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College Students' Motivational Strategies, Study Skills, and Mathematics Performance: A Structural Model

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Abstract

Student's academic performance occupies an important place in education and the learning process. This study aims to determine and test the assumption that learning approaches, such as motivation and study skills, affect math academic performance (GPA). Utilizing a descriptive-correlational and structural equation modeling or SEM (initial and modified) were used to clarify the interrelationships of these variables and their relative contributions to math academic performance. The sample consists of 703 respondents. Motivated Strategies for Learning Questionnaire (MSLQ) and Study Skills Assessment Questionnaire (SSAQ) were adapted and used as instruments. The data were analyzed using SPSS 26 and Amos 23. The respondents' motivation beliefs were high in all components: value, expectancy, affective. Similarly, their study skills were also high in all six domains: time management and procrastination, concentration and memory, study-aids and notetaking, test strategies and test anxiety, organizing and processing information, motivation and attitude. The created model shows the influence of motivation and study skills on GPA, which has an explanatory power of 39%. Both motivation and study skills were positively correlated to math performance. Students' motivation directly affects math performance, while study skills have an indirect effect on it. Motivation mediates the effects of study skills on academic achievement. Connecting study skills to motivation could stimulate behaviors that are more likely to contribute toward students meeting their academic goals. When motivation and study skills are improved, the higher the GPA they will achieve. Implications for practice and recommendations for action relative to the improvement of student performance is recommended.

Keywords: Motivation and study skills, math performance, development education, descriptive-correlational, Cebu Philippines.

1. INTRODUCTION

Academic literature and the mass media are often illustrated with problems concerning student achievement, so educators must be informed and study the variables relating to student academic performance (Bakar et al., 2010). Academic performance has become an essential topic for educational stakeholders, particularly for students who are direct beneficiaries of the results. The value of commitment and involvement in studying mathematics has contributed to several research studies on factors correlated with motivation and successful study skills (Gettinger & Seibert, 2002). Therefore, solutions to the problems affecting students' performances have received unprecedented interest from the populace.

Researchers have come up with more questions than answers while investigating what really influences the learners' academic performance. Previous literature showed that learning

outcomes (academic performance and academic achievement) were assessed based on factors such as motivation, school, family, community, etc. (e.g., Aremu & Sokan, 2003; Mushtaq & Khan, 2012). Vahedi & Nikdel (2011) noted that many previous studies focused on academic performance impacts on socio-psychological and demographic variables. Some of these variables were strongly connected to student academic performance, while others argued that the combination of the different factors might contribute to the students' academic performance (Kim et al., 2010).

Credc and Kuncel's (2008) meta-analysis found that the increased variance in academic performance outside of standard testing and previous grades was due to non-cognitive factors such as study skills, study habits, motivation, and other factors. As students are central to the learning process, a survey tailored to their motivations, study skills, and factors that prevent learning is vital. Students play a crucial role in changing their learning and gaining enhanced academic performance. Studies have shown that motivation and learning approaches enhance student success (Moenikia & Zahed-Babelan, 2010; Bulent et al., 2015).

Recognizing that motivation and study skills affect students' educational processes requires finding ways to characterize these variables. The characterization, understood as determining the distinctive characteristics of a specific population's motivation and study skills, provides information for both teachers and students (Echeverry et al., 2016). It provides starting points for the teacher to propose educational interventions to motivate and enhance the student's skill set (Credé & Kuncel, 2008). It also provides information for assessing the motivational and cognitive effect of such actions, allows students to self-test their methods of motivation and learning skills, and provides feedback to identify strengths and weaknesses that can be used to help scaffold their learning. This self-testing process will enable students to adjust their idea of why to learn and how to study (Echeverry et al., 2016). This will also help pave the groundwork for implementing instructional training systems as implications of mixed curriculum approaches and help students develop effective coping techniques and learning skills.

2. RESEARCH OBJECTIVES

This study created and tested the theoretical model of the influence of motivational strategies and study skills on mathematics performance and determine the relationship of these variables and their proportion to explain the math performance of the college students of Cebu Technological University during the school year 2020 – 2021 as the basis for crafting a development plan.

Specifically, this study sought to answer the following:

1. What is the demographics of the respondents as to:

1.1. gender;

1.2. age;

1.3. course; and

1.4. economic status.

2. What is the students' extent of perception as to the following:

2.1. Motivation;

2.1.1. Value components;

2.1.2. Expectancy components;

2.1.3. Affective component;

2.2. Study skills;

2.2.1. Time management and procrastination;

2.2.2. Concentration and memory;

2.2.3. Study aids and note-taking;

2.2.4. Test strategies and test anxiety;

2.2.5. Organizing and processing information; and

2.2.6. Motivation and attitude

3. What is the respondents' level of mathematics performance based on GPA?

4. What structural model can be created reflecting the influence of motivation and study skills on mathematics performance?

3. REVIEW OF RELATED LITERATURE

Academic performance is the fundamental criterion used to measure students' achievement, making it essential to consider the variables that evaluate, forecast, mediate, and trigger variability (Ahmed & Bruinsma, 2006). Researchers in developmental and educational psychology believe that motivation and study skills are necessary for learning (Mundia & Metussin, 2019). Without enough motivation, it is unlikely that satisfactory learning and study abilities will take place (Gettinger & Seibert, 2002; Bulent et al., 2015). Motivation, study skills, and their effects on student academic performance are essential components of effective learning.

