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Predictors of Performance in Mathematics of Science, Technology And Engineering Students of a Public Secondary School in The Philippines

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Abstract
Purpose: To fully participate in the future world, students of today should be mathematically skilled. Nowadays, mathematics backs directly and fundamentally the ways of business, health, finance, governance, and technology. Thus, this study predicts the performance in Mathematics through attitude in Mathematics, reflective thinking skills, and problem-solving skills of the Science, Technology, and Engineering (STE) students.
Research methodology: This study utilized the descriptive-predictive method. It was conducted in Sto. Tomas National High School has 58 respondents.
Results: There is a positive significant relationship between attitude in Mathematics, reflective thinking skills, and performance in Mathematics. However, it was revealed that there is a negative not significant relationship between problem-solving skills and performance in Mathematics. Furthermore, it was discovered that attitude in Mathematics significantly predicts performance in Mathematics.
Limitations: The study is quantitative non-experimental research. The respondents are only those students who specialized in science, mathematics, and engineering.
Contribution: The model that predicts the performance in Mathematics can be considered by mathematics teachers in improving the performance of STE students in Mathematics.
Keywords: *Attitude in Mathematics, Reflective Thinking Skills, Problem Solving Skills, Performance in Mathematics*
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1. Introduction

Mathematics is an essential part of every human life, and no one can avoid it (Mariano, 2004). Performance in Mathematics is efficiently engaging our knowledge of concepts and facts, not only what we have learned and knew (Schoenfeld, 2014). However, a study revealed that a student, when answering Mathematics, felt tense and anxious, which leads them to anxiety and poor performance (Guita & Tan, 2018). Further, high school students undergo difficulties and problems, and they interpret Mathematics as a complicated, abstract, not too practical, and tedious subject (Ignacio, Nieto, & Barona, 2006). The development of performance is alarming that the Department of Education considers performance in Mathematics as a significant problem in Education (Novriani & Surya, 2017). Furthermore, more students also revealed that they did not know the method of the actual teaching of their teachers in a math-related subject (Muhammed et al., 2021).

Nowadays, critical thinking in answering Mathematics is a required skill for an individual to succeed in academics, but also it helps to have high performance in Mathematics (Kay, 2010). As well as choosing the appropriate strategy and analyzing the Mathematics problem thoroughly, leads to attaining success in performance in Mathematics (İncebacak & Ersoy, 2016).

Attitude is an important characteristic that a student should have in Mathematics as it was determined that the enhancement and boosting of the confidence of a student is showing a positive attitude in learning (Ngussa & Mbuti, 2017). Accordingly, personality impairment distracts students' focus and negatively affects their performance (Hafezi& Etemadi, 2022). On the other hand, a study found that reflective thinking skills are an active process in which students can participate Mathematics by thinking profoundly and giving a recommended solution that could be considered the showing high performance (Albayrak & Şimşek, 2018). Moreover, problem-solving skills must be part also of Mathematics as students will develop a habit of perseverance, and confidence will be built that will lead them to high performance in Mathematics. In fact, in the ASEAN Economic Community, standard skills and soft skills are observed in the curriculum (Zulaikha et al., 2021).

Although, there is a lot of research that have been carried out in the international setting investigating factors that may have a link to the performance in Mathematics such as parent involvement, gender, self-efficacy, problem-centered teaching, and teacher styles regrettably, the researchers have not come across of a study that models attitude in Mathematics, reflective thinking, and problem-solving skills toward performance in Mathematics, particularly in Science, Technology, and Engineering (STE) students. Hence, the researchers were persuaded to conduct this study to fill the gap in the literature covering these subjects, especially in the local context.

This study is assessing the STE students' performance in Mathematics. Since STE students are commonly considered a mathematician, this study will show whether their performance is based upon attitude in learning Mathematics, reflective thinking, and problem-solving skills. This is the focus of the research.

Research Objectives

The main purpose of the study is to determine if attitude in Mathematics, reflective thinking, and problem-solving skills significantly predict performance in Mathematics, particularly among STE students. This study will deal with the following objectives:

1. To describe the level of attitude in learning Mathematics of STE students in terms of:
   1.1 Confidence in Mathematics;
   1.2 Importance of Mathematics; and
   1.3 Engagement in Mathematics.
2. To describe the level of reflective thinking skills of the STE students.
3. To describe the level of problem-solving skills of STE students.
4. To describe the level of performance in Mathematics of STE students.
5. To determine the significant relationship between:
   5.1 Attitude in Mathematics and performance in Mathematics;
   5.2 Reflective thinking skills and performance in Mathematics; and
   5.3 Problem-solving skills and performance in Mathematics.
6. To determine if attitude in learning Mathematics, reflective thinking skills, and problem-solving skills significantly predict performance in Mathematics of STE students.

Hypothesis

1. There is no significant relationship between:
   1.1 Attitude in Mathematics and performance in Mathematics;
   1.2 Reflective thinking skills and performance in Mathematics; and
   1.3 Problem-solving skills and performance in Mathematics.
2. Attitude in learning Mathematics, reflective thinking skills, and problem-solving skills do not significantly predict performance in Mathematics of STE students.

Theoretical Framework

The theoretical framework presents the theory, which is the cornerstone of the research or springboard of the study. The authorities who formulated the theories and ideas used are the bases of the study.

Bruner (1966)'s typology of constructivist theory will be used to provide a theoretical framework where it was focused on the mathematics development of a child or person. Constructivism is a cognitive activity, or conscious intellectual activity was understanding, thinking, and learning are emphasized. Cognitive learning is to construct the past and current knowledge into a new idea and allow their experiences to go beyond the information. This will use for investigating reflective thinking and problem-solving skills as a predictor of performance in Mathematics of STE students.

Also, metacognition theory (Flavell, 1976) is making the value of one's cognitive processes. This utilization of their performance, and attitude was reflected in their cognitive thinking processes, through metacognition, students could evaluate their performance as well as the way they feel towards the given task. This will be used to examine the attitude in Mathematics and performance in Mathematics. Furthermore, the constructivist theory will provide a theoretical framework for investigating prior knowledge as a key to analytical thinking and making a solution to solve the problem. In contrast, metacognition theory will examine the behavioral implication of metacognitive experiences.

Conceptual Framework

Presented in figure 1 below is the conceptual framework of the study. The dependent variable is the performance in Mathematics that will be assessed among the STE students. And the independent variables are the attitude in Mathematics, reflective thinking skills, and problem-solving skills.

The attitude in learning Mathematics can be developed and changed at a time, but once a positive attitude is formed, it might progress a student's learning. In contrast, a negative attitude is established; it blocks learning, and subsequently affects the performance of students. According to a researcher, it contains three factors cognitive, affective, and behavioral responses that a student act toward solving a problem based on how they feel or get interested (Han, 2014). Below are the indicators of attitude in learning Mathematics. The first indicator of attitude in learning is confidence in mathematics. According to a study, the level of confidence increased when the positive feelings while learning mathematics making the students satisfied with high performance in mathematics. Whenever the students feel anxious when solving a mathematical problem will be comfortable depending on the teacher's teaching style in Mathematics (Yilmaz, 2020).

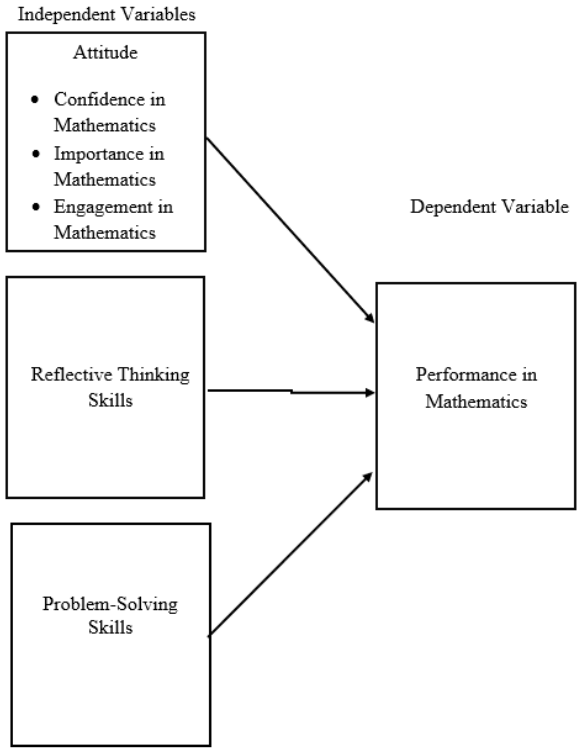

Figure 1. Conceptual Framework Showing the Variables of the Study

The second indicator of the attitude in learning Mathematics is the importance of Mathematics. A student gives importance to mathematics when they are aware of the relations between solving and its impact on their lives. Through this, the student considers Mathematics as necessary in real life to the point they agreed Mathematics is a valuable subject (Sullivan & McDonough, 2007).

The third indicator of attitude in learning Mathematic is engagement in Mathematics. According to a study, students are more interested when their Mathematics lesson is more interactive (Afari, Aldridge, Fraser, & Khine, 2013). As stated, the students with high performance in Mathematical problems are the ones who enjoyed mathematics, and it shows a positive attitude towards Mathematics (Zan & Di Martino, 2007).

The development of a reflective thinking skill as a higher-order thinking skill, such as critical thinking, has a positive significant role when it comes to performance in Mathematics. As an effect, reflective thinking skill is deemed to be an essential skill that must consider its developed (Baş & Kıvılcım, 2013).

Problem-solving is a cognitive process through thinking a way of having a logical succession that is to find a solution to the given problem. Thus, students should practice problem-solving to be critically thinking. Problem-solving encourages students to use content knowledge in creative ways, innovative and promotes in-depth understanding to have a higher performance in Mathematics (Kalaycı, 2001).

The performance of a student is based on their remarks in Mathematics. A student's performance in mathematics is a reflection of how deep or what are the learnings a student. Performance may depend on what and how students analyze Mathematics activity (Özsoy, 2005).

2. Literature review and hypothesis development

Attitude in Mathematics

A study found out many students are still avoiding mathematics because of what they have heard from earlier students which create negative thought in their minds. This was the reason some students get hated or fear the mathematics subject (Ingram, 2015). A study showed a student could express their ideas, and not feel scared in mathematics has an increased the percentage that a student could get high mathematics performance (Barnes & Venter, 2008). However, Low self-esteem will probably result in poor performance (Bandura & Watts, 1996). A student needs to analyze and understand the process of

Mathematics. Hence, in a survey study, it was shown that there was a high percentage when students answered Mathematics was a worthwhile and necessary subject. Students also said that in daily living, Mathematics is essential (Sanchal & Sharma, 2017). As revealed by a researcher, that student tends to make meaning with a particular subject and its result of giving importance to the specific subject (Ingram, 2015), The engagement of a student is depending on how they were getting interested. The necessary factors in engagement are the student's willingness and showing positive feelings toward Mathematics. (Afari et al., 2013). Furthermore, A study results that students are likely to engage when they find enjoyment and get interested in learning Mathematics. Enjoyment and interest affect the continuity of engagement in learning (PISA, 2003).

Reflective Thinking Skills

Reflective thinking skill is an action where a student finds a way to solve a given problem. It was stated that reflective thinking skill is a process of developing strategies and even improving critical thinking (Muin, 2011). Also, it was revealed that student that has higher-order thinking skills can apply and evaluate alternative solutions that get them to correct answers(Cumaoğluet al., 2009). Further, a study also found out, and there is a significant and positive relationship between reflective thinking skills and Mathematics performance; the higher reflective thinking skills the student has, the higher of performance in Mathematics will be (Baş & Kıvılcım, 2013).

Problem Solving Skills

A study found out that the success of a student is when the question problem is related to solving a problem; it does not only contribute to success in Mathematics, but it also helps to find skills that are essential in this day forward (Soylu & Soylu, 2006). On top of that, problem-solving is practical thinking that helps the student to be better intellectual answering problem-solving (Adair, Kalaycı, & Korkmaz, 2000).

Performance in Mathematics it was shown in the results that the success of a student's Mathematical problem could get a higher grade. It indicates that the student's performance is also one of bases on their problem-solving skills. Hence, the student's grade is the cause of how they comprehend and analyze the given solving problem (Kupcu&Ozdemir, 2012).

Correlation between Measures

In the study "Influence of Attitude on the Performance of Students in the Mathematics Curriculum," it was shown that the attitude toward Mathematics had been considered one of the essential factors that could influence the student's participation in their class (Manoah, Indoshi, & Othuon, 2011). Thus, positive and negative feelings or emotions could affect its attitude, but it depends on the motivation (Slavik, 2015).

It was found that the relationship between performance and reflective thinking skills is significantly related, to the way how will scores change according to their assessment (Whitehead, 2008). According to a study conducted in Tangerang Banten, finding shows that 60% of most students are still at a reduced level of reflective thinking, which might hinder their performance in Mathematics. This finding didn't explain any satisfaction with the process of reflective thinking in Mathematical production (Nindiasari, 2011). Another study found that a thoughtful thinking process is useful for students to help them create new knowledge to solve and get appropriate solutions (Muin, 2011).

On the other hand, today's children and teens face particular difficulties and complexities in the problem they feel. Still, it is essential to have problem-solving skills where it could help them think and decide appropriately (Sheikhpour, 2012).

3. Research methodology

Research Design

The study used a descriptive-predictive method in research in which this method is a measure of relations of the variable with varying levels of measurement. The descriptive-predictive process produces the prediction by applying a statistical model for future observation or predicting new (Shmueli, 2021). This was used to investigate if the attitude in Mathematics, reflective thinking skills, and problem-solving skills significantly predict performance in Mathematics of STE students.

Research Respondents

The respondents of the study were students of Science, Technology, and Mathematics within Sto. Tomas National High School located at Santo Tomas, Davao del Norte, Philippines. This research used the method of complete enumeration in identifying the respondent's population. This will determine the sample size population of the study.

Complete enumeration is used to list all the elements in a group. The group will be the actual population of the respondents by enabling totals for the population of the group (Lavrakas, 2008). Table 1 illustrate the population of the research respondents.

Research Instrument

The study adopted the questionnaires from Kizilkaya and Askar (2009) entitled "The Development of Reflective Thinking Skill Scale Problem Solving," Sanchal and Sharma (2017) entitled "Student's Attitude Towards Learning Mathematics: Impact of Teaching in a Sporting Context," and Indumathi and Ramakrishnan (2017) entitled "Development and Validation of Tool on Problem Solving Skill for High School Students." The first questionnaire consists of 14 questions. Meanwhile, the second questionnaire has 44 questions divided into three subscales: confidence in Mathematics, the importance of Mathematics, and engagement in Mathematics. Also, the third questionnaire consists of 20 items. The scoring guide in the problem-solving skills of STE students' analysis of responses was into six levels are indicated below.

Through pilot testing, the questionnaire was tested its reliability with Cronbach Alpha. Cronbach's alpha reliability coefficient usually ranges between 0 and 1, and the closer Cronbach's alpha to 1.0, the more critical the internal consistency of the items in the scale (Tavakol & Dennick, 2011).

Table 1. Scaling for Reflective Thinking Skills

Score interval	Descriptive Equivalent	Interpretation
5.17 – 6.00	Very high	This means that reflective thinking skills among STE students are always manifested.
4.34 – 5.16	High	This means that reflective thinking skills in STE students are oftentimes manifested.
3.52 – 4.33	Minimum	This means that reflective thinking skills in STE students are manifested.
2.68 – 3.15	Low	This means that reflective thinking skills in STE students are sometimes manifested.
1.84 – 2.67	Very low	This means that reflective thinking skills in STE students seldom manifested.
1.00 – 1.83	Extremely low	This means that reflective thinking skills in STE students are not manifested.

Reflective thinking skills generated a Cronbach's alpha of .818, which is higher than the required 0.70 for the reliability from the pilot testing of the scale given to 30 respondents. The scoring guide of the reflective thinking skill will be categorized into six levels; the range is listed above.

Table 2. Scaling for Attitude in Learning Mathematics

Score interval	Descriptive Equivalent	Interpretation
5.17 – 6.00	Very high	This means that attitude in learning Mathematics among STE students is always manifested.
4.34 – 5.16	High	This means that attitude in learning Mathematics among STE students is oftentimes manifested.
3.52 – 4.33	Minimum	This means attitude in learning Mathematics among STE students is manifested.
2.68 – 3.15	Low	This means that attitude in learning Mathematics among STE students is sometimes manifested.
1.84 – 2.67	Very low	This means that attitude in learning mathematics among STE students seldom manifested.
1.00 – 1.83	Extremely low	This means that attitude in learning mathematics among STE students is not manifested.

The attitude in learning Mathematics generated a Cronbach's Alpha of .820, which is higher than the required 0.70 for the reliability from the pilot testing of the scale given to 30 respondents. Thus, the result found that one of the items had scored low. Therefore, Cronbach's alpha selected 43 items in the final draft. The scoring guide of the attitude in learning mathematics will be categorized into six levels. The scale is listed above.

