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Metacognitive Strategies: Instructional Approaches in Teaching and Learning of Basic Calculus

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Abstract**—*****The purpose of the study is to determine the effectiveness of the metacognitive strategies as instructional approaches in teaching and learning of Basic Calculus. A number of 48 students consisting of 24 boys and 24 girls were purposively sampled in this study. Pretest-posttest quasi experimental research design was used which applied t-test and descriptive statistics. Both groups were subject to two instruments that were comprised of problem-solving test (pretest and posttest) and observation guide. Experimental group was taught Basic Calculus using metacognitive strategies while the control group was taught Basic Calculus using traditional teaching strategies. Both groups were subject to a pretest. Class observation was done while the two teaching strategies were applied. In the end, the posttest was administered to both groups to identify the effectiveness of the two teaching strategies. The data gathered were treated using paired sample t-test and independent sample t-test. The results of the study showed that the experimental group had significantly higher posttest scores as compared to control group which proved that metacognitive teaching strategies were more effective in improving the performance and problem-solving skills of the students than the traditional teaching strategies. It was also observed that students who taught using metacognitive strategies helped the students to be extremely engaged in Basic Calculus lessons cognitively, behaviorally, and affectively. The study reveals that the significant increase of the students' learning engagement in Basic Calculus lessons led the students to a corresponding increase in their posttest scores.*

Keywords**— *****Basic Calculus, Instructional Approaches, Learning Engagement, Level of Proficiency, Metacognitive Strategies.***

I. INTRODUCTION

The K-12 curriculum of the Philippines has been reconstructed from the former 10-year basic education into 13-year mandatory education which added Kindergarten and 2- years from Senior High School by virtue of the Republic Act No. 105333. Senior high school is composed of four tracks and one of these is "Academics" wherein the Science Technology, Engineering, and Mathematics (STEM) are included. The Science Technology, Engineering, and Mathematics (STEM) strand of the Philippines K-12 curriculum is designed to produce graduates in the secondary level who will take science, research, mathematics, and engineering related courses in the tertiary level. In senior high school, the STEM students are required to take Basic Calculus as part of the specialized subjects of the strand.

The K-12 Mathematics Curriculum Guide emphasizes the need of the students to learn and explore mathematics comprehensively because its value goes beyond the classroom and school. That is why the STEM curriculum plays an important role in producing trained professionals to enhance the academic performances of the learners, specifically in the field of mathematics.

Seeing that Basic Calculus is one of the specialized subjects in Science, Technology, Engineering, and

Mathematics (STEM), it is substantial for the future career and next level of education of the students. According to the authors in [13], Calculus is one of the subjects that is relevant and beneficial in real life situations. However, many students have difficulty in learning Basic Calculus because majority of the junior high school students entering in the senior high school have weak performance in mathematics. [1] stated that mathematical education is still plagued with problems in terms of mastery of mathematical concepts. This statement revealed that the competencies needed in taking the Basic Calculus were possibly not attained.

In the study of [4] as cited by the authors, the performance of the junior high school in mathematics was weak. Additionally, the study of [5] pointed out that the majority of the students were in the beginning level of mathematics proficiency. The strategies/approaches used by the majority of the teachers in teaching Basic Calculus are sometimes laborious and complicated for the students. As observed by the authors, some students are not performing well in mathematics because they have not developed the needed skills. The reason behind, they are taught by the content of the books but they are not trained to recognize what they know and how to learn to think to develop their metacognitive skills. Calculus teachers seldom used engaging learning activities and mostly did not hear the queries and concerns of the students during the discussion. Instead, they had always resorted into lecturing, giving board works, and providing graded recitation. Mathematics educators may consider positive approaches and innovative teaching strategies instead of making use of traditional approaches in teaching Calculus, [6] emphasized that without new approaches to instruction that connect to the learning needs of students, many will perform poorly and are likely to cause drop outs. Therefore, it is essential to pursue the teaching strategies that employ collaborative learning, group activities that arouse the students' interest, and value the learners' queries and concerns [8].

