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MOTIVATED STRATEGIES FOR SELF-REGULATED LEARNING IN CALCULUS IN RELATION TO SELECTED VARIABLES

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ABSTRACT
This study aspired to uncover motivated strategies for self-regulated learning in calculus in relation to selected variables – attitude towards technology and academic performance in calculus. This study used the mixed method approach. The participants of this study were the engineering students in two private schools of Tagum City, enrolled during the S.Y. 2022-2023 comprised of 321 students as the sample size, utilizing a stratified random sampling technique.. Mean, T-test, Pearson-r and Thematic Analysis were the statistical tools being used in interpreting the data gathered. Findings were, self-regulated learning is manifested in almost all occasions, motivated strategies for learning calculus is observed, there is no significant difference on the level of motivated strategies for learning calculus of the participants when analyzed according to gender but found significance when grouped according to school, attitude towards technology is manifested, there is no significant difference on the level of attitude towards technology of the participants when analyzed according to gender and school, the academic performance of the participants in calculus meets the expectations in some occasions, there is no significant difference on the level of academic performance of the participants when analyzed according to gender and school, there is a significant relationship between motivated strategies and self-regulated learning in calculus, there is a significant relationship between motivated strategies for learning calculus and attitude towards technology, there is a significant relationship between motivated strategies and academic performance in calculus and there are four (4) major themes about problems and challenges encountered in learning calculus emerged from the participants: 1) Lack of knowledge of the concepts; 2) Poor application; 3) Complicated formulas and processes; and 4) Confusion in understanding mathematical problems. Based on the findings, students may adjust for the strategies that they used in the acquisition of learning. Teachers are encouraged to continuously monitor students' progress, especially on academic performance for them to create suitable interventions and cater to the learners needs to increase students' academic performance. Understanding the level of these areas may help to strengthen effectiveness of mathematical learning in calculus as well as to increase academic performance among engineering students.
KEYWORDS: *Academic Performance in Calculus, Attitude Towards Technology, Motivated Strategies for learning, Self-Regulated Learning in Calculus, Davao del Norte, Philippines*

INTRODUCTION
Motivated strategies for learning are one of the main determinants of learning achievement in numerous educational studies Crookes (2017). In mathematics class, several students have exhibited unmotivated learning strategies. These students have shown a lack of interest in understanding the topic and its intricate mathematical principles Ariapooran & Karimi (2021). Moreover, Katz (2018) attested that motivation for learning affects students' learning and performance. However, according to Boggiano (2017), there are significant issues found on students' motivational strategies for learning that should be explored as one of the essential variables for attaining effective motivation. In addition, Hopper (2021) added that students also have issues on their intrinsic value such as showing poor interest in learning, and often avoid engaging in challenging mathematics activities. Moreover, according to Little (2017), some students lack the motivation to study, are unhappy in the learning environment, and soon lose interest in the normal curriculum. Learning online involves unique problems, and learners may require some type of supplemental help to be successful particularly in learning mathematics (Breslow et al., 2013; Jordan, 2014).

On the other hand, distance learning has replaced face-to-face instruction in the new normal, Self-Learning Modules (SLM) are a standard teaching method used particularly in private schools. SLM allows students to learn from home. According to Azevedo et al. (2020), the school closure policy for COVID-19 has a significant potential impact on academic attainment. This will clearly create a huge gap in the learning situations of children who come from economically and geographically advantageous families (Tran et al., 2017). Moreover, the application of online tools in learning can be a challenge for students and higher education institutions (HEIs). There is an increasing number of mandatory online courses in curricula, Cohen & Baruth (2017). In this process, an essential skill is self-regulated learning (SRL), which encapsulates autonomous navigation through learning content and enables for students to be successful in capitalizing on what online learning environments have to offer (Ejubović & Puška, 2019).

In the Philippines, the quick implementation of online learning due to the COVID-19 pandemic impacts college students' issues on their motivated strategies for learning mathematics. In the study conducted by Barrot et al. (2021) found differences on the issues of students' motivated strategies for learning mathematics. Specifically, there are students who expressed dissatisfaction with online learning in general with communication and question-and-answer formats inside online class discussions and activities as well as low interest in learning mathematics due to numerous barriers encountered in a home learning environment, such as a lack of technological mastery, insufficient technological resources, high Internet costs, and limited interaction or socialization between and among students.

