Teacher-Student Interaction and Students' Motivation as Predictors of Students' Mathematics Achievement

Brent Diesel Jake Delos Santos[1*], Samantha Maricon R. Badayos[2*], Priscilla Mae B. Ponce[3*], Jonalyn P. Beller[4*], Leslie Cagas[5*], Abdul J. Jamara[6]
Davao del Norte State College, Institute of Teacher Education, Davao del Norte, Philippines[1,2,3,4,5,6]
delossantos.brentdieseljake@dnsc.edu.ph[1*] , badayos.samanthamaricon@dnsc.edu.ph[2] ,
ponce.priscilla@dnsc.edu.ph[3] , beller.jonalyn@dnsc.edu.ph[4] , cagas.leslie@dnsc.edu.ph[5] ,
abdul.jamara@dnsc.edu.ph[6]

Abstract
Purpose: This study aimed to determine whether teacher-student interaction and students' motivation are significant predictors of students' mathematics achievement.

Research Methodology: A quantitative descriptive correlational approach was used, with stratified random sampling to select 120 first- and second-year BSED-Mathematics students from Davao del Norte State College. Three sets of validated questionnaires were used to measure the variables. Statistical analyses included mean, standard deviation, Pearson's r, and multiple linear regression.

Results: Significant positive relationships were found between teacher-student interaction ($r = 0.716$, $p < 0.01$) and students' motivation ($r = 0.714$, $p < 0.01$) and mathematics achievement. Both teacher-student interaction ($\beta = 0.417$) and students' motivation ($\beta = 0.412$) were significant predictors of mathematics achievement. The adjusted R-squared value of 0.585 indicates that 58.5% of the variation in mathematics achievement was explained by the model.

Conclusions: Teacher-student interaction and student motivation are significant predictors of mathematics achievement among first- and second-year BSED-Mathematics students.

Limitations: The study sample was limited to 120 students from a single institution, which limited generalizability. The researcher-made 50-item test for "mathematics achievement" had limitations, particularly after the post-hoc analysis removed 23 items.

Contributions: This study emphasizes the importance of teacher-student interaction and student motivation as key factors influencing mathematics achievement.

Keywords: *Correlational Study, Regression Analysis, Students' Mathematics Achievement, Students' Motivation, Teacher-Student Interaction*

How to Cite: Delos Santos, B. D. J., Badayos, S. M. R., Ponce, P. M. B., Beller, J. P., Cagas, L., & Jamara, A. J. (2026). Teacher-Student Interaction and Students' Motivation as Predictors of Students' Mathematics Achievement. *Journal of Social, Humanity, and Education,* 6(2), 153-172.

1. Introduction

Mathematics is a core subject essential for students' academic, professional, and personal development. However, poor mathematics achievement remains a significant challenge for students worldwide (Chand, Chaudhary, Prasad, & Chand, 2021). Many students fall behind, lose interest in the subject, and ultimately discontinue their mathematics studies (Garinganao & Bearneza, 2021). Internationally, studies have indicated that mathematics failure contributes to student attrition. For example, in Slovenia, Brezavšček, Jerebic, Rus, and Žnidaršič (2020) reported high dropout rates among college students due to difficulties in mathematics.

In Malaysia, research highlights that students' mathematics achievement remains suboptimal, necessitating immediate remediation (Hashim, Masek, Mahthir, Rashid, & Nincarean, 2021). Likewise, studies in Indonesia indicate that many students struggle with essential mathematical skills, exhibiting weak problem-solving and reasoning abilities critical for academic success in mathematics (Pradila, Agustika, & Wiyasa, 2024). In the Philippines, mathematics is recognized as a crucial subject that contributes significantly to academic success (Cassibba et al., 2020). A study conducted at Cebu Technological University revealed that students' mathematics grades decreased from 87 (SD = 1.8) in the first year to 84 (SD = 2.1) in the second year, while their overall GPAs ranged from 75 (SD = 3.0) to 81 (SD = 2.4) in the third and fourth years, respectively (Guinocor et al., 2020).

At Davao del Norte State College in Panabo City, interviews with ten mathematics students revealed that challenges contributing to low performance in College and Advanced Algebra included rapid topic progression by instructors and insufficient opportunities for clarification. Six of the ten students reported being enrolled in the mathematics course because they were unable to enter their desired programs of study. Joy, Rose, Nathaniel, Nobis Martin Jr., and Erika (2024) reported that 63.9% of their respondents obtained low mathematics scores, indicating the urgent need for intervention.

2. Literature Review and Hypothesis Development

2.1 Hypotheses

The following were the hypotheses provided by the researchers is used as the basis for the further investigation at a 0.05 level of significance:

1. There was no significant relationship between teacher-student interaction and students' mathematics achievement.
2. There was no significant relationship between students' motivation and mathematics achievement.
3. Teacher-student interaction and students' motivation did not significantly predict students' mathematics achievement.

2.2 Review of Related Literature

This section presents a review of the related literature and studies, providing information, ideas, and insights from various sources concerning teacher-student interaction, students' motivation, and students' mathematics achievement. In this study, the independent variables were teacher-student interaction and students' motivation. Teacher-student interaction is measured through dimensions such as commitment, closeness, and complementarity (Jowett, Warburton, Beaumont, & Felton, 2023). Students' motivation is assessed using measures including intrinsic value, attainment value, self-regulation, self-efficacy, utility value, and test anxiety (Glynn, Taasoobshirazi, & Brickman, 2009). The dependent variable of this study was students' mathematics achievement.

2.2.1 Mathematics Achievement

Mathematics achievement shows to how a student's effective completion of academic tasks and goals after the teaching and learning process has taken place (Agnes, Christopher, Basil, & Stanley, 2022; Campanilla, 2025). This reflects the successful completion of school assignments, tasks, and programs, as well as the achievement of educational goals by stakeholders. Moreover, Jonathan and Ugwu (2017) characterized mathematics achievement as a measure that indicates the level of success that a student has attained during the teaching and learning process, effectively serving as an indicator of the effectiveness of the learning experience.

2.2.2 Teacher-Student Interaction

Teacher-student interaction is a dynamic system based on the ecological systems theory of human development. It is a whole structure composed of two interrelated parts: teachers and students (Xu & Yang, 2019). Numerous studies indicate that strong connections between teachers and students foster greater student involvement and mathematical achievement (Roorda, Jak, Zee, Oort, & Koomen, 2017).

2.2.2.1 Commitment

Griep (2022) stated that academic commitment affects academic performance; in other words, learners committed to their studies perform better and demonstrate higher levels of task completion. Thus, is viewed as a vital predictor of student retention, academic achievement and success.

2.2.2.2 Closeness

Closeness as an indicator of the interpersonal component of a teacher-student relationship is discussed critically because of the boundaries that must be maintained, and thus, it deserves special attention (Hagenauer, Muehlbacher, & Ivanova, 2023). Closeness with teachers, as well as perceived positive relationships with the school, may encourage students to utilize all their thinking resources effectively to explore the learning context, which may ultimately lead to positive perceptions of the school as well as good academic performance (Semeraro et al., 2023).

2.2.2.3 Complementarity

Complementarity refers to a spillover effect in which resources, such as knowledge and time, utilized in one task can also benefit the execution of another. The effectiveness of this complementarity is influenced by the type and magnitude of the tasks at hand, as time is a finite resource for all. Therefore, task complementarity depends not only on the nature of the tasks but also on the scope and scale of the tasks being performed (Reymert & Thune, 2023).

2.2.3 Students' Motivation

It is commonly known how important motivation is to learning mathematics. Motivation is the primary prerequisite for completing a learning activity and the engine that drives the educational mobile process (Lazowski & Hulleman, 2016). Motivation in school helps children concentrate on primary objectives, be indifferent to distractions and exhibit goal-oriented behaviors.

