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Cognitive Ability, Psycho-sociological Characteristics and Study Habits of Students: A Structural Model on Mathematics Performance

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Abstract *- Cognitive ability predicts mathematics performance. However, there are other factors like study habits and psycho-sociological characteristics which also influence students' performance. With these factors, this study aspires to obtain a structural model that best fit college mathematics performance. The study was conducted using descriptive - correlational method. Employing convenience sampling, a total of 278 second year to fourth year BSED students of the selected state colleges and universities in the Davao region were subjected to study. Descriptive statistics was used to determine the respondents' cognitive ability level, psycho-sociological level, level of study habits, and college mathematics performance. The structural equation modeling (SEM) was then employed to test the structural model fit of the variables. Results show that the respondents have very satisfactory cognitive ability level based on high school GPA and college admission test. Their psycho-sociological and study habits levels were both slightly high. Their college mathematics performances were also in very satisfactory level. A structural equation model that best fit mathematics performance was determined. The latent variables - cognitive ability, psycho-sociological factors, and study habits have direct effects to the mathematics performance. It confirmed that college mathematics performance is not only influenced by cognitive ability but also by psycho-sociological characteristics and study habits of the students. It concludes that enhancing psycho-sociological characteristics and study habits of the students will also improve their college mathematics performance. For further research on mathematics performance, inclusion of other non-cognitive factors in the structural model is recommended.*

Keywords – Cognitive ability, psycho-sociological factors, study habits, mathematics performance, structural equation model

INTRODUCTION

Students' mathematics performance is one of the major subjects that attract attention in several researches in education. Over the years, numerous studies have examined the multitude of factors determining mathematics performance, with cognitive ability arising as one of the most important factors. These led to most of the higher education institutions (HEI's) to administer college admission test to incoming students. However, it is still been a common observation that many of the students are struggling in terms of their mathematics performance in college. It, then, becomes a challenge among educators and learning institutions to establish an efficient teaching – learning system. According to [10], predicting students' academic performance is a key step in order to improve the efficiency of university systems. Hence, by defining the important factors affecting the students' achievement, failure can be under control.

Psycho-sociological factors play an important role in the learning process in mathematics. The psycho-sociological characteristics that the researcher studied were: Self-esteem (measures of global self-worth), Self-Efficacy (measures student's confidence in

his or her ability to achieve specific academic tasks), and Grit (measures passion and perseverance for long-term goals). Similarly, a lot of researchers argue that study habits have strong relationship with the mathematics performance of students. Further, students' study methods affect their learning and academic achievement, and the resultant process plays a role in the development of cognitive and practical skills [14].

With the foregoing claims, the researcher assessed how the cognitive ability, psycho-sociological factors, and study habits of the BSED students in selected state colleges and universities in Davao region affect their college mathematics performance. Further, it obtained a structural model that best fit mathematics performance of the BSED students.

OBJECTIVE OF THE STUDY

The study focused on determining how the student's cognitive ability, psycho-sociological characteristics and study habits affect the mathematics performance of the BSED students by conducting a structural equation modelling. Specifically, it aims to determine the Cognitive Ability Level of the respondents in terms of High School GPA and College Admission Test (CAT); determine the Mathematics performance of the respondents; determine the respondents' level of psycho-sociological factors in terms of Self-esteem, Self-Efficacy; and Grit; determine the level of study habits of the respondents; and to determine a structural equation model that best fit mathematics performance of the BSED students.

MATERIALS AND METHOD

This study employed a descriptive - correlational method. In gathering of data, descriptive-survey type was used which utilized questionnaires. The study population were the students enrolled in the State Colleges and Universities in the Davao Region on second semester of academic year 2017-2018. Participants were selected from this population using convenience sampling. Convenience sampling is a sampling method that recruits participants based on their availability and willingness to respond [11].

Table 1. The Number of Respondents Per College / University

SUC	Province	Frequency	%
SPAMAST - Malita	Davao Occidental	77	27.70
USEP - Tagum	Davao del Norte	67	24.10
DOSCST	Davao Oriental	51	18.30
SPAMAST - Digos	Davao del Sur	83	29.90
Total		278	100.00

The questionnaires are the main instruments used in gathering data in this study. The researcher adopted the survey – questionnaires formulated by the established researchers in the field of education and psychology. Survey questionnaire were administered to the targeted student population. Students were instructed to honestly respond to each item in the questionnaire without worrying of the time. This is to ensure that the responses are truthful as possible.

RESULTS AND DISCUSSION

Cognitive Ability level of the Respondents

This study utilized the two traditional measures of cognitive ability – the high school grade point average (GPA) and the college admission test (CAT) results. Most of the respondents have very satisfactory to excellent high school GPAs as well as results to college admission tests (CAT). This can be explained by noting that most of the collegiate institutions are now implementing strict admission policies to the teacher education programs because of the demanding quality performance of the schools in the Licensure Examination for Teachers (LET).

