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Determinants of High School Students' Mathematics Achievement: The Role of Motivation, Self-Efficacy, and Productive Disposition

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Abstract

This study aims to determine the partial direct effects of learning motivation, self-efficacy, and productive disposition on students' mathematics learning outcomes. Previous studies have generally focused on only one or two affective variables in isolation, whereas this study seeks to integrate three key variables that reflect students' attitudes, beliefs, and behavioral tendencies in learning mathematics. An ex post facto approach was employed, involving a sample of 150 students. The instruments used consisted of a questionnaire to collect data on learning motivation, self-efficacy, and productive disposition, as well as a set of test questions to assess students' mathematics learning outcomes. Based on the results of the data analysis, descriptive data indicated a tendency toward high scores in mathematics learning outcomes, along with varying levels of motivation, self-efficacy, and productive disposition. Further findings show that learning motivation, self-efficacy, and productive disposition each have a significant direct effect on students' mathematics learning outcomes. Therefore, enhancing learning motivation, fostering self-efficacy, and developing productive dispositions should be integral components of instructional strategies in schools to improve student learning outcomes in a comprehensive and sustainable manner.

Introduction

Mathematics learning in the 21st century has undergone a major transformation to adapt to the demands of globalization, technological advancements, and the need for future skills. No longer focused solely on the mastery of formulas and algorithms, modern mathematics education emphasizes the development of higher-order thinking skills such as critical thinking, creativity, problem-solving, communication, and collaboration (the 4Cs) (Abdul, 2022). Students are encouraged to become active learners who can explore, reason, and connect mathematical concepts to real-world situations and interdisciplinary contexts.

The use of digital technologies—such as graphing calculators, interactive applications, online learning platforms, and simulation software—is integral to modern mathematics education, enabling the visualization of complex concepts and the personalization of learning experiences. Additionally, instructional approaches such as project-based learning, problem-based learning, and inquiry-based learning are widely implemented to foster students' independence and resilience in learning. Thus, 21st-century mathematics education serves as a strategic means of preparing students to face the dynamic, complex, and data-driven challenges of modern life.

In line with this, the objectives of mathematics education in Indonesia are not only limited to the mastery of academic concepts and skills, but also aimed at equipping students with practical competencies for everyday life. In daily life, mathematics enables individuals to think logically, critically, and systematically when making decisions—for instances, when managing personal finances, interpreting data from graphs or tables, estimating time and distance, or understanding numerical information presented in the media (Jamol, 2024; Chukwuyenum & Makonye, 2019). In the world of work, mathematics serves as a foundational skill across a wide range of professions, including accounting, engineering, information technology, statistics, and business—fields that require data analysis, efficiency calculations, and risk assessment (Abd Algani, 2022). The Indonesian education curriculum emphasizes that mathematics instruction should develop students' problem-solving abilities, logical reasoning, and mathematical communication, alongside fostering attitudes such as responsibility, perseverance, and self-efficacy (Damayanti, 2024). Thus, mathematics education is expected not only to produce students who are cognitively competent, but also to prepare them to adapt to real-life challenges and meet the demands of the global workforce.

To support this, mathematics instruction is implemented using a student-centered approach, providing ample space for students to take an active role, think critically, and construct their own understanding (Hoidn, 2020). This approach has proven highly effective in helping students succeed in learning mathematics. In this model, teachers are no longer the sole source of information but act as facilitators who guide students in exploring concepts, developing problem-solving strategies, and reflecting on their thought processes (Magaji, 2021). Students are encouraged to ask questions, engage in discussions, collaborate in groups, try various solution methods, and relate mathematical concepts to real-life situations. Through this process, students gain not only procedural understanding but also conceptual meaning and awareness of the interrelationships among mathematical ideas. Moreover, student-centered learning accommodates individual learning styles, interests, and abilities, allowing each student to progress at their own pace. This creates an inclusive and motivating learning environment that fosters the development of positive dispositions toward mathematics, such as self-efficacy, curiosity, and perseverance. Consequently, this approach not only enhances academic achievement but also cultivates character and lifelong learning habits—essential components for developing 21st-century mathematical competencies.

Students' success in learning mathematics has a significant impact on their ability to navigate everyday life and meet the challenges of the 21st century. In daily life, mathematical skills enable students to think logically, analyze situations, make data-informed decisions, and manage personal finances wisely (Hadi, 2024). These skills help them solve practical problems such as calculating budgets, understanding discounts, and interpreting graphs or data tables. In the 21st century—characterized by technological advancement, data complexity, and global competition—mathematical competence is a vital asset for adapting to a digital and science-based workforce (Szabo, 2020). Strong abilities in critical thinking, problem-solving, collaboration, and numerical literacy are essential in various fields, including information technology, engineering, economics, and healthcare. Therefore, success in mathematics reflects not only academic achievement but also an individual's readiness to become an intelligent, productive, and competent citizen in the modern era. However, recent studies show that students' mathematics learning outcomes remain low (Harefa, 2023; Mariamah, 2022). These poor outcomes are attributed to several factors, such as a lack of interest in learning, ineffective instructional methods, and students' difficulties in grasping abstract mathematical concepts (Agustyaningrum, 2021; Ozturk, 2023). Furthermore, many teachers continue to implement teacher-centered approaches, which limit student engagement and active participation in the learning process (Ciddi, 2025; Tang, 2023). This situation hinders students' ability to think critically, solve problems, and apply mathematical concepts to real-life contexts. If not addressed promptly, low mathematics achievement will become a major barrier to students' development of essential 21st-century skills—skills that are increasingly required in today's competitive and globalized workforce.

The affective domain encompasses learning motivation, self-efficacy, and students' productive disposition toward mathematics, all of which play a significant role in determining how well they can understand and master mathematical concepts. Students with high learning motivation tend to be more persistent when facing challenging problems, actively seek problem-solving strategies, and are less likely to give up when encountering obstacles (Voica, 2020). In contrast, low self-efficacy can interfere with students' cognitive processes by dividing their attention and reducing working memory capacity, ultimately leading to lower academic achievement (Voica, 2020). Furthermore, a productive disposition toward mathematics enhances students' active participation in class discussions, independent practice, and collaboration with peers (Rahman, 2022). Therefore, fostering the affective domain through teacher support, a positive classroom environment, and constructive feedback is crucial for improving and optimizing mathematics learning outcomes.

Learning motivation is a key factor that significantly influences students' mathematics learning outcomes. Students with high levels of motivation tend to exhibit greater interest, a strong willingness to engage, and perseverance in the face of academic challenges (Mega, 2014; Supriadi, 2024). They are more active participants in the learning process, more willing to attempt difficult problems, and less likely to give up when encountering obstacles (Rahman, 2023). In contrast, students with low motivation tend to be passive, become easily bored, and often avoid challenging tasks, which in turn leads to lower academic achievement (Schukajlow, 2017).

Self-efficacy has a strong influence on mathematics learning outcomes. Students with high self-efficacy believe in their ability to complete academic tasks and overcome the difficulties they encounter (Hayat, 2020). This belief motivates them to be more active in class, to try new strategies, and to practice consistently until they master the concepts being taught. In contrast, students with low self-efficacy often feel defeated easily, avoid challenges, and lack motivation to engage in learning activities, which leads to poorer academic performance (Zimmerman, 2012). Self-efficacy also affects students' attitudes when facing exams or difficult questions: those who believe in their abilities tend to remain calm and focused, while those who lack efficacy are more likely to feel anxious and lose concentration.

Productive disposition refers to a positive attitude and mental habit that encourages students to continue learning, think reflectively, and persist through challenges—especially in mathematics. This disposition involves curiosity, perseverance, openness to new ideas, and the belief that sustained effort leads to success (Oyedeji, 2017). Students who possess a productive disposition are more likely to explore diverse problem-solving strategies, think critically, and view failure as part of the learning process rather than the end of their efforts (Rahman, 2025). Conversely, students who lack this disposition tend to give up easily, avoid deep thinking, and focus solely on obtaining answers without understanding the underlying concepts (Rahman, 2025). In the long term, a productive disposition not only enhances learning outcomes but also helps develop the character of independent learners who are prepared to meet the challenges of the 21st century.

Learning motivation can enhance students' self-efficacy in their own abilities, which plays a crucial role in shaping a positive attitude toward mathematics. Learning motivation, self-efficacy, and productive disposition are interrelated affective factors that form a solid foundation in the mathematics learning process. First, learning motivation serves as the primary driving force that encourages students to engage actively in learning. Highly motivated students are more likely to try new approaches, set learning goals, and maintain focus during the learning process. Second, self-efficacy reinforces this motivation. Students who believe in their ability to complete mathematical tasks are more willing to take risks, experiment with various strategies, and persevere through difficulties. This efficacy also enhances students' resilience to failure, as they trust that their efforts will eventually lead to success. Third, productive disposition refers to the attitudes and learning habits that reflect consistency in facing challenges, such as curiosity, perseverance, and openness to making mistakes. This disposition strengthens the impact of both motivation and self-efficacy, as students with a productive disposition tend to be more reflective, patient, and persistent, resulting in a more meaningful and sustainable learning process. In other words, motivation drives students to act, self-efficacy provides the belief in their capabilities, and productive disposition sustains these positive traits over time. Together, these three affective factors synergistically support the achievement of optimal learning outcomes.

This study investigates the influence of learning motivation, self-efficacy, and productive disposition on students' mathematics learning outcomes using a holistic approach to affective variables that are interrelated and significantly contribute to academic achievement. While previous studies have often focused on one or two affective factors in isolation, this research combines three key constructs that reflect students' attitudes, beliefs, and behavioral tendencies in learning mathematics. The novelty of this study lies not only in examining their individual effects but also in exploring how these variables interact with one another. For instance, high motivation can enhance self-efficacy, while a productive disposition can amplify the impact of both. Therefore, the findings of this study are expected to provide both theoretical and practical contributions in the design of more effective learning strategies—ones that promote holistic student development by fostering both academic performance and character growth.

Method

his study aims to examine the causal relationship between learning motivation, self-efficacy, and productive disposition (as partial influences) on students' mathematics learning outcomes. It employs a quantitative research design using a causal ex-post facto approach. The research was conducted with a population of 634 students from SMA Negeri 4 Kendari, located in Southeast Sulawesi Province. Based on the Slovin formula, a sample of 150 students was selected for the study.

The study involved two types of variables: exogenous variables (learning motivation, self-efficacy, and productive disposition) and an endogenous variable (mathematics learning outcomes). The instruments used were questionnaires and mathematics achievement tests. To assess students' learning motivation, a closed-ended questionnaire using a Likert scale was administered, consisting of 25 items. Similarly, students' self-efficacy was measured with a 20-item Likert-scale questionnaire, and productive disposition was assessed using a 20-item Likert-scale questionnaire. Students' mathematics learning outcomes were evaluated using essay-type test items, comprising 10 non-routine problems.The data were analyzed using descriptive statistics, classical assumption tests, and hypothesis testing. Descriptive statistics were used to describe the levels of students' learning motivation, self-efficacy, productive disposition, and mathematics learning outcomes after completing the questionnaires and tests. Classical assumption testing, which is a prerequisite for conducting path analysis, included normality and homoscedasticity tests. Path analysis was employed to test the theoretical model and examine the direct effects of the exogenous variables on the endogenous variable.

Results

To ensure the validity of the data for hypothesis testing, it is essential that the data are normally distributed and exhibit homoscedasticity. The variables analyzed in this study include learning motivation (X1), self-efficacy (X2), productive disposition (X3), and mathematics learning outcomes (Y). A normal probability plot was used to assess the normality of the data distribution, while a scatterplot was employed to examine the presence of homoscedasticity. Only after meeting these assumptions can the data be deemed appropriate for hypothesis testing.

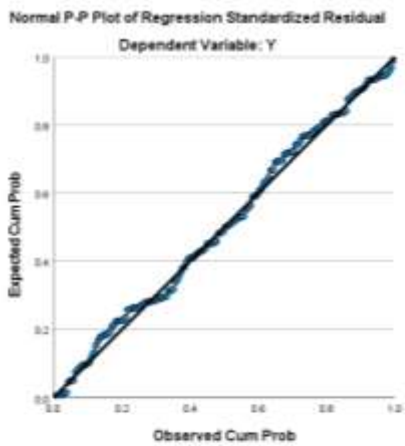

Figure 1. Normal Distribution Plot

Figure 1 shows that the distribution of mathematics learning outcome scores closely follows the normal line. Therefore, it can be concluded that the data for learning motivation, self-efficacy, productive disposition, and mathematics learning outcomes are normally distributed. The homoscedasticity test is used to determine whether the residuals from one observation to another exhibit constant variance, which is a key assumption for conducting valid regression or path analysis.

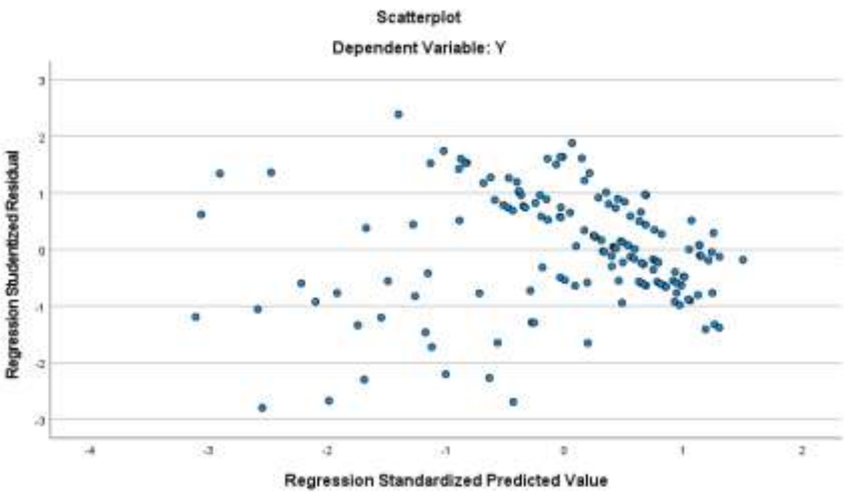

Figure 2 Residual Scatter Plot Graph

Figure 2 shows no specific pattern, and the data points are evenly distributed above and below the zero line on the X-axis and symmetrically to the left and right on the Y-axis. This indicates that homoscedasticity is present among the independent variables in the dataset. Based on Figures 1 and 2, it can be concluded that the data are both normally distributed and homoscedastic, indicating that the assumptions for further statistical analysis have been met and that the data are suitable for use in hypothesis testing.

Table 1. Descriptive Data

Descriptive statistics	X1	X2	X3	Y
Mean	78.24	76.72	77.13	83.02
Median	80	78	80	86
Modus	80	70	83	86
Variance	91.38	132.43	11.39	75.72
Std. Deviation	9.56	11.51	10.69	8.71
Maximum	96	98	90	94
Minimum	40	35	45	51

Based on Table 1, it can be observed that variable Y (mathematics learning outcomes) has the highest mean score of 83.02, indicating a higher performance tendency compared to the three independent variables (X1, X2, and X3). Both the median and mode of Y are 86, suggesting a relatively symmetrical and centered distribution of data. Meanwhile, variables X1 (learning motivation), X2 (self-efficacy), and X3 (productive disposition) have similar mean values, ranging between 76 and 78. Among them, X2 exhibits the highest data variability, with a standard deviation of 11.51 and a variance of 132.43, indicating a wider spread of responses.

In contrast, X3 shows the lowest variance and standard deviation, reflecting the most homogeneous distribution among all variables. The value ranges also support this pattern, with X2 having the widest range (35–98), and X3 the narrowest (45–90). Overall, these results indicate a general tendency toward high achievement in variable Y, along with differing levels of variability across the three predictor variables.

Table 2. Path Coefficient Calculation Results

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	24,316	4,396		5,532	0,000
	X1	0,178	0,056	0,196	3,194	0,002
	X2	0,154	0,051	0,204	3,041	0,003
	X3	0,427	0,052	0,525	8,200	0,000

Based on Table 2, an equation can be obtained as follows.

$$\hat{Y} = 24{,}316 + 0{,}178X1 + 0{,}154X2 + 0{,}427X3$$

The regression equation can be interpreted as follows:

1. When learning motivation (X1), self-efficacy (X2), and productive disposition (X3) are all at zero, the predicted value of mathematics learning outcomes (Y) is 24.316. This represents the intercept of the regression model.
2. The regression coefficient for learning motivation (X1) is 0.178. This indicates that for every one-unit increase in learning motivation, the learning outcome (Y) increases by 0.178 units, assuming other variables remain constant. This suggests a positive relationship between learning motivation and learning outcomes.
3. The regression coefficient for self-efficacy (X2) is 0.154, meaning that a one-unit increase in self-efficacy is associated with a 0.154 unit increase in learning outcomes, holding other variables constant. This also reflects a positive influence.
4. The regression coefficient for productive disposition (X3) is 0.427. This means that each one-unit increase in productive disposition leads to a 0.427 unit increase in learning outcomes, assuming other variables are unchanged. This demonstrates the strongest positive influence among the three predictors.

Table 3. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.765[a]	0.585	0.576	5.665

a. Predictors: (Constant), X3, X1, X2

Based on Table 3, the multiple correlation coefficient (R) between the dependent variable (Y) and the three predictor variables (X1, X2, and X3) is 0.765, indicating a strong positive correlation between the predictors and the outcome variable. The coefficient of determination (R^2) is 0.585, meaning that 58.5% of the variance in mathematics learning outcomes (Y) can be explained by the combination of learning motivation (X1), self-efficacy (X2), and productive disposition (X3). The Adjusted R^2 value, which accounts for the number of predictors in the model, is 0.576. This adjusted value is important to prevent overestimation of the model's explanatory power, particularly when multiple predictors are included. The closeness of the Adjusted R^2 to the original R^2 suggests that the model is stable and not overfitted. The Standard Error of the Estimate is 5.665, indicating the average distance between the actual values and the values predicted by the model. A lower standard error reflects a better model fit, and this value suggests that the prediction error is relatively low. Overall, these results indicate that the regression model using X1, X2, and X3 as predictors demonstrates strong explanatory power, good model stability, and acceptable predictive accuracy.

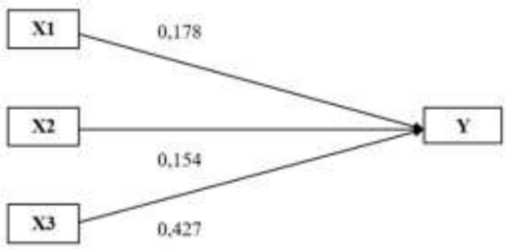

Figure 3 Causal Relationship between Variables

Table 4. Significance of Direct Influence Path Coefficients

Direct Effect	Path Coefficient	Percentage (%)	P-value
X1 → Y	0.178	17.8	0.002
X2 → Y	0.154	15.4	0.003
X3 → Y	0.427	42.7	0.000

Hypothesis 1 of this study states that learning motivation has a direct effect on mathematics learning outcomes. The hypothesis testing criterion is as follows: if the p-value > α (0.05), then H_0 is accepted; if the p-value < α, then H_0 is rejected. Based on Table 5, the p-value for learning motivation (X1) is 0.002, which is less than 0.05. Therefore, H_0 is rejected, and it can be concluded that learning motivation has a direct and statistically significant effect on students' mathematics learning outcomes.

Hypothesis 2 posits that self-efficacy has a direct effect on mathematics learning outcomes. Using the same criterion, the p-value for self-efficacy (X2) is 0.003, which is also less than the significance level of 0.05. Thus, H_0 is rejected, indicating that self-efficacy exerts a direct and significant influence on students' mathematics learning outcomes.

Hypothesis 3 proposes that productive disposition has a direct effect on mathematics learning outcomes. The p-value for productive disposition (X3) is 0.000, which is clearly below the 0.05 threshold. Therefore, H_0 is rejected, and it can be concluded that productive disposition has a direct and statistically significant effect on students' mathematics learning outcomes.

Discussion

This study demonstrates that learning motivation has a direct and significant effect on students' academic achievement. This finding underscores the role of motivation as one of the primary determinants of learning success. Students with high levels of learning motivation tend to exhibit enthusiasm, perseverance, and consistency when facing academic challenges, which ultimately contributes to improved learning outcomes. Motivation drives students to set clear goals, manage their time efficiently, and adopt learning strategies that align with their individual needs.

This result is consistent with Frommelt's (2021) study, which found that motivation is a key psychological factor in fostering students' engagement in learning. Within the theoretical framework, Self-Determination Theory (Deci, 2012) emphasizes the strong impact of intrinsic motivation—the internal drive to learn—on students' active participation in educational activities. Students who are motivated by interest and a desire to understand the material tend to outperform those who are primarily driven by extrinsic rewards such as grades or punishments. Furthermore, Sivrikaya (2019) reported a significant positive relationship between students' level of learning motivation and their academic performance across various educational stages. According to his findings, highly motivated students are more focused, more self-confident, and more likely to set ambitious academic goals. Similarly, Oyedeji (2017) emphasized that motivation is a prerequisite for meaningful learning and academic achievement.

The results of this study indicate that self-efficacy has a significant direct effect on students' learning outcomes. This suggests that the higher students' efficacy in their academic abilities, the more likely they are to achieve better academic performance. Self-efficacy refers to an individual's belief in their ability to achieve goals or complete specific tasks. In the educational context, students with high self-efficacy are generally more motivated to engage actively in learning, persist in the face of difficulties, and manage their learning strategies effectively. This finding aligns with Bandura's Social Cognitive Theory (2023), which identifies self-efficacy as a central personal cognitive factor influencing behavior and learning outcomes. Bandura emphasized that individuals' perceptions of their capabilities affect how much effort they will exert, how long they will persevere when facing challenges, and how they respond to setbacks.

Supporting research by Khan (2023) found that students with high self-efficacy demonstrated better academic achievement than their peers with lower self-efficacy, despite having similar intellectual abilities. This is because self-efficacy influences how students plan, monitor, and evaluate their learning. In school settings, self-efficacy has also been linked to time management, selection of effective learning strategies, and resilience in completing academic tasks. Lei's (2022) study on high school students confirmed that self-efficacy significantly contributes to learