The Mediating Effect of Academic Motivation on the Relationship between Metacognitive Skills, Students Attitudes and Beliefs toward Mathematics

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Abstract: **This study determined the mediating effect of academic motivation on the relationship between metacognitive skills, student attitudes and beliefs toward mathematics in selected colleges, particularly Davao del Norte. The study adopted a quantitative non-experimental correlational descriptive survey design with a sample of 339 first-year college students. Sets of adapted survey questionnaires were used in this study to obtain data from the respondents subjected for content validity and reliability analysis. The data were analyzed using the Mean, Pearson-r, Multiple Regression Analysis, and Medgraph using the Sobel z-test. The results revealed that in first-year college students; levels of academic motivation, metacognitive skills, attitude and beliefs are evident most of the time. Moreover, a significant relationship existed between these variables. The mediation of academic motivation on the relationship between metacognitive skills, students' attitudes and beliefs towards the mathematics of first-year college in a selected institution was proven in the study.**

Keywords**: Academic motivation, metacognitive skills, student attitude towards mathematics, First-year college students, Philippines**

I. INTRODUCTION

In many university courses and topics, including engineering, science, and social sciences, individual skills and attitudes are respected (Can, et al., 2017) because of their importance in many fields in academic, professional, and everyday life. Student attitude and beliefs in mathematics are the most significant factor affecting student achievement levels (Yasar, 2015). Nevertheless, students' negative attitudes and beliefs toward mathematics can influence low performance in mathematics (Samuels, 2014). In Botswana, Saharan Africa, there is the most insufficient measure of attitude and beliefs towards mathematics among all subjects, and this affects the motivation of students to study the issue, as a result, they perform poorly and are becoming worse at the subjects. Students at all levels display a deficient level of interest in mathematics, and mathematics is a terrifying topic to be avoided as far as possible (Nenty, Kgosidialwa, & Moeti, 2016).

Learning mathematics does not only entail thought and reasoning, and it depends on the learners' attitude and beliefs towards learning and mathematics (Kele & Sharma, 2014). The affective aspect of the attitudes and beliefs of students is, therefore, the root of driving student engagement with mathematics. In addition, the affective element is often affected by the idea generated by the 2 cognitive components of attitude and beliefs, which produces a mentality that becomes persistent over time and affects the students' feelings about studying mathematics (Ingram, 2015). The behavioral element of behavior is the ability to respond to learning mathematics (Mensah, 2013). Therefore, the behavioral component of attitude and beliefs also influences the cognitive element. When learners see the meaning of mathematics in real life, they feel dedicated, optimistic, and related to their learning (Attard, 2012).

Prior research has shown that academic motivation has a significant impact on the academic performance of students in higher education. Moreover, research has also shown that academic encouragement positively influences college retention and persistence (Trolian, et al., 2016). As stated by, Trolian (2016) and Guiffrida (2013) found that students' motivation expected averages of higher-grade points and intentions to persist. In addition, resilience and helping students deal with stress is correlated with academic motivation.

Metacognitive skills positively affect the problem-solving success and attitude and beliefs of students in mathematics learning (Sahin & Kendir, 2013). Metacognitive skills positively impact the attitude and beliefs of students towards mathematics in the problem-solving process. Developing metacognitive skills would also make it possible for students to be more successful and to acquire a positive attitude and beliefs towards mathematics. Metacognitive abilities are necessary for students to be able to develop the ability to "self-regulate" to have greater motivation and create a positive attitude and beliefs (Sahin & Kendir, 2013). The research of Sahin & Kendir (2013) shows that those metacognitive skills have a beneficial effect on the attitude and beliefs of students towards mathematics. In addition, the prediction of academic motivation is greatly supported by metacognitive abilities. Students should be inspired mainly to learn to use their metacognitive skills and control this method, and researchers claim (Oguz & Ataseven, 2016).

Most metacognition researchers conceptualize metacognitive skills as metacognitive knowledge and metacognitive regulation. In addition, learners with high metacognitive ability are highly likely to track, regulate and manage their learning actions, thus achieving their learning objectives (Stephanou & Mpiontini, 2017). Metacognitive skills are, therefore, one of the markers of academic motivation (Oz, 2016). Similarly, if students' enthusiasm for learning is poor, it is not assumed that they will make an effort to evaluate their learning objectives. In addition, students have a positive attitude and beliefs towards learning and are inspired if they find their way of learning and see themselves as good (Oguz & Ataseven, 2016). The researchers have not come across any analysis on how academic motivation mediates the relationship between metacognitive skills, student attitudes and beliefs towards mathematics and the body of literature. Therefore, it is essential to perform a study in a few schools in Panabo City to determine which metacognitive skills can influence academic motivation, which in turn influences students' attitude and beliefs about mathematics among first-year college students.

Objectives of the study

The investigation's purpose is to ascertain the significance of academic motivation on the relationship between metacognitive skills and student attitude and beliefs towards mathematics among First-Year College students in selected institutions of Davao del Norte. More specifically, this sought to realize the following objectives:

1. To determine the level of metacognitive skills in First Year College students towards attitude and beliefs in mathematics.
2. To determine the level of student attitude and beliefs towards mathematics among first-year college students in selected institutions in Davao del Norte.
3. To determine the level of academic motivation among first-year college students in selected institutions in Davao del Norte.
4. To determine the significant relationship between metacognitive skills, academic motivation, and student attitude and beliefs toward mathematics.
5. To determine the significant mediating effect of academic motivation on the relationship between metacognitive skills, student attitude, and beliefs towards mathematics.

Research Hypothesis

The following null hypotheses were formulated and tested at a 0.05 level of significance:

HO_1: There is no significant relationship between metacognitive skills, academic motivation, student attitude and beliefs towards mathematics.