In attempting to innovate the teaching and learning strategies, metacognitive strategies in teaching and learning of Basic Calculus may help to find a solution to these problems. Metacognitive strategies, like thinking aloud and journal writing may help the students understand the way they learn and the way they think of their thinking process to develop the metacognitive skills. Specifically, this study sought to find out the performances and problem-solving skills of the students in their pretest and posttest examination and the significant difference that exists between the two tests and the level of students' learning engagement.

Likewise, the findings of this study may help the school system in general to introduce the metacognitive strategies as one way of increasing the performances of the learners and problem-solving skills, especially in mathematics in which this research study would become beneficial and meaningful.

II. METHODOLOGY

This study used pretest-posttest quasi experimental research design. The pretest and posttest quasi experimental design measures the degree of change before and after the specified treatment or intervention. The basic premise behind the pretest- posttest design involves obtaining a pretest measure of the outcome of interest prior to administering some treatment followed by a posttest on the same measure of treatment occurs [12]. The subjects of the study were the Grade 11 STEM students enrolled in Basic Calculus subject. A group of twenty-four (24) students from the experimental group and twenty-four (24) students from the control group were chosen to be the involved in this research study. The control group was exposed to the traditional teaching strategies while the experimental group used the metacognitive strategies such as thinking aloud and journal writing.

Two instruments were used in data gathering. Firstly, the Problem-Solving test (pretest and posttest) a teacher made test designed to measure the performances and the problem-solving skills of the students. The researchers personally administered a 20-item pretest and posttest to secure the data of their performance in Basic Calculus. Before, the problem-solving test was composed of 30 items and trimmed down to 20 items after the validity and reliability was made. Secondly, Observation Guide which was done through the class observation during the teaching and learning of Basic Calculus to measure the students' learning engagement.

The statistical tools utilized in this study were frequency count, mean, percentage, and independent / paired sample t-test.

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III. RESULTS AND DISCUSSION

3.1 Pretest Scores of the Control and Experimental Group

Based on the Table 1, control group obtained a pretest mean scores of 1.67 while 1.83 for the experimental group that implies both groups are generally comparable in their performance and problem-solving skills. There were 24 or 100% of the subjects in both groups reached the proficiency level of "Did not Meet the Expectations" which means that students did not meet the establish expectations given by the Department of Education

Table 1. Comparison of the Pre-test Scores of the Control and Experimental Group.

Proficiency	Score	Control Group		Experimental Group	
		Freq.	Percent	Freq.	Percent
Outstanding	18-20	0	0%	0	0%
Very Satisfactory	16-17	0	0%	0	0%
Satisfactory	14-15	0	0%	0	0%
Fairly Satisfactory	12-13	0	0%	0	0%
Did Not Meet Expectation	0-11	24	100%	24	100%
Mean		1.67		1.83	
Standard Deviation		1.56		1.71	

The data indicate that the performance and problem-solving skills of the students in Basic Calculus were low before the experiment. This finding proved that if there are no appropriate strategies applied in the teaching and learning process, the proficiency level of the students will not meet the indicated expectations. This finding was similar to the study of [7] stating that students would have poor performance if there are no teaching strategies applied. Additionally, the standard deviation indicated that the pretest scores of the students under the experimental group is more scattered compared with the students under the control group.

3.2 Posttest Scores of the Control and Experimental group.

As revealed in table 2, the posttest scores of the students under experimental group had the greater mean score as compared the posttest scores of control group. The mean score of 8.75 for the control group reached the proficiency level of "Did Not Meet the Expectation" while the mean score of 13.38 for the experimental group reached the proficiency level of "Satisfactory". There is a difference of 4.63 which indicates that the performance and problem-solving skills of the students under experimental group is higher than the control group

The frequency and percentage results of both groups show that there are a greater number of students under the experimental group who reached the outstanding level of proficiency while there is only 1 student in the control group. Also, a bigger number of students from the control group did not meet the established proficiency set by the Department of Education while few students from experimental group remain the proficiency level of "Did not meet the Expectation.

