Journal of Interdisciplinary Perspectives
ISSN Print: 2984-8288, ISSN Online: 2984-8385
Vol. 2, No. 6, pp. 188-196, June 2024

Attitude in Learning as a Mediator for Engagement and Academic Performance in Mathematics

Raymund E. Carcueva
Samal National High School, Island Garden City of Samal, Davao, Philippines

Author email: raymund.carcueva@deped.gov.ph

Date received: April 11, 2024
Date revised: May 1, 2024
Date accepted: May 4, 2024

Originality: 85%
Grammarly Score: 99%
Similarity: 15%

Recommended citation:
Carcueva, R. (2024). Attitude in learning as a mediator for engagement and academic performance in mathematics. *Journal of Interdisciplinary Perspectives*, Vol. 2, Number 6, pp. 188-196. https://doi.org/10.69569/jip.2024.0097

Abstract. This study specifically focuses on mathematics, as it plays a crucial role in educational settings and is a fundamental subject for academic success. By examining the mediating effect of attitude on learning and its relationship with engagement, the research aims to understand how these variables contribute to academic performance in mathematics. The researcher used adapted survey questionnaires to collect information from 148 randomly selected respondents using the "Fishbowl Draw Method." Descriptive statistics, the Pearson product-moment correlation coefficient, and regression analysis were employed as statistical tools to analyze the data. These analyses indicated that students exhibited a high level of engagement, academic performance, and attitude toward learning mathematics. A significant relationship was found between student engagement and academic performance in mathematics, as well as between student engagement and attitude toward learning. However, the relationship between attitude toward learning and academic performance was not significant. Moreover, the impact of student engagement on academic performance was observed solely through its direct influence and not via an indirect effect stemming from attitudes toward learning. Accordingly, considering that attitude toward learning does not mediate the relationship between engagement and academic performance, students should focus on strengthening their classroom engagement to improve their academic performance. Future researchers are recommended to investigate other variables such as teaching methods and students' learning styles as mediators.

Keywords: Mathematics; Academic performance; Attitude in learning; Engagement.

1.0 Introduction

Poor academic performance in mathematics is a significant problem that affects students globally. It hinders their overall educational development and future opportunities. One of the key issues contributing to this problem is a lack of foundational understanding and conceptual clarity in mathematical concepts. Students may struggle to grasp fundamental principles, leading to difficulties in solving complex problems. Consequently, a negative attitude towards mathematics and fear of failure can further hinder motivation and engagement, worsening the problem of poor academic performance.

It is acknowledged that low-level academic performance is a global problem (ABD ALGANİ & ESHAN, 2019). The inherent complexity of mathematics is universally recognized, and even students pursuing engineering often encounter challenges in comprehending it (Quezada, 2020). Poor academic performance contributes to low mood (Awadalla, Davies & Glazebrook, 2020). This poor performance of our learners in mathematics is not just a problem of education alone but our country as a whole (Philippine Business for Education (PBEd), 2023).

Meanwhile, in Zimbabwe, a case study presented proves that there is a low academic performance (Varaidzai Makondo & Makondo, 2020). In Kenya, a qualitative case study showed that learners generally do not perform

well in mathematics, leading to poor performance (Mabena, Mokgosi, & Ramapela, 2021). In Jordan, a survey showed that their persistent instances of below-average academic performance resulted in an unwillingness to engage in the students' learning process (Al-Zoubi, & Younes, 2015). In Thailand, despite the significant number of resources spent on education, a survey confirmed that students' learning outcomes in national examinations in mathematics are low and have not improved (Durongkaveroj, 2023). In Malaysia, Abd Rahman, Khalid, Ismail, Kamisan, Norrulashikin, and Hamdan (2022) reported in their study that the unsatisfactory results among students in mathematics have become quite a phenomenon. Moreover, in the United States, a journalist reported that students' average math scores declined by 13 points on the 2022 Program for International Student Assessment compared to those recorded before the pandemic (Modan, 2023).

Additionally, in the Philippines, according to the 2019 Trends in International Mathematics and Science Study (TIMMS), Filipino students faced difficulty in arithmetic and only 1% of Filipino learners had reached a high standard of mathematical comprehension (Bernardo, 2020). The Davao region received a lower average score than the national average of 353 points in the 2018 Programme for International Student Assessment on mathematical literacy, which puts it below level 1 on the proficiency scale (Schleicher, 2019). Consequently, Davao City's students' performance in Mathematics is very low (Galabo, Abellanosa, & Gempes, 2018).