2.2.3.1 Intrinsic Value

Intrinsic value is related to a person's delight and interest in an activity or domain (Akinsola, 2025). Intrinsic value refers to the enjoyment anticipated from an activity before making a decision and the enjoyment experienced while acting (Eccles & Wigfield, 2020). Intrinsic value is a more accurate categorization since a work with intrinsic value can be accomplished for both intrinsic and extrinsic reasons (Rosenzweig, Wigfield, & Hulleman, 2020).

2.2.3.2 Attainment Value

Attainment value has been traditionally defined as the perceived personal importance of a task and, more recently, as reflecting identity-based importance (Eccles & Wigfield, 2020). The higher the relative personal importance of the outcome, the higher is the attainment value. Attainment value reflects students' subjective importance of doing well and having high competence levels.

2.2.3.3 Self-Regulation

Self-regulation is the capacity of people to modify their thoughts, feelings, and actions to satisfy both internal and external needs. Children's ability to self-regulate is crucial for overcoming a variety of developmental difficulties (Edossa, Schroeders, Weinert, & Artelt, 2018). Reflection, planning, time management, and monitoring are self-regulation skills that affect academic performance in varying degrees.

2.2.3.4 Self-Efficacy

Self-efficacy is the belief in one's ability to perform tasks successfully, which impacts effort, perseverance, behavioral decisions, and task performance. Higher self-efficacy levels lead to higher objectives, commitment, effort, and longer duration (Yu & Singh, 2018). Students' math achievement was strongly and favorably influenced by their self-efficacy views on learning and performance (Ozkal, 2019).

2.2.3.5 Utility Value
The utility value of an activity or domain refers to an individual's perception of its usefulness ([Sismiati, Sulaiman, Usmar, Tamrin, & Susanto, 2025](#)). Utility value or usefulness refers to how well a particular task fits into an individual's present or future plans ([Eccles & Wigfield, 2020](#)). Moreover, utility value refers to the subjective idea that an action is beneficial for accomplishing short- or long-term goals ([Vansteenkiste et al., 2018](#)). [Fong and Kremer (2020)](#) stated that utility value has very weak and largely insignificant relationships with poor math performance.

2.2.3.6 Test Anxiety
Test anxiety differs from other types of anxiety in that it focuses on evaluative (testing) events. Test anxiety is also known as exam anxiety, exam stress, or test stress ([Von der Embse, Jester, Roy, & Post, 2018](#)). Students who experience high levels of mathematics anxiety or test anxiety tend to develop bad attitudes toward the subject, avoid it, and perform poorly in mathematics ([Dowker, Sarkar, & Looi, 2016](#)).

2.2.4 Teacher-Student Interaction and Mathematics Achievement
Multiple studies have shown that students who develop a close connection with their teachers tend to demonstrate higher levels of academic interest, dedication, achievement, self-efficacy, and motivation than those with more distant interactions ([Tosto, Asbury, Mazzocco, Petrill, & Kovas, 2016](#)). The outcomes of such interactions are positive in mathematical learning processes, and they demonstrate their significance in supporting student success ([Ayuwanti & Siswoyo, 2021](#)).

2.2.5 Students' Motivation and Mathematics Achievement
Motivation is key to ensuring that students perform well in mathematical tasks. Research has identified students' motivation as a significant determinant of performance in mathematics achievement from students' perspectives ([Suren & Kandemir, 2020](#); [Yakubjanovna, 2025](#)). It is an important measure for mathematical performance and motivates and guides behavior toward learning goals ([Steinmayr, Weidinger, Schwinger, & Spinath, 2019](#)). Positive teacher-student interactions are characterized by commitment, closeness, and complementarity, which create a positive learning environment.

3. Methodology
This chapter presents the methodology of the study, including the research design, research respondents, research instruments, data-gathering procedures, statistical treatment of data, and ethical considerations.

3.1 Research Design
This study employed a quantitative approach with a descriptive-correlational research design. A quantitative approach was adopted to examine the relationships between teacher-student interaction, students' motivation, and students' mathematics achievement. Quantitative research involves the systematic collection and analysis of numerical data to identify patterns, examine relationships among variables, and generalize findings to larger populations ([Ghanad, 2023](#)).

A descriptive research approach allows researchers to examine variables as they occur naturally, without manipulation or control ([Siedlecki, 2020](#)). Descriptive methods employ statistical techniques to provide accurate interpretations of the collected data. Similarly, a correlational research design investigates the strength and direction of the relationships between two or more variables without implying causation ([Ghanad, 2023](#)). Although statistical analysis can identify predictors of an outcome, it does not confirm causal relationships. Thus, the term "predictor" in this study refers to statistical associations rather than causal mechanisms.

Measuring students' mathematics achievement may not fully capture the complexity of their learning outcomes. Therefore, interpretations of "achievement" should be made cautiously, and the findings may not fully reflect all aspects of students' mathematical competence in the study. The researchers selected this design because of its suitability for addressing the study's research questions. The descriptive-correlational design facilitated the assessment of the levels of teacher-student interaction, students'

motivation, and students' mathematics achievement, as well as the identification of statistical relationships among these variables.

3.2 Research Respondents

The respondents of this study were first- and second-year students enrolled in the Bachelor of Secondary Education major in Mathematics program at a college in Panabo City, specifically those taking the College Advanced Algebra course. During the first semester of the 2024–2025 academic year, 172 students were enrolled, including 105 first-year and 67 second-year students. The study's sample size was determined using the Online Raosoft Sample Size Calculator with a 95% confidence level and 5% margin of error, resulting in a computed sample size of 120 students. The first-year BSED-Mathematics students were divided into three sets: Set A comprised 28 students out of 36, Set B comprised 28 students out of 35, and Set C comprised 27 students out of 34.

The second-year students were divided into two sets: Set A comprised 22 of 32 students, and Set B comprised 24 of 35 students. The researchers employed a stratified random sampling technique to select respondents. In stratified sampling, the population is divided into homogeneous subgroups or strata based on specific characteristics, ensuring that each member belongs to exactly one stratum. Each stratum is then sampled using another probability sampling method, such as simple random sampling or cluster sampling, which allows for an accurate estimation of statistical measures for each subpopulation (Thomas et al., 2023).

3.3 Research Instruments

In this study, the researchers utilized three sets of questionnaires to determine whether teacher-student interaction and students' motivation influenced students' mathematics achievement. For the independent variables, a set of questionnaires was adapted from previous literature, while for the dependent variable, the researchers developed a researcher-made questionnaire aligned with the advanced algebra course. The Teacher–Student Relationship Quality Questionnaire (TSRQ-Q), adapted from Jowett et al. (2023), was used to measure teacher-student interaction. The researchers added items to the original instrument for each indicator to reduce multicollinearity and ensure comprehensive construct coverage.

The original instrument contained 11 items; after adding additional items, the total number of items increased to twenty-seven, distributed across the following indicators: commitment (6 items), closeness (7 items), and complementarity (14 items). Each statement was scored using a 5-point Likert scale: Strongly Agree (SA) = 5, Agree (A) = 4, Moderately Agree (MA) = 3, Disagree (D) = 2, and Strongly Disagree (SD) = 1. The instrument demonstrated excellent reliability during pilot testing, with a Cronbach's alpha of 0.938. The following parameters, along with their corresponding descriptions, were applied to evaluate teacher-student interaction:

Table 1. Teacher-student interaction and student motivation parameters

Parameter limits	Descriptive Equivalent	Interpretation
4.20-5.00	Very High	This means that teacher-student interaction is evident.
3.40-4.19	High	This means that teacher-student interaction is evident.
2.60-3.39	Moderate	This means that teacher-student interaction is somewhat evident.
1.80-2.59	Low	This means that teacher-student interaction is barely evident.
1.00-1.79	Very Low	This means that teacher-student interaction is not evident.