3.1 Relationship of Motivation and Mathematics Performance

Motivation explains variance in academic performance. It is the reason how an individual behaves in a given situation. A common educational issue is student engagement and their ability to excel (Bramlett et al., 2002). The researchers have described motivation contributes to academic success (Steinmayr & Spinath, 2009; Kriegbaum et al., 2015). The drive to accomplish something of significance or quality is inspired by one's attempts to fulfill expectations of excellence (Tan et al., 2003). Motivation is simply defined by the summary of internal and external factors affecting learning behavior, efforts, and curiosity (Ryan & Deci, 2000).

Everyone has a desire to achieve and a fear of failure, but these needs differ from one person to another and from one situation to another. Each student acts differently depending on the motivation levels. Many students may suffer mistakes fairly frequently, while others may be successful often. Longitudinal studies found that initial disparities in the progress of students in mathematics may have enduring implications for their subsequent motivation and successes in mathematics (Gottfried et al., 2013). This is likely because students with varying degrees of mathematical achievement will have entirely different motivational experiences. For instance, Hampton and Mason (2003) indicate that students with intellectual disabilities become less likely to gain academic success and more likely to receive negative feedback, receive less social support, and have higher anxiety levels than their normally performing peers.

Research indicates that encouraging students to participate actively in school can be a significant challenge for parents and educators to avoid academic failure (Wood, 2001). Low-performing students were reported to feel that their motivation is generally not very high (Cynthia Hynd, 2000). Such students lacking sufficient academic motivation show a poor drive toward the educational goal. These symptoms and signs of indifference and apathy towards school are evident.

The motivation's effect on a student's education in mathematics cannot be undermined. This should be seen as a predisposition to mathematics unfavorably or beneficially. By accepting this view, an individual could be seen as motivated politically, socially, and academically by the motive behind his work. Students' self-perceptions of a subject's worth and their personal motivations toward academic success in that subject make a difference when it comes to their educational outcomes.

Other studies found that high student interest or motivation in the area of mathematics generates high test scores and student achievement in diverse settings (Steinmayr & Spinath, 2009; Ahmed & Bruinsma, 2006). Cleary and Chen (2009) conducted a survey in the Northeast United States of 880 suburban middle school students and found a strong link between student engagement, motivation, and mathematics achievement. Singh et al. (2002) claimed perceptions of student mathematics and student motivation had direct effects on the mathematics achievement of students in eighth

grade. Students in middle school displayed greater motivation and accomplishment as they felt their intellect could be influenced by their commitment than those who thought their intellect could not alter.

Furthermore, research has also demonstrated that there is a positive relationship between mathematical attitudes and mathematical achievements (Thomas, 2006; Saha, 2007). In Kadijevich's (2008) study, which used a sample of 33 countries in the eighth grade of TIMSS 2003, every mathematical attitude alone has had a positive connection to mathematical performance in nearly all 33 states. Within the TIMSS evaluation, Mullis et al. (2000) found that students with positive mathematical attitudes are more likely to do well. Therefore, Orhan Özen (2017) believes students need to be inspired to encourage and maintain their interest in learning mathematics.

Motivation and academic performance have a dynamic relationship (Steinmayr & Spinath, 2009). Far more than anything else, individuals need a reliable, enduring motivation to learn and to be well prepared for lifelong learning. There is a general consensus that a distinct desire to learn improves academic performance among all students (Schick & Phillipson, 2009). Motivation, therefore, seems to contribute significantly to the variation in academic performance. Educators must have a good understanding of the empowering characteristics of their students' motivation in schools.

Motivation and achievement were the topics of many studies; however, fewer studies centered on the motivation and mathematic achievement of college students at the undergraduate level. The variations in these students' learning experiences can lead to differences in motivation and achievement. A specific variable, such as motivation, could be more important for one group of students, or perhaps there is no difference in the importance of the specific variable (e.g., there might be a positive relationship between task value and achievement in high-achieving students, but a negatively associated relationship between task value and self-efficacy in low achievers).

3.2 Relationship of Study Skills and Mathematics Performance

Study skills are learning approaches. These are vital for academic achievement, to get good grades, and important for lifelong learning. The understanding and application of effective study skills are linked to academic competence (Gettinger & Seibert, 2002; Bulent et al., 2015). According to Credé & Kuncel (2008), study skills refer to effective time management, study strategies, techniques, and other resources to achieve academic success. They added that these competencies promote success in both academic and non-academic settings (e.g., employment). Garner-O'Neale & Harrison (2013) considered that the learner's continuous practicing or repetition of study skills would develop good study habits over time.

Study skills can be developed with the use of tactics and techniques. Students that have the capacity to use study strategies and can recognize them in a versatile manner are more successful than students who are limited in their abilities and are incapable of using the study strategies correctly (Meneghetti et al., 2007). Thus, students must begin developing their study skills and study strategies at an early age to increase their academic performance at middle school and prepare them to become more autonomous and competent students in high schools and eventually as they reach college.

Offering this in university allows students who are in a very fragile period in college to develop their cognitive skills (Commander & Valeri-Gold, 2003). The strategies taught incorporate not only study aids but also learning ways such as time management, concentration, memorization, test-taking, mind-mapping, note-taking, and comprehension. For young students going through high school, this course will help them transition from high school into college and offers tips for college success but has no particular emphasis on math.

College success is partly dependent on effective study skills and learning styles (Sedlacek, 2005). Nolting (2002) found that the

lack of study skills in previous math courses is a reason for a student's difficulty with math. The majority of students do not have adequate study methods because they do not put time aside for study, nor do they create study plans. Shearn and Wilding (2000) reported similar findings, hypothesizing that students may not have had the necessary math skills to be successful.