In addition, there are further issues found on students' motivated strategies for learning that include peer and group socialization, poor class interest, negative belief on the effectiveness of learning mathematics through online, and low motivation in mathematics Lacaden (2021). Furthermore, Gorenko and Unicheck (2021) stated that several studies have proven that integrating technology in learning improves student outcomes significantly as it opens new possibilities for home education. However, adapting to technology is more complicated. For example, the educational potentials of social media, both in the formal and informal learning contexts, have been widely acknowledged. However, how social media use in the informal contexts might influence students' learning in the formal contexts is still underexplored Lai (2019). Moreover, Ayanso and Moyers (2015); Liyanapathirana et al., (2019) argued a lack of research on technology usage by students towards mathematics.

OBJECTIVES

1. To determine the profile of the students in terms of gender and school.
2. To determine the extent of self-regulated learning in Calculus of the participants in terms of goal setting, environmental structuring, task strategies, time management, help-seeking, self-evaluation.
3. To ascertain the level of motivated strategies for learning Calculus of the participants in terms of self-efficacy, intrinsic value, cognitive strategy use, and self-regulation.
4. To determine the significant difference on the level of motivated strategies in learning Calculus of the participants when grouped according to profile variables.
5. To determine the level of students' attitude towards technology in terms of adoption intention, perceived usefulness, and perceived ease of use.
6. To ascertain the significant difference of the participants' attitude towards technology when grouped according to profile variables.
7. To determine the academic performance of the participants in Calculus.
8. To determine the significant difference on the academic performance of the participants in Calculus when grouped according to profile variables.
9. To ascertain the significant relationship between motivated strategies and self-regulated learning in Calculus, motivated strategies and attitude towards technology in learning Calculus and motivated strategies and academic performance.
10. To identify the problems and challenges encountered by the students in learning Calculus.

METHODOLOGY

This study used a mixed method of research, a combination of quantitative and qualitative research methods. The quantitative approach, particularly using the descriptive-correlational research design, was intended to assess the participants' level on motivated strategies for learning, extent on self-regulated learning, level on attitude towards technology and determine the academic performance of the participants in calculus course. The correlation between the main variables will be determined also, motivated strategies for learning and self-regulated learning, motivated strategies for learning and attitude towards technology and motivated strategies for learning and academic performance of the participants in calculus. Moreover, the qualitative design was used to determine the problems and challenges the participants encountered in learning Calculus.

The participants of this study were the engineering students in two (2) private schools of Tagum City, Davao del Norte, enrolled during the S.Y. 2022-2023. The chosen participants had completed the Calculus 1 and had experienced online classes as well as had used Self-Learning Module (SLM)of Self-Instructional Module (SIM) that was shared through Learning Management Systems (LMS) like Schoology, Google Classroom or Quipper.

Three (3) adopted standardized research tools were used in this research. These were purposefully selected and fitted the study's objective. The tools were standardized with indicated Cronbach Alpha value which means that it underwent content validity and reliability testing. The instrument on Motivated Strategies for learning was adopted from the Motivated Strategies for Learning Questionnaire (MSLQ) by Pintrich and De Groot (1990). The adopted online self-regulated learning questionnaire (OSLQ) by Barnard (2009) focus in measuring the extent in measuring the extent of self-regulated learning among students. The instrument for students' attitude towards technology was adopted from Technology Acceptance Model (TAM) initially proposed by Davis (1989) and refined by many others (Hendrickson & Latta, 1996; V. Venkatesh & Davis, 2000). The basis for the participants' academic performance was the obtained final grade in Calculus.
In-depth interviews were done to elicit information on the students' problems and challenges they encountered in learning Calculus as well as to validate responses from the questionnaire. Students' suggestions for teaching plan to address problems and challenges they encountered in learning Calculus was likewise obtained through this data gathering method.

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RESULTS

There were 321 participants, there were 218 male or 67.91% and 103 females or 32.09%. School A consists of 183 students or 57% and School B has 138 participants or 43% of the total 321 participants. For the extent of self-regulated learning of the participants, the six indicators namely goal setting, task strategies, time management, help-seeking and self-evaluation got the descriptive equivalent of extensive and one indicator, environmental structuring is highly extensive. All these ratings resulted to extensive which means that the extent of self-regulated learning is manifested in almost all occasions. The finding implies that environmental structuring is highly extensive to self-regulated learning in Calculus during online classes. Moreover, with self-regulation by using their skills and becoming self-efficacious, the students learn at their own pace, as well as be able to increase their effort in a learning situation and perform better in their duties towards their academic and co-curricular activities.

This result is parallel with the study of Lai and Hwang (2016) that students need to take an active role and become responsible for their own learning process. Additionally, highly self-regulated learners feel empowered because they perceived that success is largely dependent on their ability to effectively use and adjust learning strategies (Cleary, 2014).

Moreover, the level of motivated strategies for learning calculus of the participants, the indicators, intrinsic value, cognitive strategy, self-regulation and self-efficacy was high, which indicates that all are observed. Students have high different motivational factors that encourage them to engage in a teaching-learning environment. Specifically, the results clearly suggest that students have high personal beliefs and feelings towards certain tasks or activities in a teaching-learning environment. It is also emphasized that students also have a high thinking ability and perception towards using computers in a teaching-learning environment.

These results are supported by the idea that students have high intrinsic value in a learning environment provided by their perspectives to see a successful learning environment. Students with high intrinsic value can connect with the environment successfully, actively engage with course tasks, feel more encouraged and pushed to spend more time in the environment, and ultimately learn more effectively Daradoumis et al. (2022). The works of Thai et al. (2020) attested that there are students with a high degree of cognitive strategies in a learning environment and have personal views on the usage of computers in their learning environment. These students also possessed the ability to control their behaviors, actions, and thoughts in a classroom setting.

There are no significant differences in the participants' level of motivated strategies in learning calculus when grouped according to gender. The finding is in consonance with the results of Hamid and Singaram (2016) that statistically significant differences were found between gender and the composite score for motivation. Furthermore, the finding is supported by Sikhwari (2014) results, it was found that females had higher scores then males. These studies revealed that females generally engage more with academic activities than males and are consequently higher achievers academically.

There are significant differences on the participants' level of motivated strategies in learning calculus when grouped according to school in terms of self-efficacy, intrinsic value cognitive strategy use and self-regulation when analyzed according to school. The finding is supported by the result of Mundia et al. (2021) that significant differences emerging from the research outcomes on motivated strategies for learning as the participants were analyzed according to school they attended.

Furthermore, the level of attitude towards technology of the participants, the indicators adoption intention, perceived usefulness, and perceived ease of use was high which indicates that all items are manifested. It demonstrates that students have highly positive thoughts and perceptions about their experiences using technology as a tool of instruction in a classroom setting. Specifically, the results clearly highlight that students have a high personal belief about computer usefulness in terms of satisfaction to their individual needs in a teaching-learning environment. In addition, students have strong personal ideas towards computer usage and the convenience of using computers in their learning environment. Further, the result also indicates that students have a high frequency of using computers and their ability to recommend them to other students in a teaching-learning environment.

These findings are supported by the works of Ikhsan et al. (2019) which emphasized that computers have influenced the learning experiences of students. Computers have also influenced the learning experiences of students effectively and many have demonstrated favorable thoughts towards using them. As a result, many students share and encourage their peers or other individuals to utilize computers as part of their learning environment.

There is no significant difference in the participants' attitude towards technology when grouped according to gender specifically in all indicators, adoption intention, perceived usefulness and perceived ease of use regardless of gender. The results run contrary to the findings of Hoffman (2002) that girls are less interested in technology and technological careers, this interest also declines faster than for boys. Moreover, based on the study of Ardies et al. (2014), boys are more positive about a future technological job or study.

In addition, there are no significant differences in the participants' attitude towards technology when grouped according to gender. Moreover, the finding implies that there are no significant differences among the indicators, adoption intention, perceived usefulness and perceived ease of use even in different school. The result is opposite with the findings of Andrew et al. (2018) that found out that there is a significant difference in the students' attitude towards technology among the two chosen universities. These differences could reflect how often participants use technology in learning tools at their institution.

The participants' level of academic performance in calculus reveals a satisfactory performance of the participants. This finding is supported by Reiger (2011) stating that academic performance is significant since it is strongly linked to a student's positive outcomes. The finding is also parallel with the result of Widlund et al. (2018) who stated that it has been established that not only does academic performance influence students' educational experiences, aspirations, and trajectories, but that academic well-being also influences numerous educational outcomes.

There is no significant difference in the level of academic performance of the participants in calculus when they are grouped according to profile variables. This further implies that academic performance of the participants in calculus when they are grouped according to gender and school do not differ. The result is in congruence with the findings of Sorby et al. (2013) found out that there were no meaningful gender differences for the calculus grades.

Moreover, there is a significant relationship between motivated strategies and self-regulated learning in Calculus. This implies that motivated strategies for learning have positive correlation to self-regulated learning and both has a direct relationship when indicators of motivated strategies for learning in learning increases then the indicator of self-regulated learning also increases. This finding is parallel of Pintrich et al. (2003) as cited by Tong et al. (2019) found out that students' motivation is deeply and directly correlated with their self-regulation learning ability, the better one can self-regulate learning, the more likely he or she can maintain high levels of learning strategies and motivation.