Furthermore, there was an increase in mathematically underprepared students enrolling in undergraduate courses, leading to low pass rates in higher education (HE) institutes (Chand, Chaudhary, Prasad, & Chand, 2021). The workforce of the nation will eventually become weaker, and it will affect productivity and key source of our economic growth and competitiveness (Malipot, 2023). Furthermore, the researcher was motivated by this realization to investigate the intervening effect of attitude in learning on the relationship between academic performance and engagement in greater detail, as there hasn't been enough research done in this area. This is an urgent matter since the continuous falling results on the academic performance of students in mathematics are very widespread

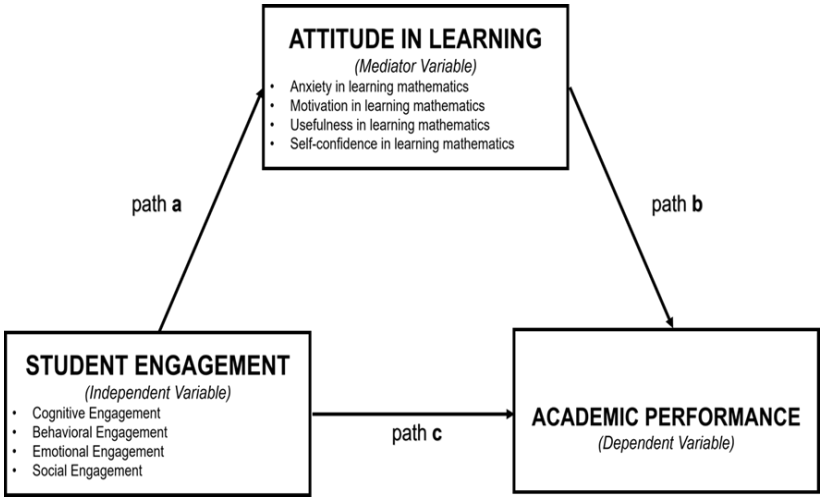

Figure 1. Conceptual framework of the study

2.0 Methodology

2.1 Research Design

The quantitative research design aimed to determine the intervening effect of attitude in learning on the correlation between engagement and academic performance by analyzing data from a wide selection of samples. Consequently, a quantitative approach was chosen. Correlational and descriptive research methods and path analysis were utilized to analyze the data further. The studied variables were student engagement as the independent variable, academic performance as the result or dependent variable, and student attitude in learning mathematics as the mediator between the two variables. Furthermore, a mediation analysis was employed to determine the effect of student attitude in learning on the relationship between student engagement and academic performance in mathematics. Mediation Analysis presumes that the independent variable impacts the mediator,

influencing the dependent variable (Abu-Bader, 2021). This study explored the relationship between the independent variable (engagement) and the outcome variable (academic performance) through the mediator variable (attitude in learning) by investigating its different effects.

2.2 Research Respondents

The study's respondents were taken from 236 students in one of the public high schools in Samal District. The sample consisted of male or female respondents, aged between 12 - 17, and enrolled as Grade 8 students during the 2022-2023 academic year. Moreover, the researcher considered the inclusion and exclusion criteria in the selection of respondents of the study. Using sample size determination to estimate the sampling size and to consider the 95% confidence levels and 5% margins of error, the researcher decided that 148 respondents are enough to acquire the required data. The researcher was aware that there may have been potential survey respondents who met the inclusion criteria yet possessed characteristics that could have been detrimental to the success of the research or increased the odds of an unfavorable outcome. This ensured that the researcher could obtain dependable and verifiable data, reduce the risk of harm to the target respondents, and protect them from being taken advantage of as vulnerable people.

2.3 Research Instruments

This study employed a three-part, adapted, and modified survey questionnaire as the primary research tool. The questionnaire included quantitative questions to gather specific responses from respondents about student engagement and attitude toward learning Mathematics. The adapted survey questionnaire comprises 25 items with four main components: anxiety, motivation, usefulness, and self-confidence about student attitudes in learning mathematics in Kasimu and Imoro's (2017) study. This adapted questionnaire is a five-point response item, ranging from 1 (Strongly disagree) to 5 (Strongly agree). This tool was designed to determine students' attitude level in learning mathematics through self-assessment.

Another adapted survey questionnaire comprises 26 items from the research questionnaire about Student Engagement conducted by Fredricks et al. (2016) with four main components: cognitive, behavioral, emotional, and social engagement. This instrument used a five-point response item ranging from 1 (Strongly disagree) to 5 (Strongly agree). This tool was designed to determine students' engagement levels through self-assessment.

The assessment of students' academic performance for the quarter was based on their grade in the fourth grading period of the academic year 2022 - 2023. The grading scale from the DepEd Order No. 8, 2015 was employed to interpret students' academic performance in Mathematics and will be interpreted from very low to very high. Furthermore, the grade, which is derived from the aggregate scores from diverse evaluations, serves as an indicator in this study (A. El Refae, Kaba & Eletter, 2021).

The survey questionnaire was validated by three (3) research experts in Mathematics and garnered a general average score of 4.67. The researcher administered the pilot test to fifteen (15) selected grade 8 students in one public school in the Island Garden City of Samal. Then, the result of the pilot test underwent reliability and validity tests administered by a data analyst. The result of the validity and reliability test of the adapted test questionnaires gave a general Cronbach's alpha internal level consistency value of 0.94, which was considered excellent (Bujang, Omar, & Baharum, 2018). There were no deleted test items in both adapted test questionnaires.

2.4 Data Gathering Procedure

The researcher distributed the survey questionnaire during the students' vacant periods. The selected classrooms provided for this purpose were adequately well-lit, well-ventilated, and furnished with enough armchairs for the respondents.

2.5 Ethical Considerations

This research study followed ethical guidelines. The respondents' participation was voluntary. They opted to dismiss themselves from answering the survey questionnaire at any point in time they felt uncomfortable. The researcher abided by the nine ethical considerations established by the Holy Cross of Davao College such as social value, informed consent and assent, risks, benefits and safety, privacy and confidentiality of information, justice, transparency, qualification of the researcher, adequacy of the facilities, and community involvement.

Furthermore, to ensure that this research is free from plagiarism from any plagiarism articles. The outcome of individual original work thus duly acknowledges all sources which the ideas and extracts have been taken in adherence to the law of Anti-Plagiarism.

2.6 Data Analysis Procedure

Mean. The mean was calculated by taking the sum of a set of integers and dividing it by the quantity of numbers in the series (Chen, 2021) to assess the level of student engagement, the level of attitude in learning, and the level of academic performance in mathematics.

Pearson's Product-Moment Correlation Coefficient. Pearson's correlation coefficient measured the strength of the relationship between two variables measured on the same interval or ratio scale (Kenton, 2022). This study utilized Pearson's product-moment correlation coefficient to investigate the relationship between student engagement and attitude in learning, attitude in learning and academic performance, and student engagement and academic performance in mathematics.

Mediation Analysis. In statistics, a mediation model was an analysis that aimed to discover the mechanism underlying an observed association between the independent and dependent variables (Baier, Kline, & Feeny, 2020). This technique was utilized to forecast the value of one variable based on the value of another. The study hypothesized that attitude in learning mediated the relationship between student engagement and academic performance. Hence, the use of mediation analysis was considered appropriate.

3.0 Results and Discussion

Table 1. Level of attitude in learning mathematics

INDICATORS	MEAN	SD	DESCRIPTIVE LEVEL
Anxiety	3.10	0.76	Moderate
Motivation	3.69	0.69	High
Usefulness	4.24	0.51	Very High
Self-Confidence	3.19	0.58	Moderate
Overall	3.55	0.36	High

Table 1 presents the level of attitude in learning in terms of anxiety, motivation, usefulness, and self-confidence among grade 8 students in Mathematics. Data revealed that the level of attitude in learning mathematics of grade 8 students is interpreted as high (M = 3.26, SD = 0.36). The results of the analysis show that the highest mean value is the indicator of usefulness (M = 4.24, SD = 0.51) measured on students' view on the importance of mathematics in their life and shows the value of mean interpretation very high and is always manifested compared to other indicators. On the contrary, the indicator of anxiety obtained the lowest mean (M = 3.10, SD = 0.76) which measured the feeling of unease, apprehension or fear that arises when a person is faced with mathematical task. In short, the high manifestation of attitude in learning mathematics of grade 8 students are affected by their usefulness, motivation, self-confidence rather than their anxiety. The mean value of all indicators is located between 3.10 and 4.24. Moreover, this positive attitude may encompass a strong interest in the subject, enthusiasm for mathematical challenges, and a willingness to engage actively in math-related activities.

This substantiates the idea of the authors, Davadas and Lay (2018), who noted that motivation, enjoyment, self-confidence, and usefulness in mathematics all contribute to developing individuals' attitudes toward the subject. This positive attitude towards mathematics dramatically influences one's ability to excel. Therefore, it is imperative to implement educational interventions to cultivate a positive attitude toward mathematics among students, as emphasized by Hwang and Son (2021). Additionally, achieving academic performance in mathematics education centers on students' perception of its usefulness, motivation, and self-confidence.

Table 2 presents the level of student engagement in terms of cognitive, behavioral, emotional, and social engagement among grade 8 students in Mathematics. Data revealed that the level of student engagement in mathematics of grade 8 students is interpreted as high (M = 3.85, SD = 0.42). The results of the analysis show that the highest mean value is the indicator of emotional (M = 3.95, SD = 0.59) measured the students' positive emotions when doing school-related activities and is interpreted as high level and is often manifested. On the contrary, the

indicator cognitive engagement mean value (M = 3.81, SD = 0.44) measured the active and meaningful mental processes that student engages in when learning mathematical concepts and the indicator behavioral engagement mean value (M = 3.81, SD = 0.54) which measures the observable expression of students' involvement in their educational activities. These indicators have the lowest mean values and are still interpreted as high. In short, the grade 8 students have a high level of engagement in learning mathematics. The mean value of student engagement is located between 3.81 and 3.95.

Table 2. Summary of the level of student engagement in learning mathematics

INDICATORS	MEAN	SD	DESCRIPTIVE LEVEL
Cognitive Engagement	3.81	0.44	High
Behavioral Engagement	3.81	0.54	High
Emotional Engagement	3.95	0.59	High
Social Engagement	3.83	0.56	High
Overall	3.85	0.42	High

This finding supports the research conducted by Delfino (2019), which established a connection between academic performance and the three aspects of student engagement, namely, behavioral, emotional, and cognitive engagement. This discovery reinforces that those students actively involved in their learning process, in terms of their behavior, emotions, and cognitive efforts, tend to perform better academically. Moreover, teacher-student interactions play a crucial role in promoting learning, and educators and educational institutions must give this dimension significant importance.

Table 3. Level of student academic performance

INDICATOR	GRADE	DESCRIPTIVE LEVEL
Level of Student Academic Performance	86.7	High

Table 3 presents the level of student academic performance in mathematics with a General Percentage Average of 86.7. Data revealed that the level of student academic performance in mathematics is high. Additionally, grade 8 students have a very satisfactory level of academic performance in learning Mathematics. It further implies that students are doing satisfactorily in mathematics. They understand math concepts and engage well in their mathematics class. This shows that they are good at math and are committed to their studies.

This finding is consistent with Urquijo and Extremera (2017), who found that more engaged students achieve good academic results. Furthermore, Garcia et al. (2016a) identified motivation and enjoyment of mathematics as solid indicators of performance in mathematics. These findings underscore the significance of creating a supportive and engaging learning environment that encourages students to actively participate and enjoy their educational journey, ultimately leading to enhanced academic performance.

Table 4. Relationship between student engagement and academic performance

	R	P-VALUE	DECISION	INTERPRETATION
Student Engagement	0.289	0.000	reject	significant

Table 4 shows the inferential analysis results on the relationship between the grade 8 students' engagement and their academic performance in learning mathematics. Based on the analysis in the said table, the r-value of 0.289 shows a low positive correlation. This positive correlation is highly significant through the p-value (0.000) and means that the higher student engagement, the higher their academic performance. It implies that their math grades increase as they perform well in class. Hence, the set null hypothesis in this study is rejected. It further implies that students actively participating in class will learn a lot and can easily remember the lesson. Since they have much learning, they can answer their task correctly, leading them to have good grades in mathematics. Utilizing effective instructional methods also plays a significant role in boosting student engagement and active participation in the classroom. Appropriate teaching strategies tailored to diverse students can improve academic performance in mathematics.