The Mathematics Motivation Questionnaire (MMQ), adopted from Fiorella et al. (2021), was used to measure students' motivation. The researchers modified the original instrument by adding items to the attainment value indicator to better capture this construct. This instrument was used as a data collection tool for this study. The original instrument consisted of 30 items. After adding new items and removing certain items based on pilot testing, the revised instrument comprised thirty-one items distributed across the following indicators: intrinsic value (5 items), attainment value (7 items), self-regulation (4 items),

self-efficacy (5 items), utility value (7 items), and test anxiety (3 items). Each item was scored using a 5-point Likert scale: Always (A) = 5, Often (O) = 4, Sometimes (S) = 3, Rarely (R) = 2, and Never (N) = 1. Pilot testing of the instrument demonstrated good reliability, with a Cronbach's alpha of 0.94 for the overall scale. The following parameters, along with their corresponding descriptions, were applied to evaluate students' motivation.

Table 2. Mathematics summative test

Parameter Limits	Descriptive Equivalent	Interpretation
4.20-5.00	Always	This means that the students were always motivated.
3.40-4.19	Often	This means that the students were frequently motivated.
2.60-3.39	Sometimes	This means that the students were somewhat motivated.
1.80-2.59	Rarely	This means that the students were rarely motivated.
1.0-1.79	Never	This means that the students were not motivated at all.

Table 2 shows the researcher administered a 50-item test to assess students' mathematics achievements. The test was designed in accordance with the College Advanced Algebra course and aligned with the course syllabus, covering topics included in the midterm exam. The Table of Specification (TOS) was employed to construct the test items to ensure coverage of the competencies required in the College Advanced Algebra course. The researcher calculated each respondent's total number of correct answers and determined the mean score. After item analysis, 23 items were discarded, 10 were revised, and 17 were retained. The instrument demonstrated acceptable reliability, with a Cronbach's alpha of 0.765. The following parameters were used to evaluate students' mathematics achievements based on their mean scores on the College Advanced Algebra test:

Table 3. College advanced algebra test

Parameter Limits	Descriptive Equivalent	Interpretation
21.61-27.00	Very High	This means that students' mathematics achievement was outstanding.
16.21-21.60	High	This means that students' mathematics achievement is satisfactory.
10.81-16.20	Moderate	This means that students' mathematics achievement is satisfactory
5.41-10.80	Low	This means that students' mathematics achievement is fair.
1.00-5.40	Very Low	This indicates that students' mathematics achievement is poor.

4. Results and Discussions
4.1 Level of Teacher-Student Interaction in Mathematics in terms of Commitment
Table 1 illustrates the level of teacher-student interaction in mathematics in terms of commitment to the subject. The statement *"I can improve my mathematics skills with my mathematics teacher"* has the highest mean score of 3.70, followed closely by the statement *"I am made to work hard in this teacher's class,"* which received an average of 3.66. Both statements have a descriptive equivalent of high, indicating that the items are evident. The statement *"I am close to my mathematics teacher"* had the lowest average at 3.25, which categorizes it as moderate, suggesting that the item is somewhat evident. Moreover, the category average of 3.50 aligns with the descriptive equivalent of high, signifying that the level of teacher-student interaction regarding commitment is evident. According to the students' feedback, the standard deviation of 0.58 suggests a low variance in their responses, meaning that the students' responses were closely tied to the category mean score.

Table 4. Level of teacher-student interaction in mathematics in terms of commitment

Items	Mean	Standard Deviation	Descriptive Equivalent
I am close to my mathematics teacher.	3.25	0.86	Moderate
I put in effort and remain engaged with my mathematics teacher.	3.52	0.74	High

I can improve my mathematics skills with my mathematics teacher.	3.70	0.73	High
I am allowed to work on things that I like in my teacher's class.	3.47	0.76	High
I am able to make choices about my learning in this teacher's class.	3.40	0.72	High
I am made to work hard in this class.	3.66	0.74	High
Category	**3.50**	**0.58**	**High**

Table 4 indicates that students can improve their mathematics skills with their teacher, and they are also made to work in their teacher's class. This result is supported by the study of Che Ahmad, Shaharim, and Abdullah (2017), which also reveals a high level of student commitment to learning. Higher levels of student learning commitment are associated with better learning outcomes in a micro-teaching course.

4.2 Level of Teacher-Student Interaction in Mathematics in terms of Closeness

Table 5 illustrates the level of teacher-student interaction in mathematics in terms of their closeness. The statement *"I appreciate my mathematics teacher's hard work to improve my ability in mathematics"* has the highest mean score of 4.09, closely followed by *"I trust my mathematics teacher,"* which received a mean score of 4.07. Both items have a descriptive equivalent of high, suggesting that they are evident.

The statement *"I enjoy how my teacher explains the mathematics lesson"* achieved the lowest mean of 3.78, but still has a descriptive equivalent of high, indicating that this statement is also evident in the interviews. Additionally, the overall category mean was 3.95, which corresponds to a descriptive equivalent of high. This suggests that the level of teacher-student interaction in terms of closeness is evident. Based on the students' responses, the standard deviation was 0.60, reflecting low variability among the students' scores, which indicates that their responses were closely aligned with the mean score.

Table 5. Level of teacher-student interaction in mathematics in terms of closeness

Items	Mean	Standard Deviation	Descriptive Equivalent
I enjoy how my teacher discusses mathlessons.	3.78	0.84	High
I trust my mathematics teacher.	4.07	0.69	High
I appreciate my mathematics teacher's hard work to improve my mathematical ability.	4.09	0.77	High
I like that my mathematics teacher can influence me to learn mathematics.	4.05	0.72	High
I appreciate that my mathematics teacher has a good sense of humor.	3.94	0.78	High
I like how my mathematics teacher listens to what I want to say	3.86	0.84	High
I enjoy attending the class of my mathematics teacher.	3.85	0.78	High
Category	**3.95**	**0.60**	**High**

The results imply that the students appreciate their teacher's hard work in improving their ability in mathematics, and that the students trust their mathematics teacher. To support the results, Freire, Pipa, Aguiar, Vaz da Silva, and Moreira (2020) also reported a relatively high level of closeness between teachers and students. Learners who establish solid, nurturing connections with their teachers frequently experience increased emotional stability, which provides them with the assurance and tools to fully engage in their learning (Verschueren, 2015).

4.3 Level of Teacher-Student Interaction in Mathematics in terms of Complementarity

Table 6 displays the level of teacher-student interaction in mathematics in terms of complementarity. The statement *"When I am taught by my mathematics teacher, I feel that my efforts are valued"* received the highest mean score of 3.88, followed closely by the statement *"When I am taught by my mathematics teacher, I respond to his/ her efforts"* with a mean score of 3.84. Both statements had a descriptive equivalent of high, indicating that both statements were evident. The statement "*When I am taught by my mathematics teacher, I am eager to participate in class activities*" received the lowest mean score of 3.59, which also has a descriptive equivalent of high, suggesting that this item is also evident. Additionally, complementarity holds a categorical mean of 3.77, which carries a descriptive equivalent of high, indicating that the level of complementarity is evident in the study. Based on the students' responses, the standard deviation was 0.60, which reflects a low level of variation in the students' responses, meaning that the responses were closely aligned with the mean.

Table 6. Level of teacher-student interaction in mathematics in terms of complementarity

No	When I am taught by my mathematics teacher, …	Mean	Standard Deviation	Descriptive Equivalent
1	I feel relaxed and comfortable.	3.70	0.83	High
2	I respond to their efforts.	3.84	0.89	High
3	I am ready to do my best in this regard.	3.83	0.81	High
4	I have a friendly personality.	3.82	0.74	High
5	I feel motivated to succeed in my work.	3.72	0.80	High
6	I am confident in my learning ability.	3.80	0.75	High
7	I feel encouraged to ask questions.	3.81	0.79	High
8	I am eager to participate in class activities.	3.59	0.80	High
9	I feel supported in my learning process.	3.76	0.73	High
10	I feel comfortable making mistakes and learning from them.	3.72	0.83	High
11	I am more willing to challenge myself with difficult problems.	3.76	0.73	High
12	I feel that my efforts are valued.	3.88	0.79	High
13	I feel that the learning environment is positive and welcoming to students.	3.77	0.75	High
14	I feel more confident in my problem-solving skills.	3.74	0.79	High
	Category	**3.77**	**0.60**	**High**

The results imply that when teachers teach, students feel that their efforts are valued, and they respond to their teachers' efforts. This is supported by Reeve and Shin (2020), who state that a nurturing and welcoming school atmosphere is crucial for both educators and students to foster effective teaching and learning exchanges.