HO_2: There is no significant relationship between metacognitive skills, student attitude and beliefs towards mathematics as a mediating effect on academic motivation.

II. METHOD

Research Design

This study used a quantitative non-experimental correlational descriptive survey design in which researchers utilize the correlational statistic to define and assess the degree of association (or relationship) between two or more variables or sets of scores (Creswell, 2012). Furthermore, mediation analysis that stands between the independent and dependent variables mediates the effects of the independent variable on the dependent variable (Creswell, 2008). This study determined the levels of metacognitive skills, academic motivation, and student attitude and beliefs towards mathematics. The mediating effect of academic motivation on the relationship between metacognitive skills and student attitude and beliefs towards mathematics was investigated.

Research Locale

The study was conducted on first-year college students in selected Universities in Davao del Norte. Specifically, these include the universities in Tagum City, Panabo City, and the Island City of Samal located in the Philippines. Moreover, these students met the requirement that qualifies their participation in the study as respondents who can share their ideas and perceptions on how they measured the existing variables to their knowledge development level in learning mathematics.

Population and Sample

This research involved 339 first-year college students from the selected institutions located in Davao north Philippines. The respondents had been given the right to withdraw their involvement without any penalty at any time. Given the situation, the participants may withdraw when he feels threatened or uncomfortable responding to the survey questionnaire. The study used stratified random sampling in selecting the sample size. According to Shi (2015), stratified random sampling narrows the difference between different types of individuals through classification, is conducive to extracting representative samples, and reducing the sample size, and it has relatively remarkable advantages.

Research Instrument

Three sets of survey questionnaires were used to obtain data from the respondents adapted from previous studies. The survey questionnaires were undergone content validity and reliability analysis to ensure the accuracy of measurements. External validators validated the survey instruments with expertise in social research and statistics.

The metacognitive scale was adapted from the study of Baltaci (2018). This tool measures the learner's metacognitive skills. The questionnaire is a 5- point Likert Scale from (1) never, (2) sometimes wrong, (3) neutral, (4) sometimes true, and (5) always true and has eight subscales, namely; Declarative Knowledge, Procedural Knowledge, Conditional Knowledge, Planning, Information Management,

Comprehension Monitoring, Debugging Strategies, and Evaluation.

The student attitude and beliefs questionnaire was adapted from the study of Tapia and Marsh (2004) and validated for Nigerian use by Awofala (2017). The questionnaire has a total of 72-items that were constructed to assess confidence, anxiety, value, enjoyment, motivation, and teacher expectations. These items were graded on a modified five-point Likert scale: (1) strongly disagree, (2) disagree, (3) undecided, (4) agree, and (5) strongly agree.

The academic motivation scale was adapted from the study of Utvaer and Haugan (2016). The items are scored on a 5-point Likert scale (1 = ―Does not correspond at all; 2 = ―Corresponds a little‖; 3 = ―Corresponds moderately‖; 4 = 39 ―Corresponds a lot‖; 5 = ―Corresponds exactly‖). The scale comprises seven subscales containing four items each, three subscales for intrinsic motivation, three for extrinsic motivation, and one related to a motivation. The subscales for intrinsic motivation are related to Knowledge, Accomplishment, and Stimulation. There is a subscale for Identified regulation, Introjected Regulation, and External Regulation for extrinsic motivation. There was another subscale that assesses motivation.

The overall validation result of the questionnaires is 3.86, which means very good and having a reliability coefficient index of 0.91 for academic motivation, 0.97 for metacognitive skills, and 0.93 for student attitude with an internal consistency of excellent.

Data Collection

In data collection, the researchers took the following steps: First, the researcher presented his concept to his adviser before the survey instruments were initially drafted. Second, the survey instruments were validated by the experts' opinions of notable research enthusiasts from different Universities. Third, after validating the survey instruments, the researcher conducted the pilot testing of the instruments on the date scheduled. Fourth, the accomplished survey instruments were submitted to the statistician for reliability testing. Fifth, after completing the validation and reliability testing for the survey instruments, the researcher submitted his manuscript to Ethics Review Committee for review (ERC).

After approval from UMERC, written permission and endorsement were obtained from the Department. On the sixth step, a letter was attached to the 42 acceptance and then submitted to the different schools. As soon as the individual permission was granted, a schedule was made to distribute and retrieve the survey forms. Seventh, apart from the researcher, administered the survey instruments through a google form. The researcher gave explicit instruction that the survey process be conducted during break time, ―tool box‖ meetings, refresher courses, and other group activities to maximize the time and effectively answer each item of the questionnaire. Eighth, the researcher collected and gathered the answered questionnaires. After retrieval, the data were screened, encoded, tabulated, and analyzed.

Finally, the researcher obtained the results with the guidance of the statistician. With the data, the researcher drew conclusions and recommendations based on the study's findings.

Statistical Tools

The following statistical tools were utilized for a more comprehensive interpretation and analysis of the data.

Mean this was used to measure the levels of metacognitive skills, academic motivation, and student attitude and beliefs towards mathematics.

Pearson Product Moment Correlation was utilized to determine the relationships between metacognitive skills, academic motivation, and student attitude and beliefs towards mathematics.

Multiple Regression Analysis was used to measure the influence of academic motivation on metacognitive skills among senior high school students.

Medgraph using Sobel z-test was employed to determine the mediating effect of academic motivation on the relationship between metacognitive skills and student attitude and beliefs towards mathematics

Ethical Considerations

This research was performed with strict adherence to the ethical protocols and standards set out by the Ethics committee. The researcher religiously sought and received the corresponding permission required to complete this research from key school officials. The researcher ensures that the established recruitment parties are adequate and has performed a risk level analysis and mitigation measures (including physical, psychological, and social economics). The study sample also obtained proper authorization and consent, ensuring that all of their interests were entirely secured.