Table 3. Scaling for Problem-Solving Skills

Score Interval	Descriptive Equivalent
17-20	Outstanding
13-16	Very satisfactory
9-12	Satisfactory
5-8	Fairly Satisfactory
1-4	Did not meet Expectations

This standardized test of problem-solving skills was developed and validated by Indumathi and Ramakrishnan (2017). The scoring guide of the problem-solving test will be categorized into five levels. The scale is listed above:

Table 4. Scaling for Performance in Mathematics

Score Interval	Descriptive Equivalent
90-100	Outstanding
85-89	Very satisfactory
80-84	Satisfactory

75-79	Fairly Satisfactory
Below 75	Did not meet Expectations

Source: Department of Education

Mathematics 2nd quarter grade of the student was used to measure the performance in Mathematics. The scoring guide for performance in Mathematics will be categorized into five levels. The scale is listed above.

Data Gathering Procedures

The researchers personally distributed and administered the research instrument to the respondents to ensure 100% retrieval of the questionnaire. The permission letter was sent and directly approved by the principal. The survey was conducted in the second semester of the school year 2019-2020. The questionnaire was checked and has been approved by the research committee of the Senior High School Department. Pilot testing was conducted right away to check if the questionnaire is valid in the chosen locale. The data gathered by the researcher was tallied, tabulated, analyzed, and interpreted based on the purpose of the study.

Statistical Treatment

The following statistical tools were used in the computation of the data and testing the hypothesis at the alpha 0.5 level of significance.

Mean. This was used to determine the level of, attitude in Mathematics, reflective thinking skills, problem-solving skills, and performance in Mathematics

Pearson r. This was used to determine the interrelationship between attitude in Mathematics, reflective thinking skills, problem-solving skills, and performance in Mathematics

Multiple Regression analysis. This was used to determine if attitude in Mathematics, reflective thinking skills, and problem-solving skills significantly predict performance in Mathematics.

4. Results and discussions

Level of Attitude in Mathematics

Table 5 shows the summary data gathered from the respondents about their attitude toward learning Mathematics. The result showed an overall mean of 4.30 and a standard deviation of 0.48 with a descriptive level of high. The score signifies that attitude in learning Mathematics is oftentimes manifested.

Based on the findings, the indicator that has the highest level is the *importance of Mathematics* which has a mean of 4.3 and a standard deviation of 0.71, which is described as a level of high. It means that the STE students give importance to Mathematics. However, the indicator that got the lowest level is the *engagement in Mathematics* which has a mean of 3.76 and a standard deviation of 0.59 described as a minimum level. These indicate that the STE students are valuing the importance of mathematics as part of their Mathematics performance.

Confidence in Mathematics indicator that has the highest level of description. According to Barnes and Venter (2008) that *confidence in Mathematics* is a way where the students express their thoughts and ideas and are no longer scared in answering mathematics. The increasing percentage of performance in the subject could indicate that the students could perform well in Mathematics. Therefore, the level of confidence in Mathematics of STE students is oftentimes manifested.

Importance of Mathematics the indicator that is described as the high level is the importance of Mathematics. Hence this is also the same as Sanchal and Sharma (2017)'s through their study revealed a high percentage that the student found Mathematics a worthwhile and necessary subject in their daily lives which makes it an integral part of their performance in Mathematics. Thus, the *importance of Mathematics* among STE students is oftentimes manifested.

The last indicator, *Engagement in Mathematics*, is described as a minimum. As to Afari et al. (2013), engagement is an essential factor that students showed willingness and a positive attitude toward Mathematics. Hence, engagement in Mathematics among the STE students is manifested.

Table 5. Level of Attitude in Learning Mathematics

Attitude in Learning Mathematics	Mean	SD	Description
Confidence in Mathematics	3.90	0.43	Minimum
Importance of Mathematics	4.93	0.71	High
Engagement in Mathematics	3.76	0.59	Minimum
Overall mean	4.30	0.48	High

Legend:

1.00 – 1.83 Extremely low	2.68 – 3.51 Low	4.34 – 5.16 High
1.84 – 2.67 Very low	3.52 – 4.33 Minimum	5.16 – 6.00 Very High

Level of Reflective Thinking Skills

Table 6 shows the summary data that has been gathered and collated. The result of the respondents' reflective thinking skills showed a mean of 4.54 and a standard deviation of 0.57 indicators at a high descriptive level. The score signifies that the reflective thinking skills of the STE students are oftentimes manifested.