4.4 Summary on the Level of Teacher-Student Interaction in Mathematics

Table 7 presents the levels of teacher-student interaction in mathematics in terms of commitment, closeness, and complementarity. Based on the table, closeness achieved the highest average at 3.95, with a standard deviation of 0.605, which corresponds to a descriptive equivalent of high. The standard deviation reflects a low level of variation in the students' responses, indicating that the responses are closely aligned with the mean. This implies that warmth, trust, and a positive connection between students and their mathematics teachers are evident in the classroom environment.

This was followed by complementarity, with a mean score of 3.77 and a standard deviation of 0.601, which corresponds to a descriptive equivalent of high. The standard deviation reflects a low level of variation in the students' responses, indicating that the responses are closely aligned with the mean. This implies that cooperative and balanced interactions between students and their mathematics teachers are evident. Meanwhile, the commitment indicator had the lowest mean of 3.50, with a standard deviation of 0.586, which corresponds to a descriptive equivalent of agree. The standard deviation reflects a low

level of variation in the students' responses, indicating that the responses are closely aligned with the mean. This means that the students' dedication and active engagement in learning mathematics was evident.

Table 7. Summary on the level of Teacher-Student Interaction in Mathematics

Indicators	Mean	Standard Deviation	Descriptive Equivalent
Commitment	3.50	0.586	High
Closeness	3.95	0.605	High
Complementarity	3.77	0.601	High
Teacher-Student Interaction	3.74	0.52	High

The results specified that effective communication between teachers and students fosters positive interaction within the classroom, enhancing students overall learning outcomes. A supportive classroom promotes collaboration and transparency between teachers and their students. Strong teacher–student interaction is an important factor that supports the growth of both teachers and learners (Ye et al., 2022).

4.5 Level of Students' Motivation in Mathematics in terms of Intrinsic Value
Table 8 displays the level of students' motivation based on the intrinsic value of mathematics. The statement *"I find learning mathematics interesting"* achieved the highest mean score of 3.88, closely followed by the statement *"Understanding mathematics gives me a sense of accomplishment,"* which received a mean score of 3.83. Both statements have a descriptive equivalent of often, indicating that they are frequently observed. On the other hand, the statement *"The lesson I learn in mathematics is more important to me than the grade I receive"* received the lowest mean score of 3.73, yet it also carries a description of often, signifying that this statement is frequently observed.

Moreover, the overall category mean of 3.80, which is described as often, suggests that the students' motivation levels in terms of intrinsic value are frequently observed among the students. Based on the students' feedback, the standard deviation was 0.70, reflecting a low variability in their responses, which indicates that their responses were generally consistent with the average score.

Table 8. Level of Students' Motivation in Mathematics in terms of Intrinsic Value

No	Items	Mean	Standard Deviation	Descriptive Equivalent
1	I enjoy learning mathematics.	3.81	0.84	Often
2	The lesson I learn in mathematics is more important to me than the grade I receive.	3.73	0.77	Often
3	I find learning mathematics to be interesting.	3.88	0.91	Often
4	I enjoy mathematics lessons that challenges me.	3.74	0.93	Often
5	Understanding mathematics gives me a sense of accomplishment.	3.83	0.75	Often
Category		**3.80**	**0.70**	**Often**

The results indicate that the students often find mathematics interesting, and understanding it gives them a sense of accomplishment. This was supported by the study of Navarro, Sanchez-Verdejo, Anguita, and Gonzalez (2020), who stated that high intrinsic motivation is related to visual and reflective learning styles among university students. The research conducted by Saaidin (2020) indicated that intrinsic value positively influences learning.

4.6 Level of Students' Motivation in Mathematics in terms of Attainment Value
Table 9 illustrates the level of students' motivation in mathematics in terms of attainment value. The statement *"I think about how my mathematics grade will affect my overall grade point average (GPA)"* received the highest average rating of 4.03, followed closely by *"I feel really proud when I can solve hard mathematics problems that not many other people can do,"* which scored an average rating of 3.93. Both statements were categorized as often, indicating that these statements were frequently

observed. The statement *"I like to do better than the other students on mathematics tests"* recorded the lowest average score of 3.57, but still corresponds to an often-descriptive equivalent, suggesting that this feeling is frequently observed.

The overall category mean is 3.81, which also falls under the often-descriptive equivalent, signifying that the level of students' motivation in terms of attainment value among students is frequently observed. According to the students' feedback, the standard deviation was 0.62, reflecting minimal variation in their responses, which suggests that the students' answers were closely aligned with the average score.

Table 9. Level of students' motivation in mathematics in terms of attainment value

No	Items	Mean	Standard Deviation	Descriptive Equivalent
1	I like to do better than other students on mathematics tests.	3.57	0.88	Often
2	Earning good grades in mathematics is important to me.	3.87	0.77	Often
3	I think about how my mathematics grade will affect my overall grade point average (GPA).	4.03	0.74	Often
4	I like being known as a good mathematics student.	3.70	0.93	Often
5	I really like it if my mathematics achievements are noticed by others.	3.78	0.91	Often
6	I feel really proud when I can solve difficult mathematics problems that not many other people can do.	3.93	0.83	Often
7	It is really important to me that others see me as being very good at math.	3.77	0.94	Often
	Category	**3.81**	**0.62**	**Often**

The results imply that the students often think about how their mathematics grade will affect their overall grade point average, and they feel proud of themselves when they solve difficult mathematics problems that not many people can do. This is supported by the research conducted by Schnettler, Bobe, Scheunemann, Fries, and Grunschel (2020), which indicated that attainment value was key to academic success. In learning environments, fostering these needs can lead to a higher attainment value, as students feel more competent and autonomous, which in turn bolsters their intrinsic motivation and commitment to achieve their academic goals (Merdiaty & Sulistiasih, 2024).

4.7 Level of Students' Motivation in Mathematics in terms of Self-Regulation

Table 10 shows the level of students' motivation in mathematics in terms of self-regulation. The statement *"I put enough effort into learning mathematics"* received the highest average score (3.90). It was closely followed by *"I use strategies that ensure I learn mathematics well,"* which earned a mean score of 3.88. Both statements have a descriptive equivalent of often, suggesting that these behaviors are frequently observed. However, the statement *"If I am having trouble learning mathematics, I try to figure out why"* scored the lowest, with a mean of 3.78, yet it also carries a descriptive label of "often," indicating that it is commonly observed by the respondents. The overall average score of 3.85, categorized as often, reflects that the students' motivation levels concerning self-regulation are typically observed among students. Based on the students' feedback, the standard deviation was 0.64, which signified minimal variation among the students' responses, indicating that their answers were closely aligned with the average.

Table 10. Level of Students' Motivation in Mathematics in terms of Self-Regulation

No	Items	Mean	Standard Deviation	Descriptive Equivalent
1	If I have trouble learning mathematics, I try to figure out why.	3.78	0.72	Often

2	I have put in sufficient effort to learn mathematics.	3.90	0.89	Often
3	I use strategies that ensure that I learn mathematics well.	3.88	0.85	Often
4	I prepare well for math tests and quizzes.	3.82	0.76	Often
	Category	**3.85**	**0.64**	**Often**

The results indicate that the students frequently put enough effort into learning mathematics and used strategies that ensured that they learned mathematics well. This result is in line with Tee, Leong, and Abdul Rahim (2021), who revealed that students with higher levels of motivational regulation are more likely to use deep learning strategies to facilitate their learning and attain their academic goals.