Whether or not to engage in the collection of data, the researcher will value the views and opinions of the respondents and their decision. After the data had been processed and interpreted to resolve those questions, the questionnaires answered were seared and scorched. In the conduct of the study, the researcher upheld complete ethical standards following the evaluation criteria of the research protocol, especially in population management and data collection.

Voluntary Participation. Without any outcome, penalty or loss of benefits, the first-year college students of the selected three institutions were given free options to answer the questionnaire. The researcher shall respect the respondents' viewpoints and their decision as to whether or not to engage in the data collection process. Therefore, the rights of the respondents' contribution to the body of

information were carefully considered and adhered to after the intent and benefits of the study had been identified and presented to the respondents.

Privacy and Confidentiality. The respondents' personal information that may be required in the study was kept in private, and the utmost confidentiality of the respondents' data was adhered to. It emphasized that the researchers should give proper attention to critical ethical issues such as confidentiality, respect for participants' opinions, and integrity.

Besides, as an ethical requirement of the research study, the respondents' privacy and confidentiality are positively observed by the researcher with respect and integrity. The third ethics principle of the Economic and Social Research Council (ESRC) states that: "The confidentiality of the information supplied by research subjects and the anonymity of respondents must be respected." However, sometimes confidentiality is limited. For example, if a participant is at risk of harm, we must protect them. It might require releasing confidential information.

The researcher is responsible for maintaining confidentiality that goes beyond ordinary loyalty. Clarke addresses the researcher's ethical dilemma when confidentiality must be broken because of the moral duty to protect society. The researchers must always bear all the psychological and social implications of a breach of privacy on subjects. The researcher must inform participants of their rights and use all possible coding systems that they regard appropriate in each case to protect participants. Treece suggests that whenever subjects refuse to report personal information as they believe it is an invasion of privacy, the researcher ought to respect their views. It may even apply to notes of age, income, marital status, and other details that the subject may regard as intimate.

Informed Consent Process. Respondents participated based on informed consent. The researchers provided sufficient information and assurances about taking part to allow individuals to understand the implications of participation and reach a fully informed, considered, and freely given decision about whether or not to do so without the exercise of any pressure coercion. Informed consent states that individuals must provide their explicit consent to participate in the study. It is an agreement of trust between the researcher and the participants.

The researcher ensured integrity with the respondents' opinions, views, comments, and decisions on whether they would participate while gathering the data. The respondents can withdraw their consent at any time and suspend their participation without any punishment. Informed consent is the major ethical issue in conducting research. According to Armiger: "it means that a person knowingly, voluntarily and intelligently, and clearly and manifestly, gives his consent."

Moreover, the researcher considers that persons with physical, cultural, and emotional barriers may require a straightforward language to understand them. Finally, the freed given a chance must be explained. It is essential but raises how difficult the subjects can withdraw after developing a personal and sometimes friendly relationship with the researcher. A researcher may be in a dilemma about withdrawal if many issues choose to draw at an advanced stage of the study because this can affect the results' validity. The Declaration of Helsinki provides some help as it declares that the subject's interest must always prevail over society and science interests. It further implies that the matter must be respected at any cost for the research.

Recruitment. The allocation of respondents was considered in the population, and the sample has shown the disseminated population. In addition, it was stated in the inclusion and exclusion of the respondents—Furthermore, the data collection proceedings and how the questionnaires were distributed. And the kind of population involved in the study. Lastly, in the data collection, it was stated clearly the process in conducting the survey.

Risks. The researcher made sure to protect study participants. For this, it should focus on the chance-to-benefit ratio. If possible, risks outweigh the benefits, then it abandons or redesigns the study. The risk of harm also requires the researcher to measure the chance-to-benefit ratio as the research progresses.

Some awkwardness or discomfort during the survey questionnaire's answering; the participants may not choose not to answer questions. If the respondents feel any mental or emotional distress, they can withdraw from participating in the research study. The researcher will give importance to the respondents' participation to benefit from the primary significance during the study's development.

Benefits. For this, the researcher identifies the following: the conduct of research guarantees the quality and integrity of results, the study will be distributed appropriately, the research aims are clear, and the methodology is appropriate.

It is imperative to study how it is beneficial to teachers, learners, and administrators. This creates many excellent opportunities for schools and teachers to benefit from integrating some forms of technology in the classroom and to make teaching and learning more effective. The results, discussions, and findings from this study can be used by or department of education in public and private schools.

Plagiarism. The researcher makes sure that the correct and accurate way of citing ideas from other writers and scholars was fully observed. To do this, this paper underwent grammar and plagiarism checking via Grammarly and Turnitin software.

Fabrication. This study considers accurate data to be gathered firsthand, and no other information shall be

generated without an authentic source. Also, this manuscript was made firsthand by the researcher to address fabrication issues. Likewise, the documents needed, such as letters and other pertinent papers, were generated with appropriate signatories to avoid fabrication. The study has no trace or evidence of intentional misinterpretation of what has been done. No data and results or purposefully putting forward conclusions that are not accurate.

Falsification. This research complies with the APA 6th edition citation format; hence, there is no misrepresentation of work or alterations of any data gathered in the study. The data and information obtained are presented in the most accurate writing.

Conflict of Interest. The study has no trace of conflict of interest like for example, the disclosure of COI, which is a set of conditions in which professional judgment concerning primary interest such as participants' welfare or the validity of the research tends to be influenced by a secondary interest such as financial or academic gains or recognitions.

Deceit. The study has no trace of misleading the respondents to any potential harm. All information shall be laid down so respondents will understand the research as it is.

Permission from Organization/Location. The study was conducted with formality and precise adherence to the ethical standards; thus, a formal letter is sent to the authorities of the Institutions of Davao Del Norte. The research was only conducted after approval from the authorities.

Technological Issues. Due to COVID-19 and health restrictions, the sending and gathering of data was done through Google form and made sure that instructions were clearly understood by the participants. Additionally, corrections and suggestions by the panelist were made through online and again made sure that suggestions were followed.

Authorship. Lastly, this study considers authorship qualifications in the conduct of the study. The researcher and the help and guidance of the research adviser had substantially contributed to the conception and design, acquisition of data, or analysis and interpretation of data. The researcher and adviser collaboratively draft the article and revise it critically for important intellectual content. Both have contributed to the study leading to the publication of the research.

III. RESULTS AND INTERPRETATION

The following are the results of the study carried out in selected colleges in Davao del Norte.

3.1 Level of Metacognitive Skills among First-Year College Students

Table 1: Level of Metacognitive Skills among First-Year College Students

Indicators	Mean	SD	Descriptive Level
Knowledge of Cognition	4.04	0.49	High
Knowledge of Regulation	4.01	0.55	High
Overall	**4.03**	**0.52**	**High**

Shown in Table 1 are the results of the descriptive statistics on assessing the level of metacognitive skills, which has an overall mean of 4.03 (SD=0.52), described as high. Taken individually, the indicators of the level of Metacognitive Skills of the participants were as follows: Knowledge of Cognition ($\bar{x}$ = 4.04, SD = 0.49) and Knowledge of Regulation ($\bar{x}$ = 4.01, SD = 0.55), both of which are assessed to be high. It implies that first-year college students are frequently practiced the knowledge of cognition and regulation in learning mathematics.

3.2 Level of Attitude and Beliefs towards Mathematics among First-Year College Students

Table 2. Level of Attitude and Beliefs towards Mathematics among First-Year College Students

Indicator	Mean	SD	Descriptive Level
Confidence	3.13	0.62	Moderate
Anxiety	2.71	0.99	Moderate
Value	4.06	0.68	High
Enjoyment	3.72	0.89	High
Motivation	3.69	0.97	High
Teacher	4.07	0.55	High
Overall	**3.56**	**0.78**	**High**

Shown in table 2 are the results of the descriptive statistics in measuring the level of attitude and beliefs towards mathematics among first-year college students. The overall mean of attitude and beliefs towards mathematics is 3.56 (SD = 0.78), assessed to be high. The high level could be attributed to predominantly moderate ratings given by first-year college students on confidence ($\bar{x}$ = 3.13, SD = 0.62) and anxiety ($\bar{x}$ = 2.71, SD = 0.99), with teacher ($\bar{x}$ = 4.07, SD = 0.55) being the highest and followed by value ($\bar{x}$ = 4.06, SD = 0.68), enjoyment ($\bar{x}$ = 3.72, SD = 0.89), and motivation ($\bar{x}$ = 3.69, SD = 0.97) are measures assessed to be high. In general, it is surmised that first-year college students are fairly reliable in their attitude and beliefs towards mathematics. The high level of teacher factor, value, enjoyment, and motivation in learning mathematics means that these dimensions are more pronounced than two other indicators of attitude and beliefs towards mathematics among first-year college students. An overall high rating indicates that the first-year college students' attitude and beliefs towards learning mathematics are often practiced.

3.3 Level of Academic Motivation among First-Year College Students

Table 3. Level of Academic Motivation among First-Year College Students

Indicator	Mean	SD	Descriptive Level
Intrinsic Motivation	4.12	0.66	High
Extrinsic Motivation	4.28	0.54	Very High
Amotivation	4.15	0.37	High
Overall	**4.18**	**0.52**	**High**

Shown in table 3 is the descriptive statistics result on assessing the extent of academic motivation among first-year college students, which has an overall mean of 4.18 (SD = 0.52), described as high. The high level is also reflective of high to very high levels of its indicators, including intrinsic of which are high and extrinsic motivation (($\bar{x}$ = 4.28, SD = 0.54) being the highest and a measure assessed to be very high. Intrinsic motivation (($\bar{x}$ = 4.12, SD = 0.66), amotivation (($\bar{x}$ = 4.15, SD = 0.37) both It can be seen that the first-year college students' academic motivation in learning mathematics is considerable. The very high level of extrinsic motivation indicates that the first-year college students have a very substantial motivation in external factors in learning mathematics.

3.4 Relationship between Metacognitive Skills, Student Attitude and Beliefs toward Mathematics

Table 4. Relationship between Metacognitive Skills and Student Attitude and Beliefs Towards Mathematics

Pair	Variables	Correlation Coefficient	p-value	Decision on Ho
IV and DV	Metacognitive Skills and Student Attitude and Beliefs towards Mathematics	0.437	0.000	Reject
IV and MV	Metacognitive Skills and Academic Motivation	0.432	0.000	Reject
MV and DV	Academic Motivation and Student Attitude and Beliefs towards Mathematics	0.353	0.000	Reject
**. Correlation is significant at the 0.05 level (2-tailed).				

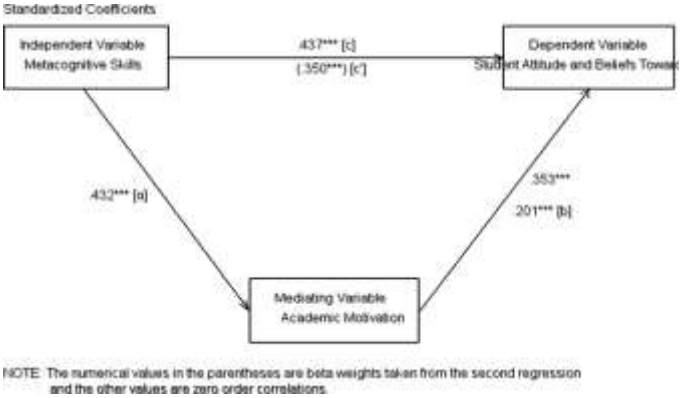
Displayed in Table 4 are the results of the relationship between the independent (metacognitive skills), dependent (attitude and beliefs towards mathematics, and mediator (academic motivation) variables. Bivariate correlation analysis using Pearson product-moment correlation was employed to determine the relationship between the variables mentioned. The first zero-ordered correlation analysis between metacognitive skills and students' attitude and beliefs towards mathematics revealed a computed r-value of 0.437 with a probability value of p<0.000, which is significant at the 0.05 level. It indicates a positive and strong association between the two variables (Sahin & Kendir, 2013). Thus, the null hypothesis of no significant relationship is therefore rejected. Similarly, the second bivariate correlation analysis involving metacognitive skills and academic motivation yielded an r-value of 0.432 with a probability value of p<0.000 , which is significant at 0.05 level. It indicates a positive association between the two variables (Oguz & Ataseven, 2016). Thus, the null hypothesis of no significant relationship is also rejected. The third correlational analysis between academic motivation and student attitude and beliefs towards mathematics yielded an r-value of 0.353 with a probability value of p< 0.000, which is significant at 0.05 level. It indicates a positive association between the two variables (Tagsin & Coskun, 2018). Thus, the null hypothesis of no significant relationship is rejected.

3.5 Mediating Effect of Academic Motivation on the Relationship Between Metacognitive Skills and Student Attitude and Beliefs Towards Mathematics.

Table 5. Regression results of the variables in the four criteria of the presence of mediating effect

Step	Path	Beta (Unstandardized)	Standard Error	Beta (Standardized)
Step 1	c	0.324	0.036	0.437
Step 2	a	0.418	0.047	0.432
Step 3	b	0.154	0.041	0.201
Step 4	c'	0.259	0.039	0.350
**. Significant at the 0.05 level				

Data were analyzed with the linear regression method as input to the medgraph. Mediation analysis developed by Baron and Kenny (2001) is the mediating effect of a third variable in the relationship between two variables. There are four steps to be met for a third variable acting as a mediator. In Table 5, these are categorized as steps 1 to 4. In step 1, metacognitive skills as the independent variable (IV) significantly predict student attitude and beliefs towards mathematics among first-year college students, which is this study's dependent variable (DV). In step 2, metacognitive skills significantly predict academic motivation, the mediator (M). In step 3, academic motivation significantly predicts student attitude and beliefs towards the mathematics of first-year students.



IV. RESULTS

Significance of Mediation		Significant
Sobel z-value	3.448954	$p = < 0.000563$
95% Symmetrical Confidence Interval		
Lower	.02779	
Upper	.10095	
Unstandardized indirect effect		
a*b	.06437	
Se	.01866	
Effect size Measures		
Standardized Coefficients		
Total:	.437	
Direct:	.350	
Indirect:	.087	
Indirect to Total Ratio:	.198	

Since the three steps (paths a, b, and c) are significant, further mediation analysis through medgraph is warranted, involving the Sobel z test to assess the significance of the mediation effect. If the effect of the independent variable on the dependent variable becomes non-significant at the final step of the analysis, full mediation will be achieved. It means the mediator variable mediates all the effects. In addition, if the regression coefficient is substantially reduced at the final step but remains significant, which implies that part of the independent variable (metacognitive skills) is mediated by the mediator (academic motivation), but other factors are either direct or mediated by other variables that are not included in the model. In this case, as gleaned in step 4 (denoted as c'), the effect of metacognitive skills on student attitude and beliefs towards mathematics was even found to reduce after being mediated by academic motivation. With this, the result was found to be significant at $p<0.05$ level.

Furthermore, the result of the computation of mediating effects is shown in Figure 3. The Sobel test yielded a z-value of 3.448954 with a p-value of 0.000563, significant at 0.05 level. It means that the mediating effect is significant, such that the original direct effect of metacognitive skills on student attitude and beliefs towards mathematics reduced upon the addition of academic motivation.

The positive value of Sobel z indicates that the addition of academic motivation reduces the effect of metacognitive skills on student attitude and beliefs towards mathematics.

The figure also shows the results of the computation of the effect size in the mediation test conducted between the three variables. The effect size measures how much of the effect of metacognitive skills on student attitude and beliefs towards mathematics can be attributed to the indirect path. The total effect value of 0.437 is the beta of metacognitive skills towards student attitude and beliefs. The direct effect value of 0.350 is the beta of metacognitive skills towards student attitude and beliefs with academic motivation included in the regression. The indirect effect value of .087 is the amount of the original beta between the metacognitive skills and student attitude and beliefs towards mathematics that now goes through academic motivation to student attitude and beliefs towards mathematics (a * b, where "a" refers to the path between MS→SABTM and "b" refers to the path between AM→SABTM).

The ratio index is computed by dividing the indirect effect by the total effect; in this case, 0.087 by 0.437 equals 0.199. It seems that about 19.9 percent of the total effect of metacognitive skills on student attitude and beliefs towards mathematics goes through academic motivation, and about 80.1 percent of the total effect is either direct or mediated by other variables not included in the model.

IV. DISCUSSION OF FINDINGS

The findings of the study revealed that there is a descriptive level of High metacognitive skills among first-year college students. It means that the students can incorporate their knowledge of cognition and regulation. It also implies that first-year college students frequently use metacognitive skills to affect their students' attitudes and beliefs.