Table 2. Comparison of the Posttest Scores of the Control and Experimental Group.

Proficiency	Score	Control Group		Experimental Group	
		Freq.	Percent	Freq.	Percent
Outstanding	18-20	1	4.17%	8	33.33%
Very Satisfactory	16-17	0	0%	2	8.33%
Satisfactory	14-15	0	0%	3	12.50%
Fairly Satisfactory	12-13	4	16.67%	3	12.50%
Did Not Meet Expectation	0-11	19	79.17%	8	33.33%
Mean		8.75		13.38	
Standard Deviation		3.50		4.19	

This implied that both groups increase their performance and problem-solving skills, but the experimental group had a greater improvement. Findings signify that the use of metacognitive strategies like thinking aloud and journal writing is better than the traditional teaching strategies in improving the performance and problem-solving skills of the students. This finding was supported by [1] statements that metacognitive learning strategies can be used as intervention that help the students to attain mastery.

3.3 Significant Difference of the Pretest Score of Control and Experimental Group

Table 3 shows the pretest of the control and experimental groups which acquired a **t-value of 0.296** with a **significant value of 0.768**. Since the significant value computed was greater than the **significant value of 0.05,** it simply means that there was no statistically significant difference between the pretest of the control and experimental groups. The finding was the same with the research study about metacognitive strategies conducted by [11] where in the pretest of both the control and experimental groups was not significant when compared to the accepted level of significance.

Table 3. Difference of the Pretest Score of Control and Experimental Group

Test	Group	Mean	t-value	Sig. Value	Interpretation
Pretest	Control	1.67	0.296	0.768	Not Significant
	Experimental	1.83			

The result indicates that both groups possessed similarities in terms of their performances and problem-solving skills in Basic Calculus before the experiment was conducted. Additionally, it revealed that that the students had almost the same competencies and level of skills and emphasized that both groups were very acceptable to conduct the experiment on the teaching process.

3.4 Significant Difference of the Pretest and Posttest Score of Control Group

The Table 4 shows the pretest and posttest of the control group got a **t-value of -10.485** with a **significant value of 0.000.** The significant value of the control group is smaller than the **significant value of 0.05.** This concluded that there was significant difference between the performance and problem-solving skills of the students. This means that the intervention is effective in improving their performance.

Table 4. Difference of the Pretest and Posttest Score of Control Group

Group	Test	Mean	t-value	Sig. Value	Interpretation
Control	Pretest	1.67	-10.485	0.000	Significant
	Posttest	8.75			

The results reveal that using the traditional teaching strategies in Basic Calculus enhance the students' performance and problem-solving skills. The control group's pretest and posttest, have significant difference simply because of the teaching strategies used. According to [10], making use of other methods or approaches could improve or enhance the performance of the students. Additionally, when the lessons are introduced to the students, the problem-solving skills would increase. This only proves that any teaching strategy would help the students increase their knowledge toward the lesson.

3.5 Significant Difference of the Pretest and Posttest Score of Experimental Group

As seen on Table 5, the pretest and posttest of the experimental group acquired a t**-value of -14.579** with a **significant value of 0.000.** The significant value of the experimental group was smaller than the **significant value of 0.05** this simply indicates that there was significant difference between the pretest and posttest of the experimental group.

