany and Wilson (2007) and Wetzel (2005) that the professional literature in teaching mathematics to struggling learners offer several strategies that can be used in general education settings. These strategies include schema based instruction in

which students are expected to break the problem down in order to understand how to proceed, cognitive strategies which allow the students to focus on the necessary steps for solving problems successfully, scaffolding which allow the students to build new instruction onto previously taught skills, peer-mediated instruction in which the students are paired by higher performing students, mnemonics involves choosing words that sound like the word and concrete representational abstract sequence which allow the students to form previous instruction to promote retention. It is important for both general and special education teachers to recognize how to implement these strategies in the classroom.

According to Marzano of 2001, students periodically assess their level of effort on assignments and trail the impact of their energy on the grades they earn. Teachers can give the students a set of power and achievement rubrics which students can use to assess and track effort and achievement on a chart. When students observe the impact that their effort and attitude have on their progress, they begin to see the value of applying reading strategies to improve their comprehension and learning. They also gain a sense of control over their learning – a crucial step in assuming more responsibility for their learning.

As a result of pedagogical experiences over an approximate seven years period using the Imaginative Education theory of Egan of 1997, a research question began to emerge that would help address the above situation. The question was formalized for a pilot project as "Does the use of the concept affect the student engagement in the learning of elementary mathematics?" It is suggested that the use of this theory can assist with establishing a more egalitarian dynamic form of learning mathematics by providing additional entry points for students that engage their imagination with a positive emotional response. Combining the main elements of the theory i.e. students' emotional response, with the use of their imaginations, it provides a stepping-stone of opportunity to both increase engagement and greater cognitive development. Students can thus, increase their engagement with mathematics when the curriculum presented to them is inviting and recognizes their contribution as part of a larger socio-cultural conversation.

Sex differences emerge on more complex quantitative tasks and most of the studies; these differences begin during or after elementary school and grow larger with the increasing age (Beilstein & Wilson, 2000). A few studies find differences at younger ages in some, but not all, samples (Levine, et al. 1999; Huttenlocher et al., 1998). Because the differences emerge well after infancy, it is difficult to tease apart the biological and social factors that produce them (Halpern, 2013).

OBJECTIVE OF THE STUDY

The objective of the study was to determine the level on the engagement of mathematical thinking in terms of schema-based instruction, cognitive strategies, scaffolding, peer-mediated instruction, mnemonics, and concrete – representational-abstract and the level of mathematical proficiency.

METHODOLOGY

This research used the descriptive-correlation design. Pertinent data weregathered through the use of questionnaires in assessing the level of achievements of the fourth - year students of Kapalong public secondary schools.

As the term descriptive survey implies, this involved collecting data to test and answer questions on the hypotheses concerning the current status of the subject. These descriptive studies typically consist of observing behavior over a period (Rog 1998). It supported the teachers in engaging the students in mathematical thinking and the proficiency level among fourth - year students of secondary schools of Kapalong District.

This research was conducted at the Kapalong East District, Division of Davao del Norte more particularly in the three (3) public secondary schools. The schools and the number of respondents that will be involved are as follows: Capungagan High School (63 respondents); Mabantao National High School (70 respondents) and Sua-on National High School (30 respondents). The researcher obtained an informed consent from the study respondents in compliance to research ethics protocol.

The research instruments used in this research are questionnaire and test results. The questionnaire was checked; content was validated and approved by the researcher's adviser and the panel of examiners.

The researcher made such questionnaire determine the engagement of the students in mathematical thinking and proficiency level of the fourth - year students of secondary schools of Kapalong District. The items of the questionnaire were revised into simple, brief and concise that involve Mathematics subject activities related details to provide the respondents' basic understanding about the purpose of the research.

The parameter and scaling used for the interpretation of the engagement of the students in mathematical thinking were: 4.20 – 5.00 very high; 3.40 – 4.19 high; 2.60 – 3.39 moderate; 1.80 – 2.59 low; and 1.00 – 1.79 very low. The second instrument used was the test results of the Division Unified Test of the

fourth - year students in Mathematics SY 2010-2011.

The following showed scaling and parameter to be used for the interpretation of the Performance of students as based on the Test Result: 96 – 100 which means excellent; 89 – 95 with a descriptive meaning of high; 82 – 88 implies as an average; 75 – 81 indicates low; and 74 – below denotes very low.

During the data gathering procedure, the researcher utilized the revised questionnaire to determine the engagement of the students in mathematical thinking and the proficiency level. The questionnaire was distributed to the 163 students /respondents of the fourth - year level to assess the level of their engagement in mathematical thinking. With the assistance of the mathematics teachers, it was distributed during their time in Math. The questionnaires were retrieved personally by the researcher.