Hassanbeigi et al. (2011), in their analysis of the relationship between different study skills and academic achievement of college students, found that students with higher GPAs had statistically higher scores on all seven skills (time management and procrastination, concentration and memory, study aids and note-taking, test strategies and test anxiety, organizing and processing information, motivation, and attitude, and reading and selecting the main idea). Therefore, student study skills influence their GPA.

Rezaie Looyeh et al. (2017) looked at a range of study habits in various medical universities in Iran. It revealed that 32% of the students who participated in their research suffered from a serious lack of study skills and behaviors. Indeed, many studies have found that increased study skills lead to better academic performance (Mohammadi et al., 2017; Triyogo & Syaprizal, 2019). However, in Rahim & Meon (2012) and Lawrence (2014) studies, no meaningful relationship was found between these two variables.

Independent research of second-and third-year undergraduates at one of the universities in Hong Kong also found that study skills are a good predictor of academic performance (Yip, 2007). The growth of intellectual activity is enhanced by the proper study of skills. This suggests that students need a better variety of study skills to complete their schoolwork successfully. In this grade, they would be required to develop useful skills they could use later in school. It works with an investigation by Simmons (2006). Many students at colleges have a lack of confidence about being able to study effectively.

Therefore, these results indicate that students need to develop a more critical approach to learning to maximize their personal learning potential. Furthermore, research has shown that academic success will increase in higher education institutions by concentrating on certain types of interventions aimed at learning strategies, studying skills, and studying behaviors such as time management, taking class notes, using information resources, preparing for and taking exams, and communicating with teachers (Ap et al., 2009).

Ezeala & Siyanga (2015), a study of 67 participants from both programs, regular and parallel, concluded that students had moderate to good study skills. The students in the parallel program have prior work experience. This allows them to manage their time better and work effectively. Students of regular programs must complete more intense training to improve their time management and writing skills. The findings differed from those that were found in Didarloo and Khalkhali's study (2014), which could have been due to other factors. The results show that students from the Medical Sciences University Urmia do not have favorable study skills, with many scoring poorly on critical aspects of academic performance. This study found the same results as others.

Malek & B's (2009) study showed that university student's study habits were sub-optimal. In light of the Hosseini et al. study, the organization's importance is highlighted. Enhancing the effectiveness of college students' educational programs requires the design and implementation of study skills in the classroom. Those in the education field of universities should take this information into consideration.

One reason for students' failure is the lack of learning and study skills (Meneghetti et al., 2007). They tend to be passive learners and depend on others to teach them. Bulent et al. (2015) suggest that combining study skills and other factors may clarify students' academic performance in any course of study. It is believed that their grades would improve when students in the school setting study hard. It is acknowledged that the students' study behavior

ultimately results in the desired performance, such as school grades.

If students do not employ effective strategies, they need a long time to study and hard and still do not do well. Students require appropriate methods to effectively research resources. In this context, study skills have an important role to play in achieving efficient and effective strategies. Students with good study skills can quickly identify and implement successful strategies, and vice versa. On top of that, academic success is much more about hard work than talent. The students need to commit the time to be successful. Time and hard work alone do not make one succeed. To get an efficient and effective study, the students need to know, understand, and improve their study skills. The study skills are of utmost importance to student learning.

While studying skills are important for college success, the way students learn in the 21st century in a world that offers more interactive tools and pedagogical approaches is not yet given much attention (Shetty & Srinivasan, 2014). There are many different ways to study, but not all methods may enhance learning (Gurung, 2005). Considering the importance of study skills and their study strategies, and the important role they play in students' math performance, taking into account that learning methods vary from person to person and from place to place.

There is a great deal of information on mathematics and study skills, but minimal literature addresses the relationship between study skills and mathematics achievement. The present study will establish the link between learning and particular study strategies. This study sought to examine the relationship between university students' study skills and math performance.

3.3 Relationship of Motivation and Study Skills

Academicians are in question of what individual beliefs, behaviors, and personal attributes contribute most positively to the academic performance of students. Griffin et al. (2012) found that the student's motivation level is one of the most critical determinants of superior academic performance between learning and study skills. However, there is still uncertainty regarding common values and attitudes that inspire high-performing students. Duncan & McKeachie (2005) studied learning strategies, motivation for achievement, personality features, and other intrinsic factors related to successful first-year academic performance. Kim et al. (2010) expanded their research into motivational aspects such as time management, competitiveness, participation in extracurricular activities, and stress management. Ridgell and Lounsbury (2004) examined the implications for emotional intelligence in academic research. Kanfer et al. (2010) examined 25 personality measurements and motivational characteristics such as awareness, willingness to learn, goal orientation, and critical thinking. All of the above are either motivational elements or have motivational implications.

Credé and Kuncel (2008) found through their research that, aside from cognitive factors such as test scores and grades, non-cognitive factors such as study habits, study skills, and motivation also impact achievement in school. The factors that inhibit poor academic performance among university graduates were reviewed by Nuthana & Yenage (2009). Some of these factors are intellectual capacities, poor study habits, limited achievement, lack of vocational objectives, poor socioeconomic status in family structure, and so on. A combination of study skills, study attitude, and study method culminates in the concept of study habits. A negative attitude towards the study contributes to less academic achievement and lower study habits. Students who succeed have positive attitudes towards learning and persistently continue studying (Anwar, 2013).