The finding reveals that there is a significant relationship between the participants' motivated strategies for learning calculus and attitude towards technology. This means that the motivated strategies for learning calculus have direct connection to students' attitude towards technology and how students view their usage of computers in a learning setting. The result is in consonance with the works of Linnenbrink and Garcia (2012) who mentioned that by motivating students to explore computer integrated learning resources and understand their attitude towards technology, a growing interest leads them to have new experiences, which influences their motivated strategies for learning. Furthermore, Granito and Chernobilsky (2012) emphasized that attitude towards technology has a significant and strong relationship with students' motivated strategies for learning.

Furthermore, this study reveals that there is a significant relationship between the participants' motivated strategies and academic performance. This means that the motivated strategies for learning calculus have a direct connection to students' academic performance. This implies that there is a positive correlation between the two variables as participants' motivated strategies increases so as with the academic performance in Calculus. The result is parallel to the study conducted by Hamid & Singaram (2016) found that there is a significant moderate relationship between academic performance and the motivation strategies subsumed within task value and self-efficacy for learning performance. It is also associated with higher engagement in learning. Increased effort and engagement with the subject matter could contribute positively to academic performance. Self-efficacy for learning performance relates to the students' sense of confidence in their ability to achieve their goals. Moreover, the findings are also in consonance with the study conducted by Zbainos & Beloyianni (2018) that found that motivated strategies for learning significantly and positively correlated with academic achievement. Specifically, intrinsic value, self-efficacy, cognitive strategy use, and self-regulation were shown to be strongly correlated with academic achievement, while there was a low correlation between creative ideation and respondents' academic achievement.

Although students were exposed to an "extensive" to self-regulated learning, "high" motivated strategies for learning calculus, "high" attitude towards technology and was assessed as 'satisfactory' with their academic performance in calculus, they too have encountered difficulties and challenges in learning Calculus. These are summed up into four (4) major themes, namely: lack of knowledge of the concepts, poor application, complicated formulas and processes, and confusion in understanding mathematical problems.

Major Themes

1. Lack of knowledge of the concepts
   Interviews were conducted with six learners, who revealed that lack of knowledge of concepts in calculus led to difficulty on understanding the terms and concepts in calculus. These concepts, "basic principles" and "technical terms" that needs prior knowledge from lessons discussed from previous years that should have mastered already. Furthermore, they have had hard time solving the problem and accomplish certain given tasks, having trouble remembering formulas and equations, and often didn't understand them even when they were explained.
2. Poor Application
   One participant shared that he encountered difficulty about the formula and solving. Collectively, one can't understand the equation as well as having difficulties in fractions or decimals. Another participant added about his difficulty in applying rules and formulas to solve problems. Furthermore, a participant expressed that during the online class, one of the problems that he/she had encountered in learning calculus is about the simplification of derivatives since there are many coefficients involved. One had a hard time understanding derivatives and also graphing and another participant shared that sometimes he/she get stuck on a problem because the basics are forgotten.
3. Complicated Formulas and Processes
   One participant shared the problem or difficulty she encountered in learning Calculus was that there were many complicated formulas taught and later found out that there were alternative formulas that's much easier to understand. Another participant expressed her difficulty in solving complex equations. Further, one interviewee articulated some formulas and processes

are complicated to understand and one shared when different concepts are mixed up together it made the problem more complicated. Memorizing formulas, added by one participant. In addition, an interviewee shared that calculus is difficult and the problems that he/she encountered with a lot of formulas that needed to familiarize and memorize.

4. Confusion in understanding mathematical problems
Visualizing and interpreting some of the problems, and sometimes misinterpreted the given problem as one participant had shared. Confusion in understanding mathematical problems added by another participant. Problem solving and analyzing specifically pointed by one participant. Word problem questions are sometimes difficult to understand, solving word problems involving maxima and minima and difficulties on worded problems as what the other participants commonly shared.

SUGGESTIONS

Students may choose appropriate strategies that they use in the acquisition of learning. They may create new thoughts and discover new style while learning the lessons and answer seriously the items in the SLMs. They are encouraged to have a good time management in studying and have a positive mindset that everything could be learned so that their academic performance will improve. Moreover, teachers should continuously monitor students' progress specially on academic performance for them to create suitable interventions and cater the learners needs to increase students' academic performance. They may provide opportunities to talk with the students for them to know how to get help when having trouble in answering the SLMs, so that students' academic performance will increase. The administration also should be possible for the implementation of the researcher's propose action plan to enhance the students' self-regulated learning Calculus.