The researcher used the following statistical tool in analysing and interpreting the data collected: Analysis of Variance (ANOVA) to determine the significant difference of mathematical thinking and the proficiency level of students when analyzed by school; correlation to determine the relationship between the mathematical thinking and the proficiency level of the students; mean to determine the proficiency level of the students and t-test to determine the significant difference of mathematical thinking and proficiency level of students when analyzed by gender.

RESULTS AND DISCUSSION

Profile of the Respondents

The study was conducted at Kapalong East District, Division of Davao del Norte more particularly in the three (3) public secondary schools; 63 from Capungagan High School, 70 from Mabantao National High School and 30 students from Sua-on National High School.

Table 1. Level of engagement of students in mathematical thinking

Indicators	Mean	Description
Schema Based Instruction	3.81	High
Cognitive Strategies	3.90	High
Scaffolding	3.83	High
Peer-mediated Instruction	3.55	High
Mnemonics	3.68	High
Concrete Representational Abstract	3.68	High
Overall Mean	**3.74**	**High**

As we gleaned from the table, the overall mean is 3.74, with a descriptive equivalent of high level. This means that the strategies were applied by the teacher in the class.

Numerical proficiency

The results revealed that the weighted mean of Sua-on High School has 68.64 with a description of poor. Mabantao National High School has a weighted mean of 75.49 with a description of fair and Capungagan High School has only weighted mean of 67.84 with a description of poor. The overall weighted mean of the three schools were 70.66 which has a description of poor. This means that the level of proficiency of the students when grouped by school differ significantly. In the result, students from Mabantao National High School have the higher rating compared to the other schools involved in the investigation.

In the difference of the numerical proficiency of students when analyzed by gender, the male got a mean of 70.99, and the female posted a mean of 71.49. The researcher used t- test and the results revealed that there is no significant difference. This means that the proficiency level between the male and the female are similar or comparable.

As a whole, the result implies that women are sometimes said to excel at verbal tasks and men at spatial tasks, but the literature on sex differences reveals a more nuanced pattern according to Halpern (2013). Girls and women tend to excel on tests of verbal fluency, arithmetic calculation, and memory for the spatial locations of objects. In contrast, boys and men tend to excel on tests of verbal analogies, mathematical word problems, and memory for the geometric configuration of the environment. Meta-analyses have revealed that some of these sex differences are reliable, although most are small. Indeed, most of the variables that have been tested in men and women have yielded sex differences that are small or close to zero in meta-analyses, leading Hyde (2005) to advance the "gender similarities hypothesis." In 2000, for example, 47% of bachelor's degrees in mathematics were earned by women (Chipman, 2005). By the most meaningful measure--the ability to master new, challenging mathematical material over extended periods of time--college men and women show equal aptitude for mathematics.

The level of the engagement of students in mathematical thinking does not have any correlation with the level of numerical proficiency. Data revealed that the r – value is 0.139. Furthermore, the computed Z-value is 1.63, which is lower than the tabular Z-value of 1.96. This allows the researcher to accept the hypothesis of no significant relationship between the level of the engagement of

students in mathematical thinking and the level of numerical proficiency.

Engagement of mathematical thinking is based on the theory of Kunsch et al. (2007), Maccini, Mulchany and Wilson (2007) and Wetzel (2005) that the professional literature in teaching mathematics to struggling learners offer several strategies that can be used in general education settings. There are strategies applied by the teacher in three different schools, and some of them are schema-based instruction, cognitive strategies, scaffolding, peer - mediated instruction, mnemonics, and concrete representational abstract. As the researcher flawed to study, however, making this conclusion relevant.

CONCLUSIONS

The following conclusions revealed that the level of engagement of the students in terms of schema-based instruction, cognitive strategies, scaffolding, peer - mediated instruction, mnemonics, and concrete representational abstract were high. The level of proficiency of the students was poor. There is a significant difference in the level of engagement of the students in Mathematical thinking when grouped by gender and school. There is a significant difference in the level of proficiency of the students when grouped by school but no significant difference when grouped by gender. There is a significant relationship between the level of engagement and proficiency of the students.

RECOMMENDATIONS

Based on the conclusions, the following recommendations are offered that the engagement of the students in Mathematical thinking shall be raised to a very high level; the teacher shall enhance the techniques or approaches in the classroom setting by giving them more drills and assignments that would lead towards a more meaningful and motivating engagement in mathematical thinking; the proficiency level of the students in Mathematics should be improved (this can be done by making an analysis of the strengths and weak areas of the examination); and the school may conduct remedial classes to improve the performance of the students.

Although, the level of engagement of the students does not have any correlation with the proficiency level of the students, the researcher still believes that the engagement activities be enhanced, since it is in the classroom setting that the output in any test is anchored upon. Related studies may be conducted.

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