The finding substantiates the study executed by Lei et al. (2018) and Schnitzler et al. (2021) that student engagement had a low significant positive association with academic performance in mathematics. Involving

students in school and classroom activities is essential for enhancing their learning outcomes (Wang et al., 2016). Increased student involvement helps students better understand mathematical concepts (Ayub et al., 2017).

Table 5. Relationship between student engagement and attitude in learning mathematics

	R	P-VALUE	DECISION	INTERPRETATION
Student Engagement	0.629	0.000	reject	significant

Table 5 shows the inferential analysis result on the relationship between the grade 8 students' engagement and their attitude toward learning mathematics. Based on the analysis in the said table, the r-value of 0.629 shows a substantial positive correlation. This positive correlation is highly significant through the p-value (0.000) and means that the higher student engagement, the higher the attitude in learning of students in Mathematics. Hence, the set null hypothesis in this study is rejected. It signifies that when students become more actively engaged in class, their disposition toward learning also becomes more favorable. Consequently, when students actively participate in class, they become motivated and gain self-assurance in their ability to excel. This educational approach, facilitated by the teacher, fosters a constructive perspective regarding the subject matter. Encouraging student involvement in class discussions or group activities also alleviates their anxiety towards the subject and the teacher.

This finding confirms the consistency of the result of Nayir (2015) that there is a strong correlation between the engagement of students in their studies and their attitude, though he noted that outcomes may differ depending on the topic. This plays an important role in translating their attitudes into their actual academic performance (Lijie et al., 2020). Furthermore, students who had a positive attitude toward mathematics were more likely to actively participate and engage in their mathematics tasks (Gopal et al., 2018).

Table 6. Relationship between attitude in learning mathematics and academic performance

	R	P-VALUE	DECISION	INTERPRETATION
Attitude in Learning Mathematics	0.092	0.265	Accept	Not significant

Shown Table 6 is the inferential analysis result on the relationship between the grade 8 students' attitude toward learning mathematics and their academic performance in the subject. Based on the analysis in the said table, the correlation r-value obtained in the analysis is equal to 0.092, with a p-value equal to 0.265. The correlation could be a function of random sampling error. Hence, increasing the sample size could be a recommendation. Hence, the set null hypothesis is failed to reject. It implies that whether the students have a positive or negative attitude in learning mathematics does not significantly affect their grades in mathematics.

This finding does not support the study of Mazana et al. (2018), who found that improving students' attitude in learning can help them perform better academically. Asempapa (2022) also suggested that to have desirable academic performance, and teachers must adjust their teaching methods and provide support to students both academically and socially. Additionally, studies by Mazana et al. (2018) and Subia et al. (2018) showed that even if students have below-average math performance, having a positive attitude toward math can help them believe in their ability to improve and achieve higher results.

Table 7. Regression analysis result

	PATH	B-ESTIMATE	P-VALUE	DECISION	INTERPRETATION
Student Engagement→Academic Performance	c′	4.897	<.000	Reject	Significant
Student Engagement→Attitude in Learning	a	0.592	<.000	Reject	Significant
Attitude in Learning →Academic Performance	b	-2.706	0.095	Accept	Not significant
$a \times b + c'$	c	3.30	<.000	Reject	Significant

Shown in Table 7 is the regression analysis of the variables in the four criteria of the presence of a mediating effect of attitude in learning on the relationship between student engagement and academic performance. There are four steps to be met for a third variable to be acting as a mediator. In Table 7, these are categorized as follows: Step 1 is the relationship between student engagement and academic performance (estimate and test path c); Step 2 is the relationship between student engagement and attitude in learning (estimate and test path a); Step 3 is the

relationship between the attitude in learning and academic performance (estimate and test path b); and lastly, Step 4 is establishing mediating effect of the attitude in learning on the relationship between student engagement and academic performance in mathematics (path c') should be equal to zero (MacKinnon et al., 2007). In Table 7, Path C is called the total effect of student engagement on academic performance in Mathematics. Otherwise, Path c' is the effect of student engagement on academic performance that may be mediated by a process attitude in learning, and student engagement may still affect the academic performance of grade 8 students in mathematics.