The first year college students' level of knowledge of cognition is high which implies that metacognitive skills are oftentimes practiced by the respondents in terms such as using their previous experiences while establishing my new learning, searching for more effective techniques so that studying could be accomplished, revise their study plan that they used in studying, employing new strategy when the other fails, considering failure as part of learning a subject, using the best strategy to learn the subject, evaluating their reasoning strategy if it is successful or not, planning the resources that they will use to help them in learning a subject , having an exact idea on how to start their learning, aware of employing which strategy and how to use it, knowing their capacity to learn, knowing essential parts about a text or a learning unit, preparing the necessary things for learning process, making an advantageous plan before beginning to study, knowing which subjects are easily to learn and which challenging to learn, knowing when they need to ask for help, and determining the outcome of a topic before they start studying it.

This is parallel to the study of Oguz & Ataseven (2016), which refers that students' metacognitive skills are at a high level, which is a good outcome because students who use their metacognitive skills successfully and are more mindful of what, how, and when they can learn are more aware of the key to their success. Students with high metacognitive skills often have high levels of self-efficacy and critical thinking abilities.

The high level of knowledge of regulation indicated that metacognitive skills among first-year college students are

oftentimes practiced in terms such as reviewing their learning from time to time to determine how much they learned, can see their errors during the learning process, assessing themselves if they understand the subject during education, understanding the reason why they have experienced trouble in learning, they check if they successfully use their time during learning, relate their past experiences during the learning process, establishing the conditions to keeping their interest in learning, monitoring how much they learned about the subject and can determine in which situations they can learn and fail to learn.

The present study may align with Ajisuksmo & Saputri's (2017) study, which states that students who succeed at metacognitive skills would be motivated because they are internally interested, have high self-efficacy, and are oriented toward mastering the task. Students must learn to use all dimensions of metacognitive skills to enhance their mathematics learning achievement in this situation.

Furthermore, students can revisit their learning at any time to see how much they have learned, see their mistakes during the learning process, evaluate their comprehension of the subject during education, understand why they are having trouble learning, check whether they are successfully using their time during learning, and relate their past experiences during the learning process.

The overall level of attitude and beliefs towards mathematics among first-year college students is *High*, based on the respondents' responses in the areas of *confidence*, *anxiety*, *value*, *enjoyment*, *motivation*, and *teacher*.

The first-year college students' level of *confidence* is moderate, which implies that the respondents sometimes practice students' attitude and beliefs towards mathematics in terms such as having difficulties with many ideas in mathematics, nominated to take part in mathematical competitions, usually comprehended math content well, never get tense while taking math tests, having comfort during math courses, not worrying about their capability to solve math problems, easy for them to understand new math content, generally working hard until they understood difficult math concept, they can't remember mathematical concepts that were difficult for them to understand, and sometimes they don't seek help from their math teachers.

This parallels Awofala's (2017) statement, which discussed that confidence in mathematics is a students' ability to do well in mathematics and consistently appeared as a significant feature of mathematics attitude and beliefs. Generally speaking, a person who has self-confidence in math always performs better than the one who lacks confidence. Students are less likely to persevere without self-confidence in the face of challenging mathematics assignments, and self-confidence is a vital requirement for students to select and proceed with more challenging mathematics courses.

The moderate level of *anxiety* indicated that attitude and beliefs towards mathematics among first-year college students are sometimes practiced in terms such as new mathematical contents are being disliked, when they were having trouble with a math idea, they would generally give up, being uncomfortable and nervous with mathematics, during math tests they get agitated, when they think of trying math problems they get a worse feeling, feel uneasy and confused when studying mathematics, had trouble staying up in their math classes, can't think visibly when doing mathematics, remembering math teachers who made them feel stupid in class, they generally had difficulty relating new mathematical concepts to their previously learned, when their math teachers became frustrated with them, they feel nervous, they have never liked mathematics, and it is their most feared subject.

In addition, the high level of the *value* indicated that attitude and beliefs towards mathematics among first-year college students are frequently practiced in terms such as selecting mathematics as their important subject, considering math as a related, sequential, progression of ideas, they are interested and willing to use math outside school and on the job, appreciating mathematics because it has contributed significantly to science and other fields of knowledge, believing that math is a healthy and necessary subject, understanding mathematics is essential for artists and writers, considering that mathematics is vital in everyday life, mathematics helps develop a person's mind and teaches him to think, mathematics is essential in designing practically everything, believing that mathematics is necessary to keep the world running, and will use mathematics in my everyday life.

The statement is akin to Haciomeroglu's (2017) pronouncements that one of the measures of student attitude and beliefs towards mathematics is the importance of mathematics, which applies to one's assumptions about the value of mathematics. In addition, it is essential, advantageous, or valuable when students value mathematics (Garner-O'Neale & Cumberbatch, 2015). Also, the high level of *enjoyment* is indicative of a student's attitude, and beliefs towards mathematics among first-year college students are oftentimes practiced in terms such as taking math classes even though they were not required, they usually enjoyed math courses, believing mathematics is fun and exciting, enjoying solving new problems in math, looking forward to teaching mathematics, and not avoiding taking math classes in college.

Moreover, the high level of manifestation of first-year college students on *motivation* indicates that they want to teach mathematics in the future, they have taken math classes even if they were not required, and they think it wouldn't bother them to take more math courses. They have selected mathematics as their area of importance, generally considered math as the progress of ideas, thinking that mathematics is interesting, and they are interested and willing to acquire further knowledge of mathematics.

This is parallel to Haciomeroglu (2017) statement, who discussed that motivation relates to your interest in

mathematics and your desire to study mathematics. It is described as a pushing or moving force that makes a person aspire to achieve a set goal despite difficulties. Motivation has been described as what activates, directs, and sustains behavior. Therefore, the more motivated individuals are strongly associated with achievement; the more optimistic their attitude and beliefs towards mathematics are, the greater their success (Awofala, 2017).

