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PROBLEM SOLVING HEURISTICS, SELF – EFFICACY, MATHEMATICS ANXIETY, ATTITUDE AND PERFORMANCE OF GRADE NINE (9) STUDENTS

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ABSTRACT

This study was conducted to develop a model on Mathematics performance of the Grade nine (9) students in the Division of Bukidnon, academic year 2014-2015. It deeply investigated students' varying problem solving heuristics and performance when psychological attributes are considered. Survey questionnaires in Mathematics self-efficacy, Fennema -Sherman Attitude Scale, Problem Solving Task and interview method were used in this study. Descriptive statistics was used to describe the students' level of performance, mathematics self-efficacy, mathematics anxiety and attitude. Results of the study revealed that the level of mathematics performance of the Grade Nine (9) students fell in beginning level. Correlation results indicated that student Mathematics self-efficacy and anxiety showed statistical significance relative to student problem solving performance. Moreover, Stepwise multiple regression proved that student problem solving performance was affected by two factor variables namely: self-efficacy and mathematics anxiety. Nine (9) students participated in the qualitative aspects of the study. Participants with positive attitude tend to have high self-efficacy, low anxiety level and performed better compared to those students within the same performance level. Hence, qualitative analysis results validated the quantitative findings of this study.

INTRODUCTION

Learning Mathematics is a key fundamental in every educational system that aims to prepare its citizens for a productive life in the 21st century. A strong grounding in mathematics and a talent pool in Mathematics are essential to support the wide range of value-added economic activities and innovations. Many countries are paying attention to the quality of their mathematics education.

According to the Trends in International Mathematics and Science Study (TIMSS), Filipino students could not work with items which deviated from the usual problem types given in textbooks. This implies that the problem solving aspects of mathematics learning does not meet expectations, or perhaps is not given emphasis. Such feedback simply means that in the classroom, students deal mainly with routine problems, with perhaps teachers or students, or both, more concerned of step-by-step procedure rather than meaningful learning (Duque, 2013).

Unfortunately, an emphasis on providing students with multiple mathematics problems solving tools has not been embraced universally within the educational community (Douville & Pugalee, 2003). Kaur and Yap, as cited by Yeo (2004), said that even lower secondary students (grades 7 and 8) from Singapore, who consistently ranks first in the TIMSS, do not perform well in solving non-routine problems. Hence, mathematics problem solving in its real sense, is not only a national issue, but international as well.

Philippines, specifically in Region X, experiences similar academic setbacks in Mathematics education as seen in the NAT results released by the National Education Testing and Research Center (2012). The region's MPS is 48.92 compared to the 50% passing MPS.

In the Philippines, the government aims to improve the quality of education through producing productive citizens. Hence, the academic performance of the students must be examined because it serves as the basis for improving the teaching and learning process. However, students' achievement is influenced by factors as revealed by many studies (Dalan, 2004).

To mention, Asparin (2013) elaborated that academic performance is affected by psychological factors such as beliefs, emotions and views that influence their learning development. Some of these factors are self-efficacy, attitude towards mathematics, and mathematics anxiety (Asparin.2013).

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Fong and Aldalalah (2010) also contends that mathematics anxiety is an outcome of low self-esteem and fear of failure, an emotional state overwhelmed with a feeling of tension, apprehension or fear when one is asked to perform mathematically.

With more innovative educational strategies presented nowadays, the problem in education remains unresolved. Filipino students show low performance in the different academic areas. This urges the researcher to conduct this study with a hope to formulate a model relative to problem solving heuristics of Grade 9 students specifically in the province of Bukidnon where information can facilitate Mathematics teachers' understanding on various heuristics that students are likely to use in solving mathematical problems.

THEORETICAL /CONCEPTUAL FRAMEWORK

This study was anchored on social learning theory of Bandura (1997) that emphasizes the importance of observing and modeling the behaviors, attitudes, and emotional reactions of others. Applying this theory to Mathematics means that the students can better perform if they have somebody that they can look up to as models. These could be their teachers, their parents and their peers who can influence them to like mathematics.

In cognitive theory, motivation serves to create intensions and goal –seeking acts which can be obtained from people that surround the students. From this, the students will then be able to establish a positive attitude. Since attitude often relate in some way to interaction with others, they represent an important link between cognitive and social psychology.

The Emotional Learning Theory posits that learner's emotion, attitude, and beliefs affect the learning process (Learning –Theories. Com , 2013) ,Students develop a positive attitude when the learning environment caters a sense of belongingness, free from biases, and a positive emotional climate (Davis 2006).This could be attained when there is enough security from ridicules through the body language and verbal communication of people involved in the learning process.

The Cognitive-Experiential Self-Theory (CEST) also an adaptive view of heuristic processing. CEST breaks down two systems that process information. At some times, roughly speaking, individuals consider issues rationally, systematically, logically, deliberately, effort fully, and verbally. On other occasions, individuals consider issues intuitively, effortlessly, globally, and emotionally. From this perspective, heuristics are part of a larger experiential processing system that is often adaptive, but vulnerable to error in situations that require logical analysis.

Math self-efficacy has the most effect on math performance than math attitude and mathematics anxiety. It mediates the effect of math attitude and mathematics achievement (Kabiri and Kiamanesh, 2003).

Davidoff (1987) emphasized that attitudes are learned. People do not come into the world with them. Attitudes are formed through observation learning, rewards and punishments, and exposure.

Furthermore, mathematics anxiety is a psychological factor that affects performance. Self -efficacy beliefs affect the relationship between math anxiety and math achievement. Math anxiety mediates the effect of math self-efficacy and math performance (Kiamanesh et al., 2003). It has a negative correlation to math performance. High anxiety impairs a person's ability to perform. He has a feeling of uneasiness when asked to perform mathematically and a tendency of avoidance in math class.