When doing study skills work, it may increase students' interest because they spend more time doing that stuff. Thus, a studying strategy may not directly result from wanting to learn the strategy, but rather the time spent processing the information (Gettinger & Siebert, 2002). Although both study skills and engagement seem to work together, the current results remain inconclusive. Academic competence is intimately connected to enablers. Study skills

contribute to a learner's level of engagement. Engagement can only be improved through the value of the study.

According to Dörnyei (2001), motivation explains why we decide to do something, how much we can do it, and how long we can continue or sustain the activity. Motivation is what drives a person, keeps him going, and where he is going. Alderman & Corporation (2004) suggests that students with high motivation have an advantage as they have proactive behaviors and techniques, such as retaining intrinsic value, establishing objectives, and self-monitoring. Students who are motivated to learn more actively regulate their learning and take visible delight in accomplishing their work, using a variety of strategies.

In addition to the above, Hassanbeigi et al. (2011) explained that many factors affect study orientation, which is expressive of study skills and students' attitudes. As far as research goes, individual difference issues, effective time use, note-taking, study habits preparation, classroom environment, homework, family, proper study time, and library use become some of the common factors. On the other hand, interest, motivation, and will are fundamental determinants of the study's skills and attitudes. It is revealed that when undertaking an assignment, students with internal controls do not need to be tested too often, but students with external factors such as teachers or parent support need to be directed and encouraged to take part in school too often (Ozsoy, 2009).

It cannot be denied that many students are weak in academic performance because of other factors other than low intellectual capacity. Each student's success or failure depends on his or her study practices and their level of motivation. Some students learn more but do not get more, while others learn less and do better. Every student's success depends on skill, intelligence, and effort. Study patterns are designed to enhance and direct cognitive functions through study. Habits of study are influenced by behavior, personality characteristics, and expectations, methods of instruction, and materials.

Üredi and Üredi (2005) examined the relationship between motivational beliefs and learning strategies and students' mathematics achievement. The authors' adapted version of MSLQ was administered to 515 students in a primary school in Istanbul. The study showed that math students who used cognitive strategies had higher mathematics achievement. Self-regulatory strategies, self-efficacy, and intrinsic value also were stronger in boys than in girls.

According to Logan, Medford & Hughes (2011), learning strategies have been empirically shown to be a mediating factor in the relationship between motivation and learning success for topics like psychology, reading, and mathematics. This workgroup primarily promotes the presence of predictive connections between 1) motivational mechanisms and the use of learning strategies and 2) learning strategies and performance. However, Logan et al. (2011) only pointed to indirect links between motivation and achievement (using cognitive strategies), and no further variance in performance prediction was explained by motivation. In another study of Gbollie and Keamu (2017), they found out motivation have been empirically shown to play a mediating role in the relationship between study skills strategies and academic performance, indicating how vital motivation is to the kind of strategies used by learners and motivation is served as a bridge between study strategies and performance.

Hence, an intellectual measurement of how a student performs depends heavily on how he or she studies. A student's interest in the learning process not only comes through their engagement but also for achieving sound academic outcomes (Bakar et al., 2010). It is critical because genuine commitment during college life will contribute to higher academic performance (Zyngier, 2008). Previous research (Chemers et al., 2001; Senko & Harackiewicz, 2005) showed that the students' achievement goals, their participation in the

courses, and their performance standards were linked favorably to their final course grade.

To ensure that students and educators are not slipping into the same collection of problems, it is essential to investigate students' study skills and motivation. To this end, this study will analyze the specific aspects of motivation and study techniques that could be quantitatively correlated with success in the classroom.

4. METHODOLOGY

4.1 Research Design

A descriptive-correlational design was used to evaluate the level of motivational strategies and study skills and to identify the relationship between these variables and the math academic performance of college students through the use of survey questionnaires. Documentary analysis was employed for the gathering of the mathematics grade point average (GPA).

4.2 Respondents

Respondents were seven hundred three (N=703) respondents who were enrolled in various programs at Cebu Technological University's campuses. Since English is the language of instruction, the scales used are in English. The students are native speakers of Cebuano but are conversant in English, ranging from intermediate to advanced.

The respondents comprised mixed groups classified according to their program of studies, viz-a-viz the BSEd with 56 (8%), respondents BEEd with 162 (23%) respondents, BTLEd with 27 (15.5%) respondents (15.5%), BSHM with 109 (35.8%) respondents, BIT with 252 respondents (6.5%), BSIE with 46 (7.3%) respondents, and BSFi with 51 (3.8%) respondents.

4.3 Instrument

Data were collected using a three-part questionnaire. The first part is concerned with the respondent's demographic background, such as gender, age, economic status, course, and high school GPA.

The second part of the questionnaire is an adapted questionnaire, the Motivated Strategies for Learning Questionnaire (MSLQ) of Pintrich et al. (1991). In this study, only the section on motivation was utilized. The motivation scales are based on a general social-cognitive model of motivation that proposes three general motivational constructs: value, expectancy, and affect. The motivation section consists of 31 items that assess students' goals and value beliefs for a course, their beliefs about their ability to succeed in the course, and their anxiety about tests on the course. In the original form of the MSLQ questionnaire, all 81 items were scored on a 7- point Likert scale, from 1 (not at all true of me) to 7 (very true of me). More recently, a 5-point Likert scale has been used for most work with the MSLQ test. All the items in this study were scored on a 5-point scale: 1 (Never) to 5 (Always). The questionnaire possesses the required validity and reliability for adaptation and use by researchers, teachers, and students (Duncan & McKeachie, 2005). For this research, a reliability test was employed using Cronbach alpha analysis to determine the instrument's internal consistency. The results of the reliability turned out to be reliable for all three subscales that were used. The alpha score for value is α = 0.896; expectancy is α = 0.898; affective is α = 0.825.