4.8 Level of Students' Motivation in Mathematics in terms of Self-Efficacy
Table 11 shows the level of students' motivation in mathematics in terms of their self-efficacy. The item *"I believe that I can master the knowledge and skills in the mathematics course"* has the highest mean of 3.68, followed closely by the item *"I expect to do as well as or better than other students in the mathematics course"* with a mean score of 3.66. Both items correspond to a descriptive equivalent of often, implying that the items are frequently observed. On the other hand, the item *"I am confident that I will do well on mathematics tests"* has the lowest mean of 3.54, which also corresponds to a descriptive equivalent of often, meaning that this item is frequently observed.

The category means of 3.62, which also corresponds to a descriptive equivalent of often. This indicates that the level of students' motivation in terms of self-efficacy is frequently observed in the literature. According to the students' responses, the standard deviation was 0.70, which indicates a low dispersion among students' responses. This signifies that the students' responses were closely related to the mean score.

Table 11. Level of Students' Motivation in Mathematics in terms of Self-Efficacy

No	Items	Mean	Standard Deviation	Descriptive Equivalent
1	I expect to do as well or better than other students in the mathematics course.	3.66	0.89	Often
2	I am confident that I will do well in mathematics assignments and projects.	3.59	0.80	Often
3	I believe that I can master the knowledge and skills required in the mathematics course.	3.68	0.83	Often
4	I am confident that I will do well on mathematics tests.	3.54	0.82	Often
5	I believe that I can earn a high grade in the mathematics course.	3.61	0.83	Often
	Category	**3.62**	**0.70**	**Often**

The results indicate that the students frequently believe that they can master the knowledge and skills in the mathematics course, and they expect to do well or better than other students in mathematics. This finding is supported by Yu and Singh (2018), who discovered that greater self-efficacy encourages students to establish loftier goals, maintain higher levels of commitment, exert more effort, and persevere for longer.

4.9 Level of Students' Motivation in Mathematics in terms of Utility Value
Table 12 shows the level of students' motivation in mathematics in terms of utility value. The item *"I think about how I will use mathematics I learn"* has the highest mean of 3.98, followed by the item *"I think about how learning mathematics can help my career"* with a mean score of 3.93. Both items have corresponding descriptive equivalents. This indicates that these items are frequently observed. The item *"The mathematics I learn has practical value for me"* had the lowest mean of 3.78, which corresponds to a descriptive equivalent of often. This indicates that these items are frequently observed.

The category means of 3.85, which corresponds to a descriptive equivalent of often, indicates that the level of students' motivation in terms of utility value among students is frequently observed. According to the result, the standard deviation is 0.61, which indicates a low dispersion among students' responses, implying that students' responses are clustered tightly around the mean.

Table 12. Level of Students' Motivation in Mathematics in terms of Utility Value

No	Items	Mean	Standard Deviation	Descriptive Equivalent
1	The mathematics I learn relates to my personal goals and aspirations.	3.81	0.83	Often
2	I think about how learning mathematics can help me get a good job in the future.	3.79	0.79	Often
3	I think about how the mathematics I learn will be helpful.	3.85	0.80	Often
4	I think about how learning mathematics can help my career as a researcher.	3.93	0.78	Often
5	I think about how I will use the mathematics I learn.	3.98	0.76	Often
6	The mathematics I learn is relevant to my life.	3.80	0.69	Often
7	The mathematics I learn has practical value.	3.78	0.71	Often
	Category	**3.85**	**0.61**	**Often**

The results indicate that the students often think about how they can use mathematics in their daily lives and how this can help their careers. This is supported by Eccles and Wigfield (2020), who emphasized that utility value plays a crucial role in motivating students and facilitating their success in mathematics, as it influences their perception of the usefulness of tasks concerning their personal and future aspirations.

4.10   Level of Students' Motivation in Mathematics in terms of Test Anxiety

Table 13 shows the level of students' motivation in mathematics regarding test anxiety. The item *"I worry about failing mathematics tests"* got the highest mean of 4.10, followed by the item *"I am nervous about how I will do on the mathematics tests"* with a mean score of 4.05. Both items correspond to a descriptive equivalent of often, which indicates that these items are frequently observed. The item *"I become anxious when it is time to take a mathematics test"* attained the lowest mean among all items with a mean score of 4.01, which also corresponds to a descriptive equivalent of often, implying that this item is frequently observed. The category means of 4.05, which corresponds to a descriptive equivalent of often, indicates that the level of students' motivation in terms of test anxiety is frequently observed. Based on the students' responses, the standard deviation was 0.68, which indicates low dispersion. This means that the students' responses were clustered tightly around the mean score.

Table 13. Level of Students' Motivation in Mathematics in terms of Test Anxiety

No	Items	Mean	Standard Deviation	Descriptive Equivalent
1	I am nervous about how I will perform on mathematics tests.	4.05	0.74	Often
2	I feel anxious when it is time to take a mathematics test.	4.01	0.79	Often
3	I worry about failing mathematics tests.	4.10	0.85	Often
	Category	**4.05**	**0.68**	**Often**

The results imply that students often feel worried about failing mathematics tests and feel nervous about how they will perform on mathematics tests. This finding is supported by Caviola et al. (2022), who discovered that elevated levels of test anxiety are associated with decreased student motivation and poor performance in mathematics, illustrating that anxiety can adversely impact students' achievements.

4.11 Summary on the level of Students' Motivation in Mathematics

Table 14 illustrates the levels of student motivation in mathematics in terms of intrinsic value, attainment value, self-regulation, self-efficacy, utility value and test anxiety. The data revealed that test anxiety had the highest mean at 4.05, with a standard deviation of 0.674. This was followed by self-regulation, with a mean score of 3.85 and a standard deviation of 0.64. Similarly, the utility value also had a mean score of 3.85, with a standard deviation of 0.61. On the other hand, self-efficacy recorded the lowest mean of 3.62, with a standard deviation of 0.701.

Overall, the mean score of students' motivation is 3.83, which implies that the level of students motivation is frequently observed, indicating that students are frequently motivated when it comes to learning mathematics. According to the students' responses, it had a standard deviation of 0.674, suggesting a low variation in students' scores, meaning their scores were closely aligned with the mean value.

Table 14. Summary on the level of Students Motivation in Mathematics

Indicators	Mean	Standard Deviation	Descriptive Equivalent
Intrinsic Value	3.80	0.707	Often
Attainment Value	3.81	0.627	Often
Self-Regulation	3.85	0.639	Often
Self-Efficacy	3.62	0.701	Often
Utility Value	3.85	0.610	Often
Test Anxiety	4.05	0.685	Often
Students' Motivation	**3.83**	**0.54**	**Often**

Overall, students' motivation attained a mean score of 3.83, which has a high descriptive equivalent. This implies that students' motivation to learn mathematics is frequently observed. The score standard deviation is 0.674, which indicates a low dispersion among the students' scores. This implies that the scores were tightly clustered around the mean.

The findings are aligned to the study conducted by Chiu, Lin, and Lonka (2021), which indicated that students' motivation directly affects their learning, engagement levels, perseverance in reaching goals, and influences their instructional methods. According to Davidovitch and Dorot (2023), students with a high level of motivation often achieve better academic results. Therefore, we can deduce that because students have the autonomy to select their study programs, their motivation is likely to be stronger than that of high school students who are required to follow a predetermined curriculum.

4.12 Level of Mathematics Achievement of BSED Mathematics Students in Terms of Test Scores in College and Advanced Algebra

Table 15 shows the level of mathematics achievement of first- and second-year students at Davao del Norte State College. As shown in the table, the overall mean level of students' mathematics achievement is 19.7, which has a high descriptive equivalent, meaning that students' mathematics achievement is very satisfactory. This also attains a standard deviation of 2.85, which has a high dispersion, which means that students' scores are not tightly close to the overall mean score.