The respondent's responses that the reflective thinking skills have a high level when it comes to problem-solving skills the same also when the students that have higher-order thinking skills got the capability to apply and evaluate alternative solutions that enable them to get to the correct answer (Cumaoğluet al., 2009).

Table 6. Level of Reflective Thinking Skills

	Mean	SD	Description
Reflective Thinking Skills	4.50	0.59	High

Legend:

1.00 – 1.83 Extremely low	2.68 – 3.51 Low	4.34 – 5.16 High
1.84 – 2.67 Very low	3.52 – 4.33 Minimum	5.16 – 6.00 Very High

Level of Problem-Solving Skills

Table 7 shows the level of performance in Mathematics of STE students was measured through the score result of the standardized problem-solving skills from Indumathi and Ramakrishnan (2017). The result shows a mean of 15.26 and a standard deviation of 2.86 with a description level of high. The high score indicates that the problem-solving skills of the STE students level of problem-solving skills are very satisfactory.

Table 7. Level of Problem-Solving Skills

	Mean	SD	Description
Problem-solving Skills	15.26	2.86	Very Satisfactory

Legend:

17 – 20 Outstanding	13 – 16 Very satisfactory	9 – 12 Satisfactory
5 – 8 Fairly satisfactory	1 – 4 Did not meet expectation	

In this study, it is revealed that the high level of problem-solving skills of the students means that they can answer challenging and tough questions. Determination to solve Mathematical problems is shown

with the result of the level of problem-solving skills. And is determined to get the correct answer. It was supported by Adair et al. (2000) that problem-solving skill is essential thinking that could make the student solve challenging mathematical activities, as well as develop the intellectual capability of the students in order of getting high performance in Mathematics.

Level of Performance in Mathematics

Table 8 shows the summary data that has been gathered from the respondents regarding their performance in Mathematics. The result shows a mean of 90.43 and a standard deviation of 2.48 with a very high description of the level of performance. A score of a very high level signifies that the average performance in Mathematics of STE students is outstanding. This means that the students applied their learnings in Mathematics, and as a result, they got a very high level of performance.

Table 8. Level of Performance in Mathematics

	Mean	**SD**	**Description**
Performance in Mathematics	90.43	2.48	Outstanding

Legend:
90 - 100 Outstanding 85 - 89 Very satisfactory 80 - 84 Satisfactory
75 -79 Fairly satisfactory below 75 Did not meet expectation

Further, according to Kupcu and Ozdemmir (2012), the reason for the higher performance of the students is how they comprehended and analyzed the given mathematical problem through these students will have excellent performance. moreover, students are encouraged to learn more basic skills that would make them unable to be equipped to solve a mathematical problem resourcefully and creatively (Generalao, 2012).

Relationship Between Attitude in Mathematics, Reflective Thinking Skills, Problem-Solving Skills and Performance in Mathematics

Table 9 shows the correlation between attitude in Mathematics, reflective thinking skills, problem-solving skills, and performance in Mathematics of STE students. Correlation analysis indicated that student's attitudes in Mathematics showed a statistical significance p-value of 0.000 and r-value of 0.501, which means that there is a positive significant relationship between students' attitudes in Mathematics and their performance in Mathematics, as well as reflective thinking skills, has a p-value of 0.02 with an r-value of 0.398, it means that there is a significant relationship between reflective thinking skills and the performance in Mathematics of the STE students. However, problem-solving skills are not significantly correlated to performance in Mathematics since the r-value is -0.257 with p-value of 0.052. In addition to the result, Manoah et al. (2011) say that the attitude of students toward Mathematics is considered an essential factor that helps the students to have a high performance in Mathematics. It was found that students could get a higher grades because there is a significant and positive relationship between reflective thinking skills of the students in Mathematics performance (Basa &Kıvılcım, 2013). Sheikhpour (2012) also stated that now a day's students face difficulties in solving problem; however, problem-solving skills help them to think creatively which it could make their performance good. Hence these variables are considered essential factors to help the student to conquer fears in answering Mathematical problems and to improve their performance in Mathematics, which is their grade.