Third and last part of the questionnaire is an adapted questionnaire, which is the Study Skills Assessment Questionnaire (SSAQ) developed by the Houston University Counselling Services will be used to collect data on study skills. This questionnaire consists of 6 subscales, including time management and procrastination, concentration and memory, study aids and note-taking, test strategies and test anxiety, organizing and processing information, and motivation and attitude. Each section of the questionnaire includes eight items concerning the number of study skills used by the subjects. All items on the questionnaire are scored on a 5-point Likert scale: 1 (Never) to 5 (Always). A reliability test using Cronbach alpha analysis to determine the internal consistency of the instrument. The results of the reliability turned out to be reliable

for all six subscales that were used. The alpha score for time management and procrastination is α = 0.860; concentration and memory is α = 0.853; study aids and note-taking is α = 0.861; test strategies and test anxiety is α = 0.866; organizing and processing information is α = 0.902; motivation and attitude is α = 0.858.

4.4 Statistical Treatment

Data on demographics and the determination of the motivation and study skills' perception levels were analyzed using IBM SPSS version 26. To draw up a comprehensive model for their level of motivation, study skills, and math academic performance based on their GPA, structural equation modeling (SEM) using IBM Amos version 23 was employed to determine if studied variables can influence students' college academic performance. To assess the overall model fit, the researcher used the indices most often advised in the SEM literature (Sanchez, 2006; Hooper et al., 2007).

4.5 Ethical Considerations

This study sought approval from the University Research Ethics Committee (UREC) of the Cebu Technological University. Voluntary participation was assured. Informed consent letter was obtained from all respondents. Subjects were ensured that the data collected are confidential and anonymous and that the researcher will only use it for the present study.

5. RESULTS AND DICUSSION

5.1 Respondents' Perception Level of Motivation and Study Skills

The motivation and study skills level of students' extent of perceptions is summarized in Table 1. The final numerical ratings and descriptions are provided in the table.

Table 1. *Summary table of students' extent of perceptions*

Components	Mean	Description
Motivation		
Value	4.07	High
Intrinsic Goal Orientation	3.89	High
Extrinsic Goal Orientation	4.05	High
Task Value	4.21	Very High
Expectancy	3.73	High
Control of Learning Beliefs	3.89	High
Self-efficacy	3.65	High
Affective	3.55	High
Test Anxiety	3.55	High
Overall Mean	**3.67**	**High**
Study Skills		
Time Management and Procrastination	3.62	High
Concentration and Memory	3.55	High
Study Aids and Note-Taking	3.71	High
Test Strategies and Test Anxiety	3.79	High
Organizing and Processing Information	3.65	High
Motivation and Attitude	3.80	High
Overall Mean	**3.68**	**High**

Legend:

4.20 – 5.00 Very High 1.80 – 2.59 Low

3.50 – 4.19 High 1.00 – 1.79 Very Low

2.60 – 3.49 Fair

The mean score for each subscale for the motivational scale ranges from 3.55 to 4.21 and has an overall mean of 3.67, which shows a high positive motivational belief. The mean value of 4.21 for the task value subscale under the motivational components has the highest mean score with very high as the description, which means the students may perceive that the content of the courses is important to their success in a course. Moreover, the results show

that students have high positive motivational beliefs since their mean scores are high for intrinsic goal orientation (3.89), extrinsic goal orientation (4.05), control beliefs for learning (3.89), and self-efficacy (3.65). Additionally, the test anxiety (3.55) was high in the analysis. Adepoju (2008) found that students who lack a sufficient drive to attain academic goals are less motivated. These students are indifferent to school and apathetic towards learning. If students are motivated and have strong academic goals, even a small accomplishment will be meaningful. If a student has her own goal of wanting to pass a course, she does not feel targeted by getting an average grade of 50 percent. A student who is determined to earn a distinction is likely to feel distressed when they receive a mark below this average (Hardré & Reeve, 2003).

On the other hand, each subscale's mean score for the study skills ranged from 3.55 to 3.71 and with an overall mean of 3.68, which shows a high level of study skills. The results reveal that students have a high level of study skills since their mean scores are high for time management and procrastination (3.62), concentration and memory (3.55), study aids and note-taking (3.71), test strategies and test anxiety (3.79), organizing and processing information (3.65), and motivation and attitude (3.80). The results of this study demonstrated that students who use effective study skills benefit from them. In order for students to succeed in their studies, they must be able to properly process course content, absorb it, contemplate it, and articulate the information. The most important characteristic for students is to learn effective study skills. The earlier students start practicing and developing good study habits, the more likely they will continue developing good study skills. Educators must teach their students' study skills so that learning will be more effective and better impact the student's academic performance (Hassanbeigi et al., 2011).

5.2 Respondents' Level of Mathematics Performance Based on Grade Point Average (GPA)

The scholastic performance of learners is generally represented with numerical ratings as bases in determining their levels of achievement. GPA is an average of grades assigned for a term, a content area, a year-level, or cumulated over an entire college career. Table 2 sets out the frequency and percentile distribution of the respondents according to the level of math performance based on their given GPA.