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Research Paradigm

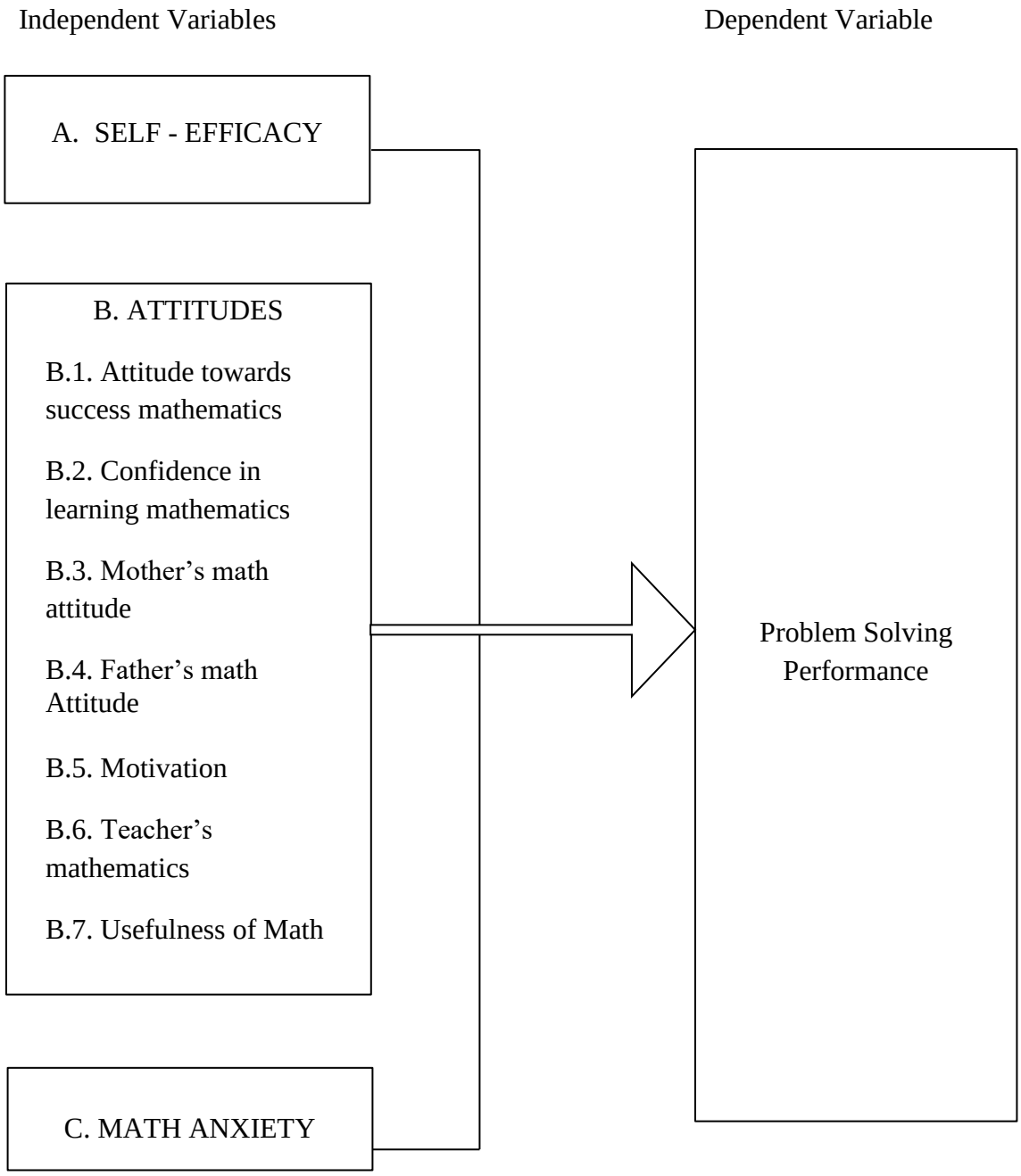


Figure1. Research paradigm showing the relationship between the dependent and Independent Variables

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METHODS

This study employed the mixed methods design, as both qualitative and quantitative approaches were used. The quantitative aspects of this study employed descriptive–correlational methods in determining the relationship among students' mathematics performance and psychological attributes.

The qualitative aspects of this study employed descriptive case study methods to look deeper on students with different psychological attributes in their problem solving performance and heuristics.

Weighted mean was used to determine the level of mathematics performance and to find out the level of students' problem solving heuristics methods. The Pearson product-moment correlation (Pearson r) was used to describe the relationship among students' psychological factors. To ascertain the best predictor of the mathematics achievement of the students, the stepwise multiple linear regression analysis was used.

The qualitative analysis of data using utilized criss-cross analysis. The data were gathered, explored, presented and interpreted. These were based on the actual responses of the respondents obtained during interviews, the videotape and the actual outputs in their problem solving task to triangulate the data observed.

DISCUSSION OF THE RESULTS

Results of the study revealed that the level of Mathematics performance of the Grade 9 students fell in beginning level. The overall mean percentage was 68.80 which means below the passing rate of 75 percent.

The respondents' level of self-efficacy was 3.42 which indicated that students were moderately confident in solving the given tasks. Moreover, their level of mathematics anxiety was 3.04 which indicated that the students were moderately anxious of the subject. It means further that their feelings of fear of failure, low self-esteem, and tension about the subject was moderate.

Fennema-Sherman Mathematics Attitudes Scales (FSMAS) revealed the following mean scores: attitudes towards success in Mathematics (3.23), mothers' attitude towards Mathematics (3.11), fathers' attitude towards Mathematics (3.16), students' motivation towards Mathematics (3.06), students' usefulness in Mathematics (3.19), teachers' attitude towards Mathematics (3.07), students confidence in learning Mathematics (3.07). This attitude scales earned an overall mean score of 3.12 which can be described as moderately positive. This means that in some degree, students perceived their feelings towards Mathematics as neither positive nor negative.

Correlation results indicated that student mathematics self-efficacy $r = 0.197$, ($p<0.01$) showed statistical significance relative to student problem solving performance. Also, correlation results further suggested that Mathematics anxiety $r = -0.108$, ($p<0.05$) were significantly associated with student problem solving performance.

Stepwise Multiple Regression validated that student problem solving performance was affected by two factor variables namely: self-efficacy, $\beta = 1.910$, t (4.718), $p<0.01$ and Mathematics anxiety $\beta = 0.069$, t (2.821), $p<0.01$.

Nine (9) students participated in the qualitative aspects of the study; participants with positive attitude tend to have high self-efficacy, low anxiety level and performed better compared to those students within the same performance level. Hence, qualitative analysis results validated the quantitative findings of this study.

CONCLUSIONS

Based on the findings of this study, the following conclusions were drawn:
Grade 9 students' mathematics performance falls in the beginning level. Students have scores lower than that of the percentage passing rate.

Students use varied problem solving heuristics. Most of them use the following: giving representations, making a calculated guess, going through the process, changing the problem and look/create/recall for a formula.

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Students' self-efficacy in Mathematics indicated that they were moderately confident. Students were not sure whether they can perform various math-related tasks and behaviors.

Students' level of anxiety indicated moderately anxious which means that there were discrete feelings characterized by uncertainty involving mathematical tasks.

The students' attitude towards Mathematics was moderately positive. Students had the feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations.