Table 5. Difference of the Pretest and Posttest Score of experimental Group

Group	Test	Mean	t- value	Sig. Value	Interpretation
Experimental	Pretest	1.83	-14.579	0. 000	Significant
	Posttest	13.38			

The result signifies that using metacognitive strategies enhance the students' performance and problem-solving skills in Basic Calculus. Metacognitive strategies in the teaching and learning of Basic Calculus were effective because of the bigger change of the pretest mean score of **1.87** to posttest mean score of **13.38.** Therefore, there was a significant difference in the metacognitive strategies and the students' level of performance. This finding was supported by [9] who confirmed that metacognitive instructions were effective in enhancing the academic performances of the students. The study of [9] reveals that students taught metacognitive instructions obtained higher metacognitive knowledge and achievement. Teachers should provide students with guidance throughout the problem-solving process and they should try to enable them to fill any gap. In this way, they can reveal and correct any mistake or wrong learning in the use of metacognitive strategies [11].

3.6 Significant Difference of the Posttest Score of Control and Experimental Group

As shown on Table 6, the posttest of the control and experimental groups acquired a **t-value of 3.818** with **a significant value of 0.000** which is lower than the **significant value of 0.05**. Therefore, there was statistically significant difference between the posttest of the control and experimental groups. This finding was parallel with the study conducted by [7] on the effect of the students' achievements using metacognitive strategies. The result revealed that there was significant difference in the control and experimental groups in which the finding favored the experimental group.

Table 6. Difference of the Posttest Score of Control and Experimental Group

Group	Test	Mean	t-value	Sig. Value	Interpretation
Experimental	Pretest	1.83		0.000	Significant
	Posttest	13.38	3.818		

The Table reveals that the level of performance of both groups differed from each other after the experiment. This implies that one group was better than the others. Meaning, both the teaching strategies were effective but the metacognitive strategies were more effective as compared to the traditional teaching strategies. This statement was supported by the posttest mean scores of both groups wherein the experimental group performed better than the control group in Basic Calculus.

According to [3], the use of the metacognitive strategy lessens the difficulty of the students which was encountered during the course of problem solving. They have the ability to reflect on their work results, clarify their thoughts about the concepts, and evaluate their learnings, resulting in the enhancement of their problem–solving skills after their exposure to the concepts and problem solving.

3.7 Students' Learning Engagement in Basic Calculus Using the Metacognitive Strategies

As seen on the Table 7, the highest mean of the students' cognitive engagement was on "The students are looking forward to learn more in Basic Calculus, "The students are asking help from their classmate in answering the Basic Calculus problems", and "The students are recognizing the value of learning Basic Calculus during the class" in which these engagement statements acquired a mean of **3.71** with a verbal interpretation of **significantly evident**. The second highest mean engagement was "The students are thinking a lot during the Basic Calculus class" that had a mean of **3.57** and a verbal interpretation of "**significantly evident"**. The lowest mean engagement obtained was on "The students are trying to learn as much as they could in the Basic Calculus class" with a mean of **3.43** having a verbal interpretation of **significantly evident.**

Table 7. Students' Cognitive Engagement in Basic Calculus

Cognitive Engagement	Mean	Interpretation
1. The students are looking forward to learn more in Basic Calculus.	3.71	Significantly Evident
2. The students are thinking a lot during the Basic Calculus class.	3.57	Significantly Evident
3. The students are asking help from their classmate in answering the Basic Calculus problems.	3.71	Significantly. Evident
4. The students are recognizing the value of learning Basic Calculus during the class	3.71	Significantly Evident
5. The students are trying to learn as much as they could in the Basic Calculus class.	3.43	Significantly Evident
Weighted Mean	3.63	Significantly Evident

The results signify that using the metacognitive strategies, the students actively participated during the discussion which could be inferred that they were interested and highly motivated to learn. This statement was supported by [11] that problem solving based on the metacognitive strategies was more interesting for the students to become more motivated to learn, and that they were eager to solve problems. The use of metacognitive strategies such as thinking aloud and journal writing increased the cognitive engagement of the students in the teaching and learning of Basic Calculus. These strategies also helped improve their performance and problem-solving skills. Therefore, the metacognitive strategies really helped the students to be cognitively engaged in Basic Calculus lessons as one of the prerequisites to improve the performance and problem-solving skills.