Table 2. *Demographic profile based on GPA*

GPA	Description	Frequency	Percentage
1.00 – 1.59	Superior	86	12.2
1.60 – 2.09	Very Good	356	50.6
2.10 – 2.59	Good	236	33.6
2.60 – 3.00	Fair	25	3.6
3.01 – 5.00	Failure	0	0
Total		**703**	**100.0**
Average		**1.97**	
Description		**Very Good**	

Table 2 shows that the majority, 356 or 50.6%, of the respondents' math performance, falls between very good and 236 or 33.6%, under the good category, which consists of grade range from 2.10 to 2.59. The passing level of 2.6 to 3.00 is only 3.6% or 25 out of the 703 respondents. Although there were only 86 or 12.2% who marked superior, the number of respondents whose performances failed do not exist among them. In general, the math academic performances of the majority of the respondents sampled in the study were either very good (1.60 – 2.09) or good (2.10 – 2.59). The average grade for this group of respondents is 1.97, with a description of very good. Nevertheless, they are able to comply with the minimum requirements of the programs of the university, capable of getting at least an average of 80 but not high enough to qualify them for the excellence or superior list.

Several studies have demonstrated that a student's performance in past grades has strong predictive power regarding how the student will do later on (Gettinger & Seibert, 2002; Credé & Kuncel, 2008). Factors such as student achievement, motivation, intelligence, ability, behavior, and effort all significantly impact a student's grade (Randall & Engelhard, 2010). While the GPA at one college or

university may not be directly comparable to that in another, the factors that drive students' GPAs are expected to be common. Therefore, the way a college or university operates mathematics may affect a student's resulting GPA. The exact timing, nature, and duration of the math curriculum are left to the school or university's discretion, so long as they follow the state's curriculum requirements. At any level of education, one's cumulative GPA and GPA at the time of graduation have important implications for a person's overall academic performance.

5.3 Relationship Among Variables Based on The Formulated Structural Model

This section presents the interrelationships of variables and determines which variables significantly affect math academic achievement using structural equation modeling.

5.3.1 Initial Model

The initial Model, as shown in Figure 4, shows the relationships between the indicators of each of the latent variables, the motivation (Mot) and study skills (SS). Such latent variables are considered exogenous variables that are viewed as predictors of the endogenous variable, the mathematics performance, based on students' GPA. As such, the Model evaluates how study skills (SS) and motivation (Mot) predict students' mathematics performance based on GPA. Since it is not assumed that these predictor variables are the only factors of mathematics performance, e13 is included as residual to show those not explained by the Model.

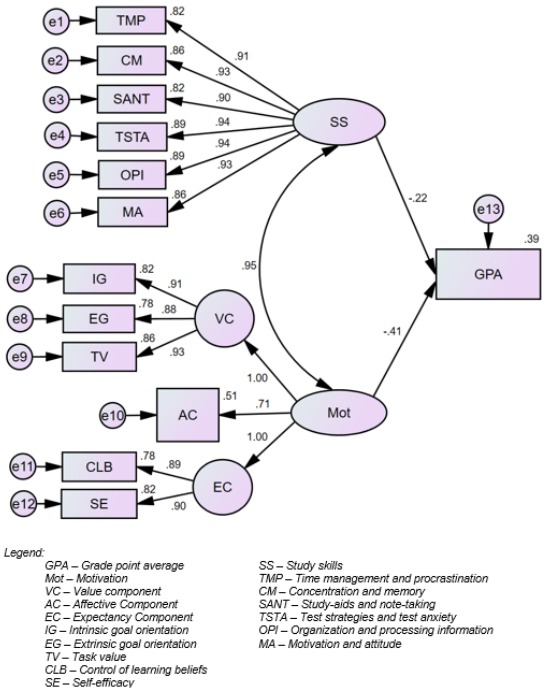


Figure 1. Initial model

As reflected from the Model, the study skills (SS) of students are significantly ($p<0.05$) measured in terms of the six observed variables, TMP, CM, SANT, TSTA, OPI, and MA. Another latent variable, motivation (Mot), is also significantly predicted by its elements: value components (VC) measured by three observed variables, IG, EG, and TV; affective component (AC), and expectancy components (EC) determined by two observed variables, CLB and SE. As seen from the Model, all the observed variables obtained standardized loadings greater than the required value of 0.5, implying that their respective latent construct significantly represents each observed variable.

Table 3. *Initial model regression weights*

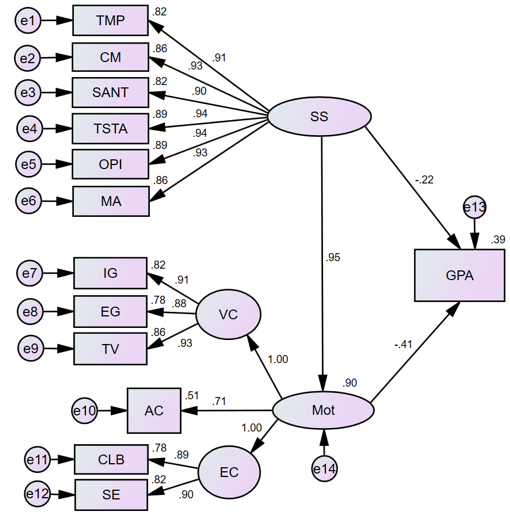
	Parameter	Unstandardized B	S.E.	Standardized B	P	Interpretation
VC	<--- Mot	1.094	0.045	1.000	***	Significant
EC	<--- Mot	1.111	0.046	1.000	***	Significant
OPI	<--- SS	1.000		0.941	***	Significant
TSTA	<--- SS	0.999	0.019	0.942	***	Significant
SANT	<--- SS	1.017	0.023	0.904	***	Significant
CM	<--- SS	0.990	0.020	0.929	***	Significant
TMP	<--- SS	0.972	0.022	0.907	***	Significant
MA	<--- SS	0.996	0.021	0.929	***	Significant
TV	<--- VC	1.000		0.926	***	Significant
EG	<--- VC	1.149	0.030	0.885	***	Significant