Also, the high level of *teacher* indicates a student's attitude and beliefs towards mathematics among first-year college students are oftentimes practiced in terms such as teacher spending the necessary amount of time helping them understand math concepts, skillful and knowledgeable. The teacher emphasized understanding and not just memorization, supported their efforts to learn mathematics, assigned several homework problems each night, had confidence in them as mathematics students, related new concepts to what they had already learned, and was very patient with them. The teacher believed that they were capable of learning mathematics, often applied their maths lessons to real-world situations, used a combination of manipulative, visual aids, and cooperative learning. The teacher also uses math games to reinforce their understanding of concepts, and we're not annoyed with them in class.

This result corroborates the study of Awofala (2017) that Anxiety, confidence, motivation, enjoyment, feelings, and beliefs are all expressions that are sometimes used interchangeably with the idea of attitude and beliefs. It's worth noting that none of these definitions explain attitude entirely; instead, they're facets of attitude and beliefs. Furthermore, self-confidence in mathematics education, or the degree to which a person believes in doing well, has consistently emerged as a critical feature of mathematics attitude and beliefs.

Furthermore, attitudes and beliefs towards mathematics are psychological features of individual students, and the psychological environments around them influence the cognitive, behavioral, and attitudinal learning outcomes. This means that the first-year college students oftentimes practice student attitude and beliefs towards mathematics.

The extent of academic motivation of first-year college students is *high* in *intrinsic motivation* and *amotivation*, while *extrinsic motivation* revealed a *very high* level. Meanwhile, the overall mean is described as *high*. This means that first-year college students oftentimes manifest academic motivation. This also implies that students internalize concepts, beliefs, aspirations, and intentions under various embedded social contexts since the interaction of a person their environment. Furthermore, students evaluate their desires to perform an activity for the pleasure and satisfaction experienced during learning and performance achievements.

The result shows that the students do not need extrinsic incentives since they are actively motivated by their pleasure and interest in a particular activity (Ariani, 2017). It is evident that the students frequently have satisfaction while learning new things when they discover new things never seen before, broadening their knowledge about subjects which appeal to them, satisfied the studies that allow them to continue to learn about many things that interest them while surpassing themselves in their studies, accomplished challenging academic activities, have pleasure going to school, studying at school, discussions with exciting teachers, and reading about various interesting subjects.

Moreover, the result also shows that first-year college students are unmotivated when they do not interpret outcomes and acts. In addition, the first-year college students oftentimes feel that they are wasting their time in school, wondering whether they should continue, and can't understand what they are doing in school. It is also evident in this study that the first-year college students have always felt pleasure thinking that education will help them better, enable them to enter the job market in a field that they like, help them make a better choice regarding their career orientation, find a high-paying job, later on, to obtain a more prestigious job and have a good life.

This result parallels the study of Deci & Ryan (2014) that the Individuals' motivation-related characteristics and motivations that influence their behaviors are the subjects of motivation. It is more specifically concerned with integrating and controlling personal motives within the self, which can be made autonomous and highly functional by sound regulation processes represented by independent motivation types. However, since the relationship between an individual, their environment, and the current context never ends, self-determination focuses on how the self internalizes ideas, values, expectations, and intentions under the influence of various embedded social contexts.

The relationship between metacognitive skills and student attitude and beliefs towards mathematics revealed a significant relationship between metacognitive skills and student attitude and beliefs towards mathematics. This implies that first-year college students' metacognitive skills are correlated with their attitude and beliefs towards mathematics. In other words, the increase in student metacognitive skills would also likely increase their attitude and beliefs towards mathematics.

This result conforms to the study of Mulendema, et al. (2016), that students develop metacognitive skills with a positive attitude and beliefs towards mathematics. In addition, metacognitive skills positively affect attitude and beliefs towards mathematics in the problem-solving process. Therefore, the development of metacognitive skills will help learners be more successful and acquire a positive attitude and beliefs in mathematics (Sahin & Kendir, 2013).

In this regard, Billstein et al. (2015) conclude that a lack of metacognitive skills is one of the major causes of students' inability to complete math assignments and creates a negative attitude and beliefs toward math lessons.

Furthermore, students with metacognitive skills affect their intrinsic motivation and promote their learning process in math lessons by using the supervision and control approach. They would achieve greater educational success due to correcting errors and increasing the pace at which they learn and solve problems, as well as a more positive attitude and beliefs toward mathematics (Price, 2016).

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The relationship between academic motivation, student attitude and beliefs towards mathematics revealed a significant relationship between academic motivation and student attitude and beliefs towards mathematics. This implies that the academic motivation of first-year college students is correlated with their attitude and beliefs towards mathematics. This means that increasing student academic motivation would also likely increase their attitude and beliefs towards mathematics.

This result is congruent with the study of Tagsin & Coskun (2018). A student's attitude and beliefs toward studying a subject and academic motivation are positively correlated, which influences learning and performance. Students' motivations are affected by their learning circumstances. Furthermore, according to Duque et al. (2018), a positive attitude and beliefs toward mathematics will significantly encourage students to pursue mathematics. Students who have a positive attitude and beliefs about learning are more likely to be inspired if they discover their learning style and see themselves competent (Oguz & Ataseven, 2016).

Students' motivation is indicated by the attitude and beliefs that they can learn mathematics, feeling of responsibility to undertake the mathematical tasks, finding mathematics interesting, perseverance, and a positive feeling that when they do mathematics tasks, they are likely to apply the appropriate cognitive strategies (Mazana, 2019). Furthermore, motivation for mathematics has degrees of correlation with attitude and beliefs in mathematics, which are essential learning objectives in mathematics education (Lim & Chapman, 2015). Students are more likely to enjoy a learning experience that improves their attitude and beliefs about math in the Nenty, Kgosidialwa, and Moeti (2016) study. Furthermore, one of the affective variables of mathematical principles is motivation, and one of the motivational frameworks generates a positive attitude and beliefs to promote student motivation (Simzar, 2016).