Table 2. Cognitive Ability Level of the Respondents

Cognitive Ability	Interpretation	(%)
HS GPA		
83-85	Satisfactory	15.1
86-90	Very Satisfactory	59.0
91-95	Excellent	25.9
Mean: 88.71	**Very Satisfactory**	
Admission Test		
1-3	Satisfactory	2.5
4-6	Very Satisfactory	67.3
7-9	Excellent	30.2
Mean: 5.79	**Very Satisfactory**	**100.0**

Mathematics Performance

As observed in Table 3, 16.2 % are having satisfactory rating on College Mathematics; 70.5% of the respondents obtained a "very satisfactory" rating of between 1.75 – 2.25; and 13.3 % are having excellent ratings.

Table 3. College Mathematics Performance

Algebra	Interpretation	(%)
1.00-1.50	Excellent	13.3
1.75-2.25	Very Satisfactory	70.5
2.50-3.00	Satisfactory	16.2
Mean: 2.03	**Very Satisfactory**	

N = 278, %=100

The Psycho-sociological Characteristics

Table 4 presents the level of the psycho-sociological factors of the respondents. In self-esteem, the respondents obtained a mean of 2.84. This indicates a slightly high self-esteem, which means that the respondents have generally good personal outlook of self-worth. In the self-efficacy factor, the mean is 2.92 which imply that most of the students are willing to exert necessary effort to manage and solve when faced with difficult problems. In grit, the mean score is 3.13 which suggest that the respondents have slightly higher grit.

Table 4. The Psycho-sociological Level

Psycho-sociological Factors	Mean	Interpretation
Self – Esteem	2.8385	slightly high
Self – Efficacy	2.9151	slightly high
Grit	3.1282	slightly high

Study Habits of the Respondents

The respondents have slightly high in "selecting a Math Class" and in "Selecting a Time and Place for Studying Math". Further, they obtained high level on "Study Strategies for Math Class" and "Math Tests Strategies". These results are presented in table 5.

Table 5. The Level of Study Habits

Study Habits	Mean	Interpretation
Selecting a Math Class	2.7978	Slightly high
Selecting a Time and Place for Studying Math	2.9994	Slightly high
Study Strategies for Math Class	3.1020	High
Math Tests Strategies	3.2657	High

A Structural Model of Students' Mathematics Performance

Figure 1 presents the hypothesized structural model 1. As observed, the latent variable cognitive ability, study habits, and psycho-sociological factors have direct effects to mathematics performance with 0.21, 0.01, and 0.39, respectively. The latent variables - Cognitive Ability, Study Habits, and Psycho-sociological Factors also exhibit positive correlation to each other at some degree. The model is able to explain only 22% of the contributions of the identified factors to the college mathematics performance.

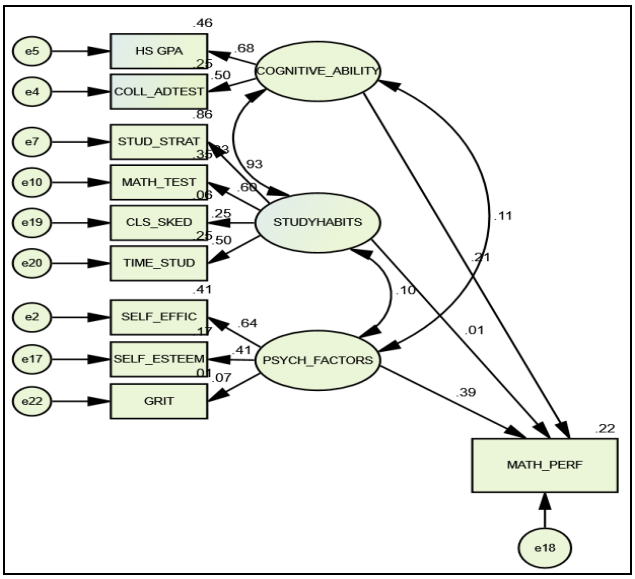

Figure 1. Hypothesized Structural Model 1

Table 6 presents the results of the fit indices of the hypothesized model 1 compared to the recommended critical values. The Minimum Discrepancy divided by its Degrees of Freedom (CMIN/DF) is 2.228; the p - value is 0.000; the Goodness of Fit Index (GFI) is 0.955; the Comparative Fit Index (CFI) is 0.877; the Tucker Lewis Index (TLI) is 0.816; the Normed Fit Index (NFI) is 0.806; and the Root Mean Square Error of Approximation (RMSEA) is 0.067. All, except the Goodness of Fit Index (GFI), failed to satisfy the recommended critical values.