	Parameter	Unstandardized B	S.E.	Standardized B	P	Interpretation
IG	<--- VC	0.986	0.024	0.906	***	Significant
SE	<--- EC	1.000		0.905	***	Significant
CLB	<--- EC	0.970	0.026	0.886	***	Significant
AC	<--- Mot	1.000		0.714	***	Significant
GPA	<--- SS	-0.122	0.067	-0.220	0.068	Not Significant
GPA	<--- Mot	-0.249	0.074	-0.413	***	Significant

Legend: *** Significant at p≤0.05

Moreover, the Model shows that the two constructs, MS & SS, directly affect the performance, GPA. However, the result, as seen in Table 3, indicated that the path from SS to GPA is not significant (p=0.068), denoting that it has no direct effect on GPA. Nevertheless, it may still affect GPA indirectly through students' motivational strategies. When students have good study skills, this may develop as well their motivation and improve their GPA. This is similar to the findings of Gbollie and Keamu (2017) that motivation has been empirically shown to play a mediating role in the relationship between study skills and academic performance, indicating how vital motivation is to the kind of study skills used by learners. Hence, the initial Model needs to be modified (see Figure 5), adding the indirect effect of SS on GPA.

5.3.3 Modified Model



Legend:
GPA – Grade point average
Mot – Motivation
VC – Value component
AC – Affective Component
EC – Expectancy Component
IG – Intrinsic goal orientation
EG – Extrinsic goal orientation
TV – Task value
CLB – Control of learning beliefs
SE – Self-efficacy
SS – Study skills
TMP – Time management and procrastination
CM – Concentration and memory
SANT – Study-aids and note-taking
TSTA – Test strategies and test anxiety
OPI – Organization and processing information
MA – Motivation and attitude

Figure 2. Modified model

Regarding the modified Model, the outcome variable, GPA, is directly affected by Mot (-0.413) while indirectly affected by SS (-0.392). The explanatory power of the Model is shown on its R-squared value of 0.39. It means that 39% of the variance of mathematics performance based on GPA is accounted for the variance in motivation and study skills. Thus, there are other predictors not included in the Model and are attributed to the residual e13.

5.3.4 Model Fit

Regarding model fit, Table 4 shows the goodness of fit criteria such as the absolute fit measures and incremental fit measures with their corresponding acceptable values. The absolute fit is indicated by the chi-square statistics, the goodness of fit index (GFI), and root mean square error of approximation (RMSEA) (Hooper et al., 2007). Based on such criteria, the initial model did not fit the data well based on the computed chi-square, $X2$ ($N=91$, $df=63$) = 0.00; $p < 0.05$. The obtained RMSEA value of 0.10 signifies a mediocre fit, while GFI shows an acceptable value of 0.89.

Table 4. *Result of model fit evaluation*

Model Fit Indices	Values	Standard Value	Reference
Chi-square (X^2)	0.000	p>0.05	Hooper et al., 2007
Relative Chi-square(x2/df)	0.000	≤ 3.0	Hooper et al., 2007
Root Mean Square Error of Approximation (RMSEA)	0.100	≤ 0.07	Hooper et al., 2007
Goodness of Fit Index (GFI)	0.890	≥ 0.95	Hooper et al., 2007
Normed Fix Index (NFI)	0.953	≥ 0.95 ≥0.90	Sanchez, 2006
Relative Fit Index (RFI)	0.942	≥0.90	Sanchez, 2006
Incremental Fit Index (IFI)	0.958	≥0.90	Sanchez, 2006
Tucker-Lewis Index (TLI)	0.948	≥0.90	Sanchez, 2006
Comparative Fit Index (CFI)	0.958	≥0.90	Sanchez, 2006

Although the Model did not fit well the data based on the absolute measures, the obtained values of baseline comparison indices, as shown in Table 21, range from 0.942 to 0.958, all above 0.90, describing the Model as almost a perfect fit. Such criteria are measured based on the normal fit index (NFI) = 0.953, Tucker-Lewis index (TLI) = 0.948, relative fit index (RFI) = 0.942, incremental fit index (IFI) = 0.958, and comparative fit index (CFI) = 0.958, which measure the fit of the hypothesized Model and the independence model. Given the indices range values from 0.942 to 0.958, the modified Model's possible improvement fit a range from 0.058 to 0.042, which appears of little significance due to minimal values. Hence, with an examination of the model fit indices, the modified Model provides an adequate representation of the data (Sanchez, 2006).

5.4 Correlation of Variables

Table 5 presents the results of the regression weights of the modified model, which describe the linkages between study skills (SS) and motivation (Mot), and their influence on academic achievement, based on GPA.