Table 9. Relationship between Attitude in Mathematics, Reflective Thinking Skills, Problem-Solving Skills and Performance in Mathematics

Independent Variables	**Performance in Mathematics**
Attitude in Mathematics	.501**

	(.000)
Reflective thinking skills	.398**
	(.002)
Problem-solving skills	-.257**
	(.052)

Predicting Performance in Mathematics through Attitude in Mathematics, Reflective Thinking Skills and Problem-Solving Skills

Table 10 shows the data analyzed by regression analysis to test if the predictors namely attitude in Mathematics, reflective thinking skills, and problem-solving skills significantly predict the performance in Mathematics of the STE students. The results indicated a significant prediction of performance in Mathematics. Therefore, the null hypothesis of this study is rejected.

The R^2 of 0.309 or 30.9 percent of the variance in performance in Mathematics is explained by the attitude in Mathematics, reflective thinking skills, and problem-solving skills. In comparison, the other 69.1 percent is the coefficient of alienation that is not covered in the study. The data illustrate that, in general, attitude in Mathematics has a considerable influence on performance in Mathematics. The other remaining two predictors scored higher than the significant level, meaning they were regarded as not significantly predicting performance in Mathematics.

Table 10.Predicting Performance in Mathematics through Attitude in Mathematics, Reflective Thinking Skills and Problem-Solving Skills

Reflective Thinking Skills, Attitude in Learning in Mathematics, and Performance in Mathematics	Performance in Mathematics			
	B	B	*T*	*Sig.*
Constant	80.248			
Attitude in Mathematics	1.767	.357	2.675	.010
Reflective Thinking Skills	.948	.236	1.861	.068
Problem-solving skills	-.110	-.132	-1.100	.276
R = 0.554				
R^2 = 0.306				
F =7.955				
P = 0.000				

The result affirms the study of Han and Carpenter (2014), which stated that attitude in learning mathematics when developed and changed to a positive attitude is formed progress to student learning, which is the performance of the students. Lots of studies show that attitude towards Mathematics is directly and significantly associated with students' performance. It also collaborated with the statement of Joseph (2013) that attitude is reflected by the view and emotion and sometimes manifested in performance.

Model that predicts Performance in Mathematics STE Students

Below is the formula for predicting the dependent variable, which is the performance in Mathematics of STE students. Further, the simulation of the said model is discussed in this section.

The formula for Multiple Linear Regression:

$$y= \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 \beta_4 + \varepsilon$$

Model for Performance in Mathematics of STE Students:

Performance = 80.248 + 1.767(Attitude) + 0.948 (Reflective thinking skills) -0.110 (Problem-solving skills)

Table 11. Simulation of the Performance in Mathematics Model

Attitude in Mathematics	Reflective Thinking Skills	Problem Solving Skills	Performance in Mathematics
4.13	3.74	14	82.85

Legend:
17 – 20 Outstanding 13 – 16 Very satisfactory 9 – 12 Satisfactory
5 – 8 Fairly satisfactory 1 – 4 Did not meet expectation

If an STE student is having a high positive attitude towards mathematics (4.13), higher-order thinking skills (3.74), and very satisfactory skills in solving a given problem (14), the student will have satisfactory performance in Mathematics (82.85). This means that if STE students enhance their abilities, their progress will be reflected in their performance in Mathematics. A positive attitude and thinking skills will make the students successful in Mathematics performance.

Attitude in Mathematics, Reflective Thinking Skills, Problem-Solving Skills in Performance in Mathematics

The result revealed that the level of attitude in mathematics is high, meaning the attitude in learning mathematics of science, technology, and engineering students are oftentimes manifested. The result also, shows that STE students are valuing the importance of mathematics as part of their Mathematics performance. According to Barnes and Venter (2008) that confidence in Mathematics is a way where the students express their thoughts and ideas and are no longer scared in answering mathematics. The increasing percentage of performance in the subject could indicate that the students could perform well in Mathematics. Furthermore, this affirms the statement of Sanchal and Sharma (2017). Also, students' attitude has a positive correlation with their interaction, self-efficacy, and self-determination (Nasir &Neger, 2022).

The result revealed that the level of reflective thinking skills is high, meaning the reflective thinking skills of science, technology, and engineering students are oftentimes manifested. The result also, shows that the respondent's responses that the reflective thinking skills have a high level when it comes to problem-solving skills the same also when the students that have higher order thinking skills got the capability to apply and evaluate alternative solutions that enable them to get to the correct answer (Cumaoğluet al., 2009).

The result revealed that the level of problem-solving skills is high, meaning the problem-solving skills of science, technology, and engineering students are very satisfactory. The result also, shows that the students mean that they can answer challenging and tough questions, the Determination to solve Mathematical problems is shown with the result of the level of problem-solving skills and it is determined to get the correct answer. It was supported by Adair et al. (2000) that problem-solving skill is essential thinking that could make the student solve challenging mathematical activities, as well as develop the intellectual capability of the students in order of getting high performance in Mathematics.

The result revealed that the level of performance in mathematics is very high, meaning the performance in mathematics of science, technology, and engineering students is significant. The result also, shows that it signifies the average performance in Mathematics of STE students is outstanding, which means that the students applied their learnings in Mathematics. Further, according to Kupcu

and Ozdemmir (2012), the reason for the higher performance of the students is how they comprehended and analyzed the given mathematical problem through these students will have excellent performance. moreover, students are encouraged to learn more basic skills that would make them unable to be equipped to solve a mathematical problem resourcefully and creatively (Generalao, 2012).

Relationships Between Attitude in Mathematics, Reflective Thinking Skills, Problem-Solving Skills and Performance in Mathematics

The result revealed that there there is a positive significant relationship between students' attitudes in Mathematics, reflective thinking skills and their performance in Mathematics. However, despite the overall result having a significant correlation, it was revealed in the table that the problem-solving skills are not significantly correlated to the performance in mathematics of STE student. This result confirms the assertion of Bruner (1966)'s constructivist theory that is a type of cognitive activity, or conscious intellectual activity, that emphasizes understanding, reasoning, and learning in a student. Constructing past and present knowledge into new ideas enables them to think beyond the information. Letting the student think deeply will result in improved skills and performance in certain areas, like as mathematics. Furthermore, it highlights the need for active learning as a foundation for true learning as well as the importance of reasoning in learning.

Moreover, the findings verify Flavell (1976)'s metacognition theory, that the attitude and performance of the student manifest when the cognitive thinking of the student is in process. This correlates the attitude and to the performance of the students in mathematics. If the students show an attitude of being critical thinkers, then it will be evident in their performance in mathematics.

Predicting Performance in Mathematics through Attitude in Mathematics, Reflective Thinking Skills and Problem-Solving Skills

The data was analyzed by regression analysis to test if the predictors namely attitude in Mathematics, reflective thinking skills, and problem-solving skills significantly predict performance in Mathematics of the STE students in general, attitude in Mathematics has a considerable influence on performance in Mathematics. The other remaining two predictors scored higher than the significant level, meaning they were regarded as not significantly predicting performance in Mathematics. The result affirms the study of Han and Carpenter (2014), which stated that attitude in learning mathematics when developed and changed to a positive attitude is formed progress to student learning, which is the performance of the students. Lots of studies show that attitude towards Mathematics is directly and significantly associated with students' performance. It also collaborated with the statement of Joseph (2013) that attitude is reflected by the view and emotion and sometimes manifested in performance.

5. Conclusion

The result showed an overall high level of attitude in learning Mathematics among the STE students. This signifies that the positive attitude of the students towards learning Mathematics is manifested.

A high level of reflective thinking skills was revealed; therefore, students are practicing reflective thinking, particularly in their academic endeavors. Problem-solving skills are very satisfactory among the STE students; hence, they are creative, innovative, have a deep understanding, and are able to solve mathematical problems.The study found that there is an outstanding performance in Mathematics among STE students. Hence, the STE students are excellently performing in the subject wherein they are believed to be more engaged and trained.

The study revealed that there is a significant relationship between the attitude in Mathematics and reflective thinking skills in the performance in Mathematics of the STE 10 students. This indicates that the positive attitude of the students and reflective thinking skills are both essential factors that lead students to get high performance in Mathematics.

The attitude in Mathematics, reflective thinking skills, and problem-solving skills revealed a model that significantly predicts performance in Mathematics. Thus, this suggests the rejection of the null hypothesis of the study.

5.1 Recommendation

In light of the findings and conclusions of the study, this study recommends that the Department of Education may consider the revealed model of this study for continuous improvement and further advancement of the performance of STE students in Mathematics. Further, students should consider instituting more reflective thinking skills and a desirable attitude toward learning Mathematics to further improve their performance in Mathematics. And lastly, future researchers may conduct further investigations related to performance in Mathematics since the study still revealed a significant amount of coefficient of alienations describing variance of dependent variable which the predictors did not cover.

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