Table 6. Fit Indices of the Structural Model 1

Index	Critical Values	Results	Remarks
CMIN/DF	< 2	2.228	Failed
P – value	> 0.05	0.000	Failed
GFI	> 0.95	0.955	Satisfied
CFI	> 0.95	0.877	Failed
TLI	> 0.95	0.816	Failed
NFI	> 0.95	0.806	Failed
RMSEA	< 0.05	0.067	Failed

Hence, hypothesized structural model 1 is not the best fit model of college mathematics performance. Modification of the model 1 resulted in the following structural model 2:

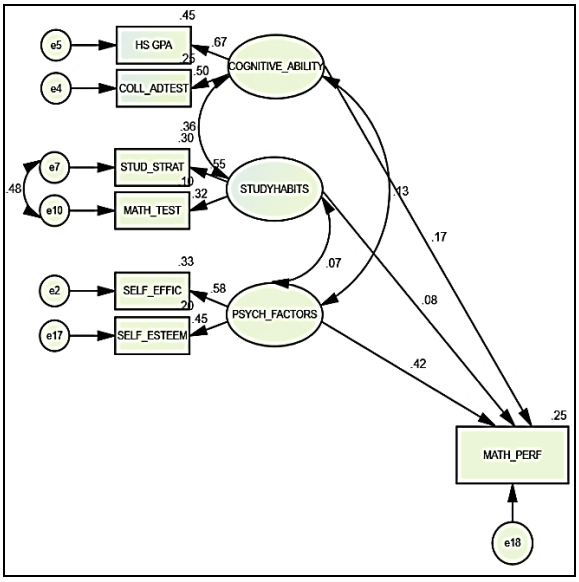

Figure 2. Hypothesized Structural Model 2

Figure 2 shows the hypothesized structural model 2. Compared to model 1, there is an increase in the R^2 value in the model from 0.22 to 0.25. It means that 25% of the college mathematics performance of the BSED students could be estimated by cognitive ability (high school GPA and college admission test CAT), psycho-sociological factors (self-esteem and self-efficacy), and study habits (study strategies and math test strategies). The model reported a positive low correlation of 0.36 between the Cognitive Ability and Study Habits. Positive Negligible correlations are also noted between Study Habits and Psycho-sociological factors as well as in Cognitive Ability and Psycho-sociological factors with 0.07 and 0.13 correlation estimates, respectively.

The three latent variables have positive direct effects to the endogenous variable – college mathematics performance. The cognitive ability has a total direct effects of 0.17, the study habits has a total direct effects of 0.08, and the psycho-sociological factors has total direct effects of 0.42. It means that when these

exogenous variables go up by 1 standard deviation, college mathematics performance will also goes up by 0.17, 0.08, and 0.42 standard deviations, respectively.

Further, the values of the fit indices of the hypothesized structural model 2 are shown in Table 7.

Table 7. Fit Indices of the Structural Model 2

Index	Critical Values	Results	Remarks
CMIN/DF	< 2	1.035	Satisfied
p – value	> 0.05	0.409	Satisfied
GFI	> 0.95	0.991	Satisfied
CFI	> 0.95	0.998	Satisfied
TLI	> 0.95	0.996	Satisfied
NFI	> 0.95	0.955	Satisfied
RMSEA	< 0.05	0.011	Satisfied

Table 7 presents the fit indices of the hypothesized structural model 2. The Minimum Discrepancy divided by its Degrees of Freedom (CMIN/DF) is 1.035; the p - value is 0.409; the Goodness of Fit Index (GFI) is 0.991; the Comparative Fit Index (CFI) is 0.998; the Tucker Lewis Index (TLI) is 0. 996; the Normed Fit Index (NFI) is 0. 955; and the Root Mean Square Error of Approximation (RMSEA) is 0.011. All of the recommended critical values of the indices are satisfactorily met. Hence, the hypothesized structural model 2 is the best fit for modeling college mathematics performance in terms of cognitive ability, psycho-sociological characteristics, and study habits of the BSED students.

CONCLUSION AND RECOMMENDATION

Mathematics performance of students got the attention of the educators for several decades now. Establishing an efficient teaching and learning system becomes a challenge among colleges and universities. A lot of researchers attempted to predict mathematics performance. It is generally believed that students' performance is influenced by a lot of factors. Identifying which of the several factors are significant is one of the key steps. The results of this study contribute to the body of knowledge in mathematics education by acknowledging the variables which have significant effects to college mathematics performance.

Cognitive ability, specifically high school GPA and college admission test, contribute greatly to the students' mathematics performance. It suggests that the elementary and secondary mathematics education is of great importance when entering college. It would be nice if the training for cognitive factors starts at the early level of education. The College administration should also strengthen the Admission Test that measures cognitive ability of the students and enhance the admission and retention policies to ensure quality performance of the graduates.

There are a lot of psycho-sociological factors which are believed to have influenced mathematics performance. In this study, two factors significantly arise. These are the self-esteem and self-efficacy. Self-esteem boosts their confidence and self-efficacy enhances their learning ability. Further, in this study, "study habits" shows a direct effect to the mathematics performance. Specifically, "study strategies" and "math test strategies" have significant effects. These two constructs are also moderately correlated to each other.

The school shall ensure good learning climate by establishing adequate student support facilities and providing various instructional materials to give students a variety of learning experiences which may boosts their psycho-sociological attributes. Mathematics Instructors are also encouraged to consider students' psycho-sociological backgrounds in choosing instructional strategies to foster meaningful

learning experiences. Also, to help students establish their own system of studying and test – taking.

The best fit structural model is able to explain 25% of the contributions of the identified factors to the college mathematics performance. It suggests that there are still other factors that have significant effect to the mathematics performance that are not considered in this study. This proposed for more exploration of the model in the future. Further research is recommended to include other factors to generate a more holistic structural equation model to the college mathematics performance of the students.

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