3.8 Behavioral Engagement

As observed on Table 8, the highest mean of the students' behavioral engagement was on "The students are listening to the teacher's discussion during Basic Calculus class". This engagement acquired a **mean value of 4.00** with a verbal interpretation of **significantly evident**. The second highest mean engagement were on "The students are standing and answering teacher's questions when called in Basic Calculus class" and "The students are actively participating in the different activities in Basic Calculus class" with a **mean value of 3.86** and a verbal interpretation of **significantly evident.**

Table 8. Students' Behavioral Engagement in Basic Calculus

Behavioral Engagement	Mean	Interpretation
1. The students are listening to the teacher's discussion during Basic Calculus class	4.00	Sig. Evident
2. The students are standing and answering teacher's questions when called in Basic Calculus class	3.86	Sig. Evident
3. The students are raising their hands whenever they know the answers.	3.57	Sig. Evident
4. The students are raising their hands and asking questions whenever they have queries about the lesson presented in Basic Calculus class.	3.57	Sig. Evident
5. The students are actively participating in the different activities in Basic Calculus class.	3.86	Sig. Evident
Weighted Mean	**3.77**	**Sig. Evident**

The findings imply that through metacognitive strategies like thinking aloud and journal writing, the students were helped to be more active listeners during the teacher's discussion and to be more active in asking questions and in raising their hands whenever they had queries. The interaction between the teacher and the students during the activities was an essential tool for the learners' extreme behavioral engagement. In the study of [7] as they observed, think aloud strategies in the experimental group influenced the students to ask questions whenever they had queries because their misconceptions bothered them in the process. Think-aloud strategies allowed students to say what they were thinking, thus, the queries that they were keeping were mentioned.

3.9 Affective Engagement

The Table reveals that the highest mean of the students' affective engagement was achieved by the statement "The students are enjoying the activities during Basic Calculus class" with a **mean value of 4.00** with a verbal interpretation of **significantly evident**. The second highest mean engagement was acquired by the statements "The students are helping their classmates in solving Basic Calculus problems whenever they have difficulties during Basic Calculus class", "The students are sharing their ideas and notes to their classmates in Basic Calculus class", and "The students are not bored during Basic Calculus class" with a **weighted a mean value of 3.71** and a verbal interpretation of **significantly evident.** The lowest mean engagement was obtained by the statement "The students are interesting of what they are learning in Basic Calculus" with a **weighted mean of 3.57** and a verbal interpretation of **significantly evident.**

Table 9. Students' Affective Engagement in Basic Calculus

Affective Engagement	Mean	Interpretation
1. The students are helping their classmates in Basic Calculus problems whenever they have difficulties during Basic Calculus class	3.71	Significantly Evident
2. The students are sharing their ideas, concerns and notes to their classmates in Basic Calculus class	3.71	Significantly Evident
3. The students are interesting of what they are learning in Basic Calculus	3.57	Significantly Evident
4. The students are enjoying the activities during Basic Calculus class	4.00	Significantly Evident
5. The students are not bored during Basic Calculus class	3.71	Significantly Evident
Weighted Mean	**3.74**	Significantly Evident

Based on the findings, through metacognitive strategies like thinking aloud and journal writing helped the students to enjoy the activities given by the teacher and also created a road in helping and sharing of ideas and notes with their classmates in solving the Basic Calculus problems. Further, the said strategies assisted the students to be interested and not to feel bored during the discussion. This implies that metacognitive strategies really helped the students to be affectively engaged in the lessons.

According to [15], emotional engagement was positively correlated to the academic performance of the students. The greater the affective engagement of the students the better the performance.