Table 5. *Modified model regression weights*

Parameter			Unstandardized B	S.E.	Standardized B	P	Interpretation
Mot	<---	SS	0.867	0.037	0.949	***	Significant
VC	<---	Mot	1.094	0.045	1.000	***	Significant
EC	<---	Mot	1.111	0.046	1.000	***	Significant
OPI	<---	SS	1.000		0.941	***	Significant
TSTA	<---	SS	0.999	0.019	0.942	***	Significant
SANT	<---	SS	1.017	0.023	0.904	***	Significant
CM	<---	SS	0.990	0.020	0.929	***	Significant
TMP	<---	SS	0.972	0.022	0.907	***	Significant
MA	<---	SS	0.996	0.021	0.929	***	Significant
TV	<---	VC	1.000		0.926	***	Significant
EG	<---	VC	1.149	0.030	0.885	***	Significant
IG	<---	VC	0.986	0.024	0.906	***	Significant
SE	<---	EC	1.000		0.905	***	Significant
CLB	<---	EC	0.970	0.026	0.886	***	Significant
AC	<---	Mot	1.000		0.714	***	Significant
GPA	<---	Mot	-0.249	0.074	-0.413	***	Significant
GPA	<---	SS	-0.122	0.067	-0.220	0.068	Not Significant

Legend: *** Significant at p≤0.05

Results indicate that all parameters are significant since p-values are all less than 0.05, except for the study skills (SS) with a p-value of 0.068. Moreover, both the motivation (Mot)

and study skills (SS) were negatively correlated to math performance with standardized weights of -0.413 & -0.220, respectively. Such values indicate that students' motivation and study skills are improved, the higher GPA they will achieve. Notably, motivation (Mot) has a higher impact on students' math performance based on their GPA and is significant ($p < 0.05$) between the two parameters.

The direct effect of SS on GPA suggests that SS is not enough to guarantee academic achievement (GPA) since motivation (Mot) is also necessary. This result validates the findings of Rahim & Meon (2013) and Lawrence (2014) that a lack of significant correlation was found between study skills and academic achievement. However, this also contradicts the results of Mohammadi et al. (2017) and Triyogo & Syaprizal (2019) that there was a significant correlation between study skills and academic performance. As assumed in our model, motivation mediates the effects of study skills on academic achievement. In this context, the two constructs are intricately linked to each other, and this relationship can't be separated. Motivation is a bridge, while strategy is what walks across the bridge. Therefore, teachers and school administrators must consider the relationship between study skills and motivation, and appropriate actions must be undertaken to match them. When students' motivation is compromised, it has a detrimental effect on students and their learning outcomes (Gbollie and Keamu, 2017).

Study skills may lead to the degree of motivation of the learner. Still, motivation will only be improved by a learner who believes that studying is valuable to their academic performance (Gbollie and Keamu, 2017). Therefore, weak studying causes low motivation, which is influenced by the effectiveness of study skills. Hassanbeigi et al. (2011) believed having good study skills causes students to be more enthusiastic, not passive, in learning; whereas, students with poor study skills appear to rely on others for learning. Students must have the motivation to learn, recognize, develop a study plan, and be skilled in study skills.

One reason why students may not be interested in math could be related to factors that may influence students' attitudes and feelings toward math (Hannula, 2006). Perhaps students' strategies for learning mathematics will help them become more motivated to study math because they are given insight into the learning process. In other words, this improved development could have an influence that increases motivation and achievement. Connecting study skills to motivation could stimulate behaviors that are more likely to contribute to students meeting their academic goals. That is, those most motivated to succeed will use various study skills to improve their performance.

In particular, motivation appears to play a more important role for students in terms of their academic performance and gleaning from the results in Table 22 that there is a significant relationship ($p < 0.05$) between motivation (Mot) and GPA. This result validates the findings of Robbins et al. (2004) and Griffin et al. (2012). Robbins and colleagues documented moderate to strong positive correlations between motivation and GPA. Griffin and colleagues asserted that what drives superior academic performance is the student’s motivation. These authors concluded that motivation generally affects the GPA. Students with a high level of motivation perform their school work at a much better level.

Motivation can be viewed as a decision-making process as it helps an individual choose the outcomes that will lead to the desired behavior. In order to learn, a variety of approaches can be used. Some focus on cognitive factors such as monitoring and strategy use, while others focus on non-cognitive factors such as perceptions, study skills, beliefs, and attitudes (Lai, 2011).

In college performance, we must consider not only high cognitive ability but also non-cognitive abilities. Cognitive ability is related to academic success; students with high cognitive ability need good study skills and motivation to perform well (Credé & Kuncel, 2008). Considering the importance of academic

achievement and the career of the students, planning, and attention are necessary to improve the level of the students' motivation and study skills.

While it is possible to teach and promote study skills and motivation, asking students to attend educational workshops in these skills' application fields can yield positive effects. Developing educational classes for them, correcting study habits in the early stages of university classes, and conducting interventional programs to educate students to improve their study habits and skills can be effective measures. Effective study strategies and motivation are key factors for learning and remembering information. By knowing the weaknesses and shortcomings of these strategies, improvements can be made, and things will function more effectively.

CONCLUSION

The students have both high motivation beliefs and study skills. However, test anxiety was also high in the analysis. Overcoming test anxiety is one of the recipes for success in helping students achieve and grow in mathematics. By understanding, recognizing, controlling, and coping with their test anxiety, they can go further in mathematics than ever before. On the other hand, the created model shows the influence of motivation and study skills on student's math achievement. Students' motivation directly affects math performance, while study skills have an indirect effect on it. The model explained 39% of the variance of motivation and study skills. Motivation mediates the effects of study skills on academic achievement. Connecting study skills to motivation could stimulate behaviors that are more likely to contribute to students meeting their academic goals. That is, when motivation and study skills are improved, the higher the GPA they will achieve. The teaching of study skills and motivation to university students can play an important role in the improvement of students' academic performance.

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DECLARATION OF CONFLICTING INTERESTS

The authors declared no potential conflicts of interest with respect to the conduct of research, authorship, and or in the publication of this paper.

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