In step 1, table 7 shows student engagement significantly predicts academic performance in mathematics of grade 8 students. Since the p-value of 0.000 is lower than 0.05, the alpha level of significance, which means that the relationship is significant. Hence, the null hypothesis 1 ($H_0 1$) is rejected. In step 2, student engagement significantly predicts the overall attitude in the learning of grade 8 students in mathematics. The data in Table 7 depicts the p-value of 0.000 for student engagement, which suggests that there is a significant effect on the overall attitude in the learning of the grade 8 students, hence the null hypothesis 2 ($H_0 2$) is rejected. In step 3, the overall student attitude does not significantly predict academic performance. As shown in Table 7, step 3, which has a p-value of 0.095, which is higher than 0.05 as the alpha level of significance; the relationship is not significant. Hence, the null hypothesis 3 ($H_0 3$) is accepted.

In the three steps (paths a, b, and c), only paths a and c are significant, and path b is not significant. Although this claim is controversial under Baron and Kenny (1986) steps because the link between the attitude in learning and academic performance is not significant, the mediating process can still proceed since there is an excellent theoretical background between their relationship (Shrout & Bolger, 2002).

To further appreciate the mediating effect of attitude in learning on the relationship between student engagement and academic performance, whether partial mediation, full mediation, or no mediation. It is crucial to determine if student engagement has a direct effect on academic performance or is having an indirect effect on academic performance through the attitude in learning using the approach of Preacher and Hayes (2008).

The Analysis reveals that student engagement has a direct significant effect on academic performance ($B = 4.90$, $p < .001$). The bootstrap confidence intervals based on 5000 samples contained zero, which is the basis of Preacher and Hayes (2008) for significance ($B = -1.60$ (95% $[-3.80\ to\ 0.21]$). Hence, the indirect effect of student engagement on academic performance with the attitude in learning is not significant. This means that student engagement is not indirectly but directly related to the academic performance of grade 8 students in mathematics. Thus, attitude in learning does not mediate the relationship between student engagement and academic performance. Student engagement in mathematics directly affects academic performance even without the influence of attitude in learning of grade 8 students.

This discovery contradicts the conclusions achieved by Ngussa and Mabuti (2017) and Mazana et al. (2018), who emphasized that elements of attitude, like motivation, self-confidence, perceived usefulness, and anxiety, can positively impact students' learning and academic achievements. On the other hand, the research findings of Nayir (2015) and Lijie et al. (2020) showed consistency in this study that stresses the interconnectedness of student engagement and attitude in learning. However, they noted that outcomes may differ depending on the topic.

4.0 Conclusion

Based on the result of the study, it can be concluded that the attitude in learning does not play a mediating role in the correlation between engagement and academic performance in mathematics among grade 8 students. This means that even if students are highly engaged in their math studies, their attitude in learning does not significantly impact their academic performance in this subject. Hence, other factors may have a stronger influence on academic performance in mathematics among grade 8 students. Moreover, based on this conclusion, this study denies the theory of the multicomponent of attitude by Eagly and Chaiken (1993) since the multicomponent of attitude theory states that attitude in learning has an intervening effect on the correlation between student engagement and academic performance, which is contrary to the result of the study.

Based on the results and conclusion, it is also recommended that the school administrators and teachers plan and approve activities in which student engagement is highly prioritized to improve their academic performance.

Moreover, considering that attitude in learning does not mediate the correlation between engagement and academic performance, students should strengthen their classroom engagement to improve their academic performance. Furthermore, it is recommended for future researchers that other variables be tried out apart from attitude in learning to determine their mediating effect on the correlation between student engagement and academic performance in mathematics. Likewise, replications of this research may be undertaken using other groups of respondents and sets of data to test further the veracity of the assertion of the theory of multicomponent attitude.

5.0 Contributions of Authors

The author reviewed and approved the final version of this paper.

6.0 Funding

This research received no specific grant from any funding agency.

7.0 Conflict of Interests

The author declared that he has no conflicts of interest as far as this study is concerned.

8.0 Acknowledgment

The author also thanks his family and friends for the support given to him in writing this study.

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