3.10 Comparison of the Learning Engagement of both groups in Basic Calculus

Table 10. Over-all Learning Engagement of Control and Experimental Group

Learning Engagement	Control			Experimental		
	Mean	SD	Interpretation	Mean	SD	Interpretation
Cognitive	2.94	0.68	Evident	3.63	0.55	Sig. Evident
Behavioral	2.97	0.71	Evident	3.77	0.43	Sig. Evident
Affective	3.00	0.76	Evident	3.74	0.44	Sig. Evident

Table 10 shows that the students' cognitive, behavioral and affective engagement under the control group obtained a verbal interpretation of "Evident" while the students under the experimental group obtained "Significantly Evident". The standard deviation shows that the data given during the observation in the control group were more dispersed as compare to the experimental group. The learning engagement of those students who were taught using metacognitive strategies like thinking aloud and journal writing was higher than the students who were taught with traditional teaching strategies. It implies that the use of metacognitive strategies could increase the students' learning engagement more than the traditional teaching strategies. According to [8], cognitive, affective (emotional) and behavioral engagement had a strong relationship in the performance or achievements of the students. Metacognitive strategies may have to be incorporated in the teaching and learning process so that the students would be highly engaged in the lessons, and in the long run, would improve the students' academic performances and problem-solving skills. In the study of [2], one of the most important indicators of quality teaching strategies is the student engagement in teaching and learning process. The more the students are engaged in the lessons, the better the teaching strategies are applied.

IV. CONCLUSION

Based on the findings the following conclusions are attained.

1. Both the control and experimental groups possessed similarities in terms of their performance and problem-solving skills in their pretest with a proficiency level of "**"Did Not Meet the Expectation".** Both groups had no enough knowledge and problem-solving skills as showed difficulties in solving Basic Calculus problems before the two teaching strategies were applied.
2. The posttest mean scores revealed that the experimental group had greater improvement in their performance and problem-solving skills than the control group. The control group manifested a proficiency level of **"Did Not Meet the Expectation"** while the experimental group manifested a proficiency level of **"Satisfactory".** Therefore, metacognitive strategies like thinking aloud and journal writing generally benefited and improved the performance and problem-solving skills of the students than the traditional teaching strategies.
3. There is no significant difference between the pretest of control and experimental group. This implied that the level of performance and problem-solving skills of the both groups are almost the same before the experiment.
4. There is a significant difference between the pretest and posttest of the control group. This implied that the traditional teaching strategies are effective in improving the performance and problem-solving skills of the students. Even though the traditional teaching strategies were used to teach the control group, the students still managed to learn the lessons as showed the increased in their posttest showing that the traditional teaching strategies were still considered as effective.
5. There is a significant difference between the pretest and posttest of the experimental group. This implied that metacognitive strategies are effective in improving the performance and problem-solving skills of the students. The bigger increase of posttest mean score of the experimental group confirmed that the metacognitive strategies were more effective.
6. There is significant difference between the posttest of the control and experimental group. This reveals that the level of performance and problem-solving skills of both groups differed from each other after the two teaching strategies were introduced. This implies that one group was better than the other. Meaning, both the teaching strategies were effective but the metacognitive strategies were more effective as compared to the traditional teaching strategies.

7. Metacognitive strategies helped the students to be more engaged in the teaching and learning of Basic Calculus. Furthermore, metacognitive strategies like thinking aloud and journal writing helped the students to be extremely engaged in Basic Calculus lessons cognitively, behaviorally, and affectively. The more the engagement of the students in the lesson, the better they could perform in their problem-solving tasks.

V. RECOMMENDATION

Based on the conclusions the following are recommended.