CONCLUSIONS

Based on the results of the research objectives, the researcher has come up with the following conclusion, there is a significant relationship between motivated strategies and self-regulated learning in calculus, a significant relationship between motivated strategies for learning calculus and attitude towards technology and a significant relationship between motivated strategies and academic performance in calculus.

TABLES AND REFERENCES

Table 1. Participants' Level of Motivated Strategies

Indicators	Mean	Descriptive Interpretation
Self-efficacy	3.54	High
Intrinsic value	4.00	High
Cognitive strategy use	3.93	High
Self-regulation	3.71	High
Overall Mean	3.79	High

Table 2. Significant Difference on The Participants' Level of Motivated Strategies in Learning Calculus When Grouped According to Gender

Motivated strategies	Mean	t- Value	p-value	Decision at 0.05
Self-efficacy	M=3.62 F=3.46	0.258	0.456	Accept Ho [Not Sig.]
Intrinsic value	M=3.98 F=4.02	0.145	0.389	Accept Ho [Not Sig.]
Cognitive strategy use	M=3.90 F=3.96	0.324	0.762	Accept Ho [Not Sig.]
Self-regulation	M=3.72 F=3.70	0.136	0.548	Accept Ho [Not Sig.]

Table 3. Significant Difference of The Participants' Motivated Strategies in Learning Calculus When Grouped According to School

Motivated strategies	Mean	t- Value	p-value	Decision at 0.05
Self-efficacy	A=3.40 B=3.68	2.564	<0.001	Reject Ho [Sig.]
Intrinsic value	A=3.50 B=4.50	3.241	<0.001	Reject Ho [Sig.]
Cognitive strategy use	A=3.45 B=4.41	3.058	<0.001	Reject Ho [Sig.]
Self-regulation	A=4.12 B=3.28	2.482	<0.001	Reject Ho [Sig.]

Table 4. Level of Students' Attitude Towards Technology

Indicators	Mean	Descriptive Interpretation
Adoption intention	4.00	High
Perceived usefulness	4.10	High
Perceived ease of use	4.08	High
Overall Mean	4.06	High

Table 5. Significant Difference in The Participants' Attitude Towards Technology When Grouped According to Gender

Motivated strategies	Mean	t- Value	p-value	Decision at 0.05
Adoption intention	M=3.92 F=4.05	0.542	0.356	Accept Ho [Not Sig.]
Perceived usefulness	M=3.98 F=4.12	0.368	0.489	Accept Ho [Not Sig.]
Perceived ease of use	M=4.04 F=4.12	0.854	0.367	Accept Ho [Not Sig.]

Table 6. Significant Difference in the Participants' Attitude Towards Technology When Grouped According to School

Motivated strategies	Mean	t- Value	p-value	Decision at 0.05
Adoption intention	A=3.94 B=4.05	1.458	0.078	Accept Ho [Not Sig.]
Perceived usefulness	A=4.08 B=4.12	2.654	0.215	Accept Ho [Not Sig.]
Perceived ease of use	A=4.05 B=4.10	2.924	0.324	Accept Ho [Not Sig.]

Table 7. Participants' Level of Academic Performance in Calculus

Academic Performance	Frequency	Percentage
90-100	37	11.53
85-89	102	31.78
80-84	95	29.60
75-79	87	27.10
Below 75	-	-
Total	321	100.00
Mean	83.54 (Satisfactory)	

Table 8. Significant Difference in the Academic Performance of the Participants in Calculus When Grouped According to Profile Variables

Variables	r- Value	p-value	Decision at 0.05
Academic Performance and Gender	1.112	0.148	Accept Ho [Not Sig.]
Academic Performance and School	2.236	0.136	Accept Ho [Not Sig.]

Table 9. Significant Relationship Between Motivated Strategies and Self-Regulated Learning

Variables	r- Value	p-value	Decision at 0.05
Motivated strategies and self-regulated learning	0.769	<0.001	Reject Ho [Sig.]

Table 10. Significant Relationship Between Strategies and Attitude Towards Technology

Variables	r- Value	p-value	Decision at 0.05
Motivated strategies and attitude towards technology	0.586	<0.001	Reject Ho [Sig.]

Table 11. Significant Relationship Between Motivated Strategies and Academic Performance

Variables	r- Value	p-value	Decision at 0.05
Motivated strategies and academic performance	0.161	0.04	Reject Ho [Sig.]

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