Correlation between students' problem solving performance and self-efficacy and Mathematics anxiety revealed statistically significant. Students' self-efficacy and anxiety have shown to influence students' performance in Mathematics.

Regression analysis validated self-efficacy and Mathematics anxiety as best predictors of students' problem solving performance.

Qualitative analysis reveals that mostly, students involved orientation and execution procedures in problem solving. In addition, the students use the problem solving heuristics for them to be able to arrive at a certain answer.

RECOMMENDATIONS

The conclusions of the study led to some recommendations which are believed to improve teaching and learning which would lead to high mathematics performance of students.

There is a need for Mathematics teachers to be re-oriented with teaching mathematics through the problem solving heuristics such as giving representations, making a calculated guess, going through the process, changing the problem and look/create/recall for a formula for the students to be acquainted with such problem solving strategies.

Mathematics teachers may look upon in a positive light to reduce math anxiety. Therefore, teachers must re-examine traditional teaching methods which often do not match students' learning styles and skills needed for the subject.

Moreover, the teachers may find ways to develop the students' ability to understand mathematical problems and algorithmic abilities by giving more exercises and encourage students to engage themselves in problem solving so that their self-efficacy will be improved and they will have a positive disposition about the subject because these variables affect mathematics performance.

Attitudes towards Mathematics play a crucial role in teaching and learning the process of Mathematics, thus, this may call for the teachers to foster this attitude because it greatly helps motivating student to do Mathematics.

It is highly essential for the teachers to boost students' self-efficacy in the subject in order for the teaching and learning become more meaningful and desirable.

Further studies may be conducted to validate anxiety in Mathematics as predictor of students' performance.

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Table 1. Frequency counts, percentage and descriptive equivalence of students performance task in mathematics

Student Performance Task Range	Frequency	Percent	Descriptive Equivalence
90 – 100	7	1.40	Advanced
85 – 89	29	5.80	Proficient
80 – 84	41	8.20	Approaching to Proficienc
75 – 79	60	12.00	Developing
74 below	349	69.80	Beginning
TOTAL	500	100	
MEAN = 68.80			Beginning

Table 2. Summary of students' attitude towards Mathematics

INDICATORS	MEAN	DESCRIPTIVE MEANING	QUALITATIVE INTERPRETATION
Attitude towards Success in Mathematics	3.23	Undecided	Moderately Positive
Mother's Attitude towards Mathematics	3.11	Undecided	Moderately Positive
Father's Attitude towards Mathematics	3.16	Undecided	Moderately Positive
Students' Motivation towards Mathematics	3.06	Undecided	Moderately Positive
Students' Usefulness of Mathematics	3.19	Undecided	Moderately Positive
Teachers' Attitude towards Mathematics	3.07	Undecided	Moderately Positive
Students' Confidence in Mathematics	3.07	Undecided	Moderately Positive
OVERALL	3.12	Undecided	Moderately Positive

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Table 3. Correlation analysis of student problem solving performance task and self-efficacy, attitude and anxiety in mathematics

INDICATORS	Correlation Coefficient	Probability
Mathematics Self-efficacy	**0.197**	**0.000****
Attitudes in Mathematics	0.065	0.114ns
Attitudes towards success in Mathematics	-0.020	0.661ns
Confidence in learning Mathematics	0.047	0.293ns
Mothers' Math attitude	-0.005	0.915ns
Fathers' Math attitude	-0.025	0.583ns
Motivation	0.001	0.979ns
Teachers' attitude in teaching Mathematics	0.007	0.868ns
Usefulness of Mathematics	0.062	0.166ns
Math Anxiety	-0.108	0.016*

Table 4. Regression analysis of student problem solving performance task and self-efficacy, attitude and anxiety in Mathematics

INDICATORS	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	4.378	1.415		3.095	.002*
Mathematics Self-efficacy	1.910	.405	.206	4.718	.000*
Mathematics Anxiety	0.069	.025	.123	2.821	.005*
R = 0.232	R^2 = 0.054		F = 14.179	Sig. 0.000	

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Table 5 Profile of nine (9) cases of varying psychological attributes and performance

ATTITUDE / PERFORMANCE	POSITIVE	NEGATIVE	NEUTRAL
Advanced	Arnold	Belen	Cynthia
Approaching to proficiency	Dorothy	Eden	Fatima
Beginning	Hazel	Irene	Gerald

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