1. Teachers may always conduct pre-assessment instrument to determine the level of difficulties of a particular lesson of the subjects, and to help them create an instructional plan and strategies to lessen or avoid learning difficulties.
2. Teachers may develop interesting and highly motivated teaching strategies that promote belongingness.
3. Teachers may also value the queries and concerns of students during the learning process [8].
4. The teacher may incorporate the metacognitive strategies such as thinking aloud and journal writing in every teaching process.
5. It is essential that the Department of Education may provide trainings and seminars to the teachers for them to gain knowledge about the metacognitive teaching strategies.
6. Similar research studies about teaching strategies that valued the queries and concerns of the students is recommended to determine the degree of relationship between learning and valuing the learners' queries and concerns.
7. The school administrators are encouraged to implement the metacognitive strategies such as thinking aloud and journal writing in the teaching and learning of mathematics since they help the students to extremely be engaged cognitively, behaviorally, and affectively toward the lessons.

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REFERENCES

[1] Abu Bakar, M.,Ismael, N. (2020). Metacognitive Learning Strategies in Mathematics Classroom Intervention: A Review of Implementation and Operational Design Aspect. International Electronic Journal of Mathematics Education e-ISSN: 1306-3030. 2020, Vol. 15, No. 1, em0555

[2] Cakir, H., Saritepeci, M. (2015). The Effect of Blended Learning Environments on Student Motivation and Student Engagement: A study on social studies course. DOI:10.15390/EB.2015.2592

[3] Casaig, M.E (2017). The effect of Metacognitive Strategies in the Problem-Solving Skills of College Algebra Students. *International Journal of New Technology and Research* ISSN: 2454-4116

[4] Del Rosario, J., & Subia, G., Lopez C. (2018). Preparing Junior High School Students in Science, Technology, Engineering and Mathematics (STEM) Track Using Journal Writing in Mathematics. International Journal of Advanced Engineering, Management and Science (IJAEMS). ISSN: 2454-

[5] Estonato, A.J. & Dio,R. (2019). Factors causing Mathematics Anxiety of Senior High School Students in Calculus. *Asian Journal of Education and e-Learning.* ISSN: 2321 – 245

[6] Ganyaupfu, E 2013, 'Teaching methods and student's academic performance', International Journal of Humanities and Social Science Invention, ISSN (Online): 2319 – 7722, ISSN (Print): 2319 – 7714

[7] Gaylo, D., Dales, Z. (2017) Metacognitive Strategies: Their Effects on Students' Academic Achievement and Engagement in Mathematics. *World Review of Business Research* Vol. 7. No. 2. September 2017 Issue. Pp. 35 – 55.

[8] Gunuc, S.(2014) The Relationship between Student Engagement and their Academic Achievement, *International Journal on New Trends in Education and Their Implications*, Volume: 5 Issue: 4 Article: SSN 1309-6249

[9] Jayapraba, G 2013, 'Metacognitive instruction and cooperative learning strategies in promoting insightful learning in science', *International Journal on New Trends in Education and Their Implications*, ISSN 1309-6249

[10] Magsino, N.F. (2018). Computational Competence on Basic Calculus of STEM Students through Mathematical Games. Asia Pacific Journal of Education, Arts and Sciences P-ISSN 2362-8022 E- ISSN 2362-8030

[11] Sahin, S., Kendir, F. (2013). 'The effect of using metacognitive strategies for solving geometry problems on students' achievement and attitude', Educational *Research and Reviews*, vol. 8, no. 19, pp. 1777-1792, ISSN 1990-3839 © 2013 Academic Journals

[12] Salkind, N. (2010) Encyclopedia of Research Design https://dx.doi.org/10.4135/9781412961288.n331

[13] Ancheta, C.M, Subia, G. (2020). Error Analysis of Engineering Students' Misconceptions in Algebra International Journal of Engineering Trends and Technology. Volume 68 Issue 12, 66-71, December 2020 ISSN: 2231 – 5381

[14] Estonanto, A. J. (2017). Impact of Math Anxiety on Academic Performance in Pre-Calculus of Senior High School. *Liceo Journal of Higher Education*. Liceo de Cagayan University. 13(2), 102-119

[15] Delfino, A. (2019). Student Engagement and Academic Performance of Students of Partido State University. Faculty of Education, Partido State University, Philippines