The relationship between metacognitive skills and academic motivation revealed a significant relationship between metacognitive skills and academic motivation. This implies that the metacognitive skills of first-year college students is correlated with their motivation towards the subject. This means that increasing student metacognitive skills would also likely increase their motivation to learn mathematics.

This result conforms to the study of Muna et al. (2017) that metacognitive skills and student academic motivation positively correlate to problem-solving. This suggests that if students' metacognitive skills and motivation are increased, they are more likely to improve their problem-solving abilities. The students' metacognitive skills and academic motivation were found to be positively correlated in the study. Furthermore, the degree of metacognition that affects problem-solving skills is contingent on the student's motivation, which explains the possible relationship between metacognition and motivation and student achievement. Based on the motivation theory that uses the aim theory approach, the goal of one's achievement can impact one's achievement by modifying the quality of the self-regulation process.

Furthermore, the Oguz & Ataseven (2016) research reveals a relationship between metacognitive skills and academic motivation. This means that people who prepare, monitor, and evaluate their learning are more motivated in learning. Learning and motivation are influenced by metacognition, which is a single factor.

According to the researchers, students should be explicitly inspired to learn and control this method using their metacognitive skills. Consequently, if students' desire to learn is poor, it is unlikely that they will make an effort to assess their learning objectives, choose and use tools, techniques, and strategies, or evaluate their learning. Students would become motivated if they discover their learning method and see themselves as successful. Students used metacognitive

skills to recognize individual learning difficulties, solve problems, and be motivated.

The mediation analysis reveals that academic motivation has mediated the relationship between metacognitive skills and student attitude and beliefs towards mathematics. The mediating effect could not claim that academic motivation is the very reason how metacognitive skills can influence the attitude and beliefs of first-year college students towards mathematics. This indicates that academic motivation can partly explain how metacognitive skills can influence students' attitudes and beliefs towards mathematics.

However, the fact that academic motivation had a significant mediating effect on the relationship between metacognitive skills and students' attitude and beliefs towards mathematics, this finding is in line with the pronouncement of Oguz and Ataseven (2016) that the students develop a positive attitude and beliefs towards learning mathematics and become motivated in learning mathematics when they discover their own manner of learning such as techniques and strategies. Furthermore, if the students have a positive attitude and beliefs towards mathematics, the more they are motivated (Awofala, 2017), the more they are motivated, the more they can plan, assess and evaluate their learning in mathematics (Abdelrahman, 2020).

V. CONCLUSION

As can be gleaned in the study's findings, conclusions are drawn in this section. The results of this study confirmed the assumptions about the mediating effect of academic motivation on the relationship between metacognitive skills and attitude and beliefs towards mathematics among first-year college students. Moreover, the findings provide evidence that their attitude and beliefs towards mathematics influence the metacognitive skills of first-year college students. In effect, the first-year college students exhibit a high level of metacognitive skills, a high-level attitude and beliefs towards mathematics, and a high level of academic motivation. It generally indicates a significant relationship between metacognitive skills, academic motivation, and students' attitude and beliefs towards mathematics. Furthermore, the result of the study also suggests that academic motivation significantly mediates the relationship between metacognitive skills and attitude and beliefs towards mathematics of first-year College students.

Lastly, the findings supported the anchored theory on the academic motivation of Deci & Ryan (2014), the propositions of Mulendema (2016), Muna (2017), Tagsin & Coskun (2018), and the pronouncements of Duque (2018), Oguz, and Ataseven (2016). For this reason, academic motivation significantly mediates the relationship between metacognitive skills and student attitude and beliefs towards mathematics. The propositions cited above discuss the association among variables used in the study. Thus, these propositions are parallel in the present study since it deals with mediating effect of academic motivation on the relationship between the metacognitive skills and student attitude and beliefs of first-year colleges students towards mathematics.

VI. RECOMMENDATIONS

Based on the previous findings and conclusions, several recommendations are offered.

1. Mathematics teachers should create a positive and conducive, attractive learning environment to improve learning.
2. Teachers must take responsibility for developing positive attitudes and beliefs toward mathematics.
3. Mathematics teachers should do activities suitable to students' cognitive demand level, give homework open to research rather than classical reading, tolerate mistakes, let the students express their opinions, and tell the students about the necessity of mathematics.
4. Teachers can use well-designed learning strategies, techniques in solving, and feedback to engage the learners in learning mathematics thoroughly.
5. Syllabus content should be consistent with metacognitive teaching, which would be method rather than solution-oriented.
6. Incorporate math class activities/projects that help students experience the everyday relevancy of math, which underlies so much of the physical world.
7. Peer tutoring and math clubs could encourage students to share their math enthusiasm and knowledge.
8. Teaching students how to engage during collaborative group work in math class could enhance their motivation.
9. Institutions should create a school environment that emphasizes metacognitive skill development rather than marks.
10. A teacher should create a constructivist classroom environment to develop metacognitive skills in students.
11. Parents should give importance to the constructivist way of learning instead of just memorizing the learning.
12. Curriculum developers should put such activities in the exercise based on a constructivist approach so that students can perform that activity and develop metacognitive skills.
13. Schools can create exciting programs that develop students' knowledge in mathematics, such as mentoring programs, math competitions, mathematics corners, and different programs that introduce mathematics.
14. Teachers must strengthen students' academic motivation to achieve a positive attitude towards mathematics.

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