Table 15. Level of Mathematics Achievement of BSED Mathematics Students in Terms of Test Scores in College and Advanced Algebra

Indicator	Mean	Standard Deviation	Descriptive Equivalent
Students' Mathematics Achievement	19.7	2.85	High

The results imply that students have a satisfactory mastery of the areas being measured. To support this claim, Abalde and Oco (2023) revealed a satisfactory level of student performance. This means that the students achieved the second-highest performance level in mathematics. This study strengthens this

model from the findings, whereby interest, attitude, and learning habits play an important role in students' performance in mathematics (Hashim et al., 2021).

4.13 Correlation of Teacher-Student Interaction and Students' Motivation towards Students' Mathematics Achievement in College and Advanced Algebra

Table 16 illustrates the relationship between teacher-student interaction and students' mathematics achievement, as well as between students' motivation and mathematics achievement. The relationship between teacher-student interaction and students' mathematics achievement had an r-value of 0.716, indicating a strong positive correlation. Additionally, the p-value was <0.01, which was below the 0.05 significance level. Consequently, the null hypothesis was rejected. This indicates a significant relationship between teacher-student interaction and students' mathematics achievement.

Similarly, the correlation between students' motivation and mathematics achievement had an r-value of 0.714, which also signifies a strong positive correlation. Furthermore, the p-value is less than 0.01, which is below the 0.05 significance level. Therefore, the null hypothesis was rejected, indicating a significant relationship between students' motivation and mathematics achievement.

Table 16. Correlation of teacher-student interaction and students' motivation to students' mathematics achievement

Variables Correlated	R	p-value	Decision on H_0	Decision of Relationship
Teacher-Student Interaction and Students' Mathematics Achievement	0.716	<0.01	Reject H_0	Significant
Students' Motivation and Students' Mathematics Achievement	0.714	<0.01	Reject H_0	Significant

The result that there is a significant relationship between teacher and student interaction and students' mathematics achievement is supported by the study of Byiringiro (2024), which shows that the interaction between teachers and students has a positive and significant correlation with students' achievements in mathematics. In the learning process, good interaction between teachers and students shapes the classroom environment, and smooth and supportive interaction can enhance students' sense of connectedness and independence. Furthermore, the result of the interaction between students' motivation and students' mathematics achievement is reinforced by Asanre, Sondlo, and Abiodun (2024), which highlights a favorable effect of motivation on mathematics achievement.

4.14 Regression Analysis on Teacher-Student Interaction and Students' Motivation as Predictors of Students' Mathematics Achievement in College and Advanced Algebra

Table 17 shows the results of the regression analysis concerning the relationship between teacher and student interactions and students' motivation as factors influencing their achievement in mathematics. The findings indicate that both teacher-student interaction and students' motivation are significant predictors of mathematics achievement. This result is based on self-determination theory, which highlights different types of motivation (ranging from autonomous to controlled) in predicting various results, such as performance, engagement, vitality, and psychological well-being. In particular, the theory distinguishes between controlled and autonomous motivations (Ryan & Deci, 2024). Since student autonomy is usually more constrained in a school setting, relatedness—which is defined as feeling securely connected to others is especially important for helping students internalize teachers' objectives and values.

Table 17. Regression analysis on teacher-student interaction and students' motivation on mathematics achievement in college and advanced algebra

Independent Variable	Unstandardized Coefiicients		Standardized Coefficients	t stat	p-value	Decision a=0.05
	ß	Standard error	Beta			
(Constant)	3.08	1.286				
Teacher-Student Interaction	2.25	0.462	0.417	4.87	<0.01	Significant
Students' Motivation	2.14	0.447	0.412	4.80	<0.01	Significant
Dependent Variable: Students' Mathematics Achievement **Adjusted R^2**:0.585						
F-ratio:85.0				**P-value:**<0.01		

The relationship between teacher and student interaction yielded a beta value of 0.417 and a p-value of <0.01, which is below the 0.05 significance level.

$$SMA= 2.25 \text{ (TSI)} +2.14 \text{ (SM)} + 3.08 +\varepsilon. \qquad (1)$$

Any variation not accounted for by the relationship between the SMA and TSI is denoted by ε. In terms of interpretation, a one-unit increase in teacher-student interaction corresponds to a 0.417 increase in students' mathematics achievement. Additionally, students' motivation showed a beta value of 0.412 and a p-value of <0.01, which is also less than the 0.05 significance level.

$$SMA=3.08+0.412 \text{ (SM)}+\varepsilon. \qquad (2)$$

Any variation not explained by the SMA and SM relationships is represented by ε. For the interpretation of the results, a one-unit increase in students' motivation results in a 0.412 increase in students' mathematics achievement. The F-ratio of 85.0 indicates the predictive capability of the regression model, whereas the adjusted R-squared value of 0.585 suggests that 58.5% of the data are consistent with the model.

The results are supported by self-determination theory (Ryan and Deci (2000), a broad theory of human personality and motivation (students' motivation) concerned with how the individual interacts (teacher-student interaction) with and depends on the social environment. Self-determination theory is centered on the basic psychological needs of *autonomy, competence, and relatedness*, and their necessary role in self-determined motivation, well-being, and growth. The finding that teacher–student interaction predicts students' mathematics achievement is in relation to the study of Appiah, Arthur, Boateng, and Akweittey (2023), which states that teacher-student interaction significantly predicts students' mathematics achievement.

5. Conclusions
5.1 Conclusion
The findings indicate that the level of teacher–student interaction is evident in the learning process. Students' motivation also appears to be relatively high, as many students frequently feel motivated when learning mathematics. In terms of academic outcomes, the mathematics achievement of first- and second-year BSED Mathematics students is categorized as very satisfactory. Furthermore, the results show a significant relationship between teacher–student interaction and students' mathematics achievement. Similarly, students' motivation is also significantly related to their mathematics achievement. In addition, both teacher–student interaction and students' motivation were found to significantly predict students' mathematics achievement. These results suggest that effective interaction between teachers and students, along with strong learning motivation, plays an important role in improving students' academic performance in mathematics.

5.2 Research Limitations

1. The sample size may not be sufficiently large or diverse to generalize the findings across different populations.
2. The measurement tools used may have limitations in terms of validity and reliability.
3. A short data collection period may not capture the long-term effects on academic achievement.

5.3 Suggestions and Direction for Future Research

In light of the study's findings, the following suggestions are offered.

1. Future studies should use more objective measures of mathematics achievement, such as final grades or standardized tests, to better capture students' learning.
2. Investigate additional factors affecting achievement, such as study habits or peer relationships.
3. Include more mathematics topics, such as geometry and trigonometry, in research instruments.
4. Longitudinal or experimental designs should be considered to explore causal relationships, as this study only identified statistical associations.

Author Contributions

BDJDS contributed to the conceptualization of the study, research design, data collection, data analysis, and manuscript drafting. SMRB assisted in the development of the research methodology, data gathering, and initial manuscript preparation. PMBP contributed to data validation, statistical analysis, and interpretation of the research findings. JPB supported the literature review process and assisted in organizing the research framework. LC contributed to data verification, manuscript editing, and formatting of the article. AJJ supervised the research process, provided critical revisions, and reviewed the final version of the manuscript. All authors read and approved the final version of the manuscript.

References

Abalde, G., & Oco, R. (2023). Factors associated with mathematics performance. *Asian Research Journal of Mathematics, 19*(6), 45-60. doi:https://doi.org/10.9734/arjom/2023/v19i6665

Agnes, O., Christopher, O., Basil, O., & Stanley, A. (2022). Test Anxiety and academic stress as predictors of secondary school studentsacademic achievement in Physics. *International Journal of Social Sciences & Educational Studies, 9*(4), 172-182. doi:https://doi.org/10.23918/ijsses.v9i4p172

Akinsola, I. T. (2025). Movie and music preferences influencing students' cultural knowledge in the Yorùbá society. *Journal of Social, Humanity, and Education, 5*(3), 211-223. doi:https://doi.org/10.35912/jshe.v5i3.2426

Appiah, J. B., Arthur, Y. D., Boateng, F. O., & Akweittey, E. (2023). Teacher-Student Relationship and Students' Mathematics Achievement: Mediating Roles of Students' Perception of Mathematics, Students' Self-Efficacy, and Cooperative Learning Strategies. *Online Submission, 3*(2). doi:https://doi.org/10.29333/mathsciteacher/13193

Asanre, A. A., Sondlo, A., & Abiodun, T. (2024). Impact of Interest and Motivation on Academic Achievement of Junior Secondary School Students in Mathematics. *Journal of Mathematics Instruction, Social Research and Opinion, 3*(3), 275-284. doi:https://dx.doi.org/10.58421/misro.v3i3.269

Ayuwanti, I., & Siswoyo, D. (2021). Teacher-student interaction in mathematics learning. *International Journal of Evaluation and Research in Education, 10*(2), 660-667.

Brezavšček, A., Jerebic, J., Rus, G., & Žnidaršič, A. (2020). Factors influencing mathematics achievement of university students of social sciences. *Mathematics, 8*(12), 2134. doi:https://doi.org/10.3390/math8122134

Byiringiro, E. (2024). Influence of Teacher-Student Relationship on Student Mathematics Achievement in High School in the USA: Mediating Roles of Students Perceptions of Mathematics. *European Journal of Theoretical and Applied Sciences, 2*(1), 375-383. doi:https://doi.org/10.59324/ejtas.2024.2(1).32

Campanilla, N. S. (2025). Self-Efficacy in Mathematics: A predictor in the Mathematics performance of grade 8 learners. *Journal of Social, Humanity, and Education, 5*(2), 87-103. doi:https://doi.org/10.35912/jshe.v5i2.2228

Cassibba, R., Ferrarello, D., Mammana, M. F., Musso, P., Pennisi, M., & Taranto, E. (2020). Teaching mathematics at distance: A challenge for universities. *Education Sciences, 11*(1), 1. doi:https://doi.org/10.3390/educsci11010001

Caviola, S., Toffalini, E., Giofrè, D., Ruiz, J. M., Szűcs, D., & Mammarella, I. C. (2022). Math performance and academic anxiety forms, from sociodemographic to cognitive aspects: A meta-analysis on 906,311 participants. *Educational psychology review, 34*(1), 363-399. doi:https://doi.org/10.1007/s10648-021-09618-5

Chand, S., Chaudhary, K., Prasad, A., & Chand, V. (2021). Perceived causes of students' poor performance in mathematics: A case study at Ba and Tavua secondary schools. *Frontiers in applied mathematics and statistics, 7*, 614408. doi:https://doi.org/10.3389/fams.2021.614408

Che Ahmad, C. N., Shaharim, S. A., & Abdullah, M. F. N. L. (2017). Teacher-student interactions, learning commitment, learning environment and their relationship with student learning comfort. *Journal of Turkish Science Education, 14*(1), 57-72.

Chiu, T. K., Lin, T.-J., & Lonka, K. (2021). Motivating online learning: The challenges of COVID-19 and beyond. *The asia-pacific education researcher, 30*(3), 187-190. doi:https://doi.org/10.1007/s40299-021-00566-w

Davidovitch, N., & Dorot, R. (2023). The Effect of Motivation for Learning among High School Students and Undergraduate Students--A Comparative Study. *International Education Studies, 16*(2), 117-127. doi:https://doi.org/10.5539/ies.v16n2p117

Dowker, A., Sarkar, A., & Looi, C. Y. (2016). Mathematics anxiety: What have we learned in 60 years? *Frontiers in Psychology, 7*, 508. doi:https://doi.org/10.3389/fpsyg.2016.00508

Eccles, J. S., & Wigfield, A. (2020). From expectancy-value theory to situated expectancy-value theory: A developmental, social cognitive, and sociocultural perspective on motivation. *Contemporary Educational Psychology, 61*, 101859. doi:https://doi.org/10.1016/j.cedpsych.2020.101859

Edossa, A. K., Schroeders, U., Weinert, S., & Artelt, C. (2018). The development of emotional and behavioral self-regulation and their effects on academic achievement in childhood. *International Journal of Behavioral Development, 42*(2), 192-202. doi:https://doi.org/10.1177/0165025416687412

Fiorella, L., Yoon, S. Y., Atit, K., Power, J. R., Panther, G., Sorby, S., . . . Veurink, N. (2021). Validation of the Mathematics Motivation Questionnaire (MMQ) for secondary school students. *International Journal of STEM Education, 8*(1), 52. doi:https://doi.org/10.1186/s40594-021-00307-x

Fong, C. J., & Kremer, K. P. (2020). An expectancy-value approach to math underachievement: Examining high school achievement, college attendance, and STEM interest. *Gifted Child Quarterly, 64*(2), 67-84. doi:https://doi.org/10.1177/0016986219890599

Freire, S., Pipa, J., Aguiar, C., Vaz da Silva, F., & Moreira, S. (2020). Student–teacher closeness and conflict in students with and without special educational needs. *British Educational Research Journal, 46*(3), 480-499. doi:https://doi.org/10.1002/berj.3588

Garinganao, N. S., & Bearneza, F. J. D. (2021). Algebraic skills and academic achievement in mathematics of Grade 7 students in a Philippine Chinese school. *Philippine Social Science Journal, 4*(3), 57-64. doi:https://doi.org/10.52006/main.v4i3.396

Ghanad, A. (2023). An overview of quantitative research methods. *International Journal of Multidisciplinary Research and Analysis, 6*(08), 3794-3803. doi:https://doi.org/10.47191/ijmra/v6-i8-52

Glynn, S. M., Taasoobshirazi, G., & Brickman, P. (2009). Science motivation questionnaire: Construct validation with nonscience majors. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching, 46*(2), 127-146. doi:https://doi.org/10.1002/tea.20267

Griep, Y. (2022). Capturing the process of academic commitment: a taxonomy and test of post-secondary student academic commitment trajectories. *Higher Education Research & Development, 41*(6), 1900-1915. doi:https://doi.org/10.1080/07294360.2021.1967886

Guinocor, M., Almerino, P., Mamites, I., Lumayag, C., Villaganas, M. A., & Capuyan, M. (2020). Mathematics performance of students in a Philippine State University. *International Electronic Journal of Mathematics Education, 15*(3), em0586. doi:https://doi.org/10.29333/iejme/7859

Hagenauer, G., Muehlbacher, F., & Ivanova, M. (2023). "It's where learning and teaching begins–is this relationship"—insights on the teacher-student relationship at university from the teachers' perspective. *Higher education, 85*(4), 819-835. doi:https://doi.org/10.1007/s10734-022-00867-z

Hashim, S., Masek, A., Mahthir, B. N. S. M., Rashid, A. H. A., & Nincarean, D. (2021). Association of interest, attitude and learning habit in mathematics learning towards enhancing students' achievement. *Indonesian Journal of Science and Technology, 6*(1), 113-122. doi:https://doi.org/10.17509/ijost.v6i1.31526

Jonathan, O., & Ugwu, C. J. (2017). Self-concept, test anxiety and achievement motivation as predictors of academic achievement in physics among secondary school students in Rivers State, Nigeria. *Journal of Education and Practice, 8*(33), 99-106.

Jowett, S., Warburton, V. E., Beaumont, L. C., & Felton, L. (2023). Teacher–Student relationship quality as a barometer of teaching and learning effectiveness: Conceptualization and measurement. *British Journal of Educational Psychology, 93*(3), 842-861. doi:https://doi.org/10.1111/bjep.12600

Joy, N. M., Rose, A. L., Nathaniel, L., Nobis Martin Jr., L., & Erika, A. A. (2024). Beyond Memorization: Building Problem-Solving Skills in Sequences for Future Math Teachers. *East Asian Journal of Multidisciplinary Research, 3*(9), 3987–3998. doi:https://doi.org/10.55927/eajmr.v3i9.9437

Lazowski, R. A., & Hulleman, C. S. (2016). Motivation interventions in education: A meta-analytic review. *Review of educational research, 86*(2), 602-640. doi:https://doi.org/10.3102/0034654315617832

Merdiaty, N., & Sulistiasih, S. (2024). Empowering Learning: The Mediating Role of Teachers in Enhancing Students' Intrinsic Motivation. *AL-ISHLAH: Jurnal Pendidikan, 16*(4), 5163-5172. doi:https://doi.org/10.35445/alishlah.v16i4.6430

Navarro, O., Sanchez-Verdejo, F., Anguita, J., & Gonzalez, A. (2020). Motivation of university students towards the use of information and communication technologies and their relation to learning styles. *International Journal of Emerging Technologies in Learning (iJET), 15*(15), 202-218. doi:https://doi.org/10.3991/ijet.v15i15.14347

Ozkal, N. (2019). Relationships between self-efficacy beliefs, engagement and academic performance in math lessons. *Kıbrıslı Eğitim Bilimleri Dergisi, 14*(2), 190-200. doi:https://doi.org/10.18844/cjes.v14i2.3766

Pradila, N. K. S., Agustika, G. N. S., & Wiyasa, I. K. N. (2024). Meningkatkan Kompetensi Pengetahuan Matematika dengan Model Realistic Mathematics Education Berbantuan Media Konkret. *Jurnal Media dan Teknologi Pendidikan, 4*(1), 61-68. doi:https://doi.org/10.23887/jmt.v4i1.62890

Reeve, J., & Shin, S. H. (2020). How teachers can support students' agentic engagement. *Theory Into Practice, 59*(2), 150-161. doi:https://doi.org/10.1080/00405841.2019.1702451

Reymert, I., & Thune, T. (2023). Task complementarity in academic work: a study of the relationship between research, education and third mission tasks among university professors. *The Journal of Technology Transfer, 48*(1), 331-360. doi:https://doi.org/10.1007/s10961-021-09916-8

Roorda, D. L., Jak, S., Zee, M., Oort, F. J., & Koomen, H. M. (2017). Affective teacher–student relationships and students' engagement and achievement: A meta-analytic update and test of the mediating role of engagement. *School psychology review, 46*(3), 239-261. doi:https://doi.org/10.17105/spr-2017-0035.v46-3

Rosenzweig, E. Q., Wigfield, A., & Hulleman, C. S. (2020). More useful or not so bad? Examining the effects of utility value and cost reduction interventions in college physics. *Journal of Educational Psychology, 112*(1), 166. doi:https://psycnet.apa.org/doi/10.1037/edu0000370

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American psychologist, 55*(1), 68. doi:https://doi.org/10.1037//0003-066x.55.1.68

Ryan, R. M., & Deci, E. L. (2024). Self-determination theory *Encyclopedia of quality of life and well-being research* (pp. 6229-6235): Springer.

Saaidin, N. (2020). The influence between metacognition practice, students' learning commitment and academic achievement of matriculation students in physics. *International Journal of Academic Research in Business & Social Sciences, 10*(3), 910-930. doi:https://doi.org/10.6007/ijarbss/v10-i3/7351

Schnettler, T., Bobe, J., Scheunemann, A., Fries, S., & Grunschel, C. (2020). Is it still worth it? Applying expectancy-value theory to investigate the intraindividual motivational process of forming intentions to drop out from university. *Motivation and Emotion, 44*(4), 491-507. doi:https://doi.org/10.1007/s11031-020-09822-w

Semeraro, C., Musso, P., Cassibba, R., Annese, S., Scurani, A., Lucangeli, D., . . . Coppola, G. (2023). Relation between fluid intelligence and mathematics and reading comprehension achievements: The moderating role of student teacher relationships and school bonding. *PLoS One, 18*(9), e0290677. doi:https://doi.org/10.1371/journal.pone.0290677

Siedlecki, S. L. (2020). Understanding descriptive research designs and methods. *Clinical Nurse Specialist, 34*(1), 8-12. doi:https://doi.org/10.1097/nur.0000000000000493

Sismiati, S., Sulaiman, S., Usmar, U., Tamrin, L., & Susanto, P. C. (2025). Enhancing employee competitiveness: The role mediation of human resources competencies. *Annals of Human Resource Management Research, 5*(1), 77-89. doi:https://doi.org/10.35912/ahrmr.v5i1.2789

Steinmayr, R., Weidinger, A. F., Schwinger, M., & Spinath, B. (2019). The importance of students' motivation for their academic achievement–replicating and extending previous findings. *Frontiers in Psychology, 10*, 464340. doi:https://doi.org/10.3389/fpsyg.2019.01730

Suren, N., & Kandemir, M. A. (2020). The Effects of Mathematics Anxiety and Motivation on Students' Mathematics Achievement. *International Journal of Education in Mathematics, Science and Technology, 8*(3), 190-218. doi:https://doi.org/10.46328/ijemst.v8i3.926

Tee, K. N., Leong, K. E., & Abdul Rahim, S. S. (2021). A self-regulation model of mathematics achievement for eleventh-grade students. *International Journal of Science and Mathematics Education, 19*(3), 619-637. doi:https://doi.org/10.1007/s10763-020-10076-8

Thomas, J., Kahane, P., Abdallah, C., Avigdor, T., Zweiphenning, W. J., Chabardes, S., . . . Hall, J. (2023). A subpopulation of spikes predicts successful epilepsy surgery outcome. *Annals of Neurology, 93*(3), 522-535. doi:https://doi.org/10.1002/ana.26548

Tosto, M. G., Asbury, K., Mazzocco, M. M., Petrill, S. A., & Kovas, Y. (2016). From classroom environment to mathematics achievement: The mediating role of self-perceived ability and subject interest. *Learning and individual differences, 50*, 260-269. doi:https://doi.org/10.1016/j.lindif.2016.07.009

Vansteenkiste, M., Aelterman, N., De Muynck, G.-J., Haerens, L., Patall, E., & Reeve, J. (2018). Fostering personal meaning and self-relevance: A self-determination theory perspective on internalization. *The Journal of Experimental Education, 86*(1), 30-49. doi:https://doi.org/10.1080/00220973.2017.1381067

Verschueren, K. (2015). Middle childhood teacher–child relationships: Insights from an attachment perspective and remaining challenges. *New directions for child and adolescent development, 2015*(148), 77-91. doi:https://doi.org/10.1002/cad.20097

Von der Embse, N., Jester, D., Roy, D., & Post, J. (2018). Test anxiety effects, predictors, and correlates: A 30-year meta-analytic review. *Journal of affective disorders, 227*, 483-493. doi:https://doi.org/10.1016/j.jad.2017.11.048

Xu, L., & Yang, Q. (2019). Modeling and Analysis on Teacher-Student Relationship. *Discrete Dynamics in Nature and Society, 2019*(1), 5481926. doi:https://doi.org/10.1155/2019/5481926

Yakubjanovna, S. N. (2025). Methods of developing the physical qualities of general secondary school students. *Journal of Multidisciplinary Academic and Practice Studies, 3*(3), 967-978. doi:https://doi.org/10.35912/jomaps.v3i3.3500

Ye, Y., Wang, C., Zhu, Q., He, M., Havawala, M., Bai, X., & Wang, T. (2022). Parenting and teacher–student relationship as protective factors for Chinese adolescent adjustment during COVID-19. *School psychology review, 51*(2), 187-205. doi:https://doi.org/10.1080/2372966X.2021.1897478

Yu, R., & Singh, K. (2018). Teacher support, instructional practices, student motivation, and mathematics achievement in high school. *The Journal of Educational Research, 111*(1), 81-94. doi:https://doi.org/10.1080/00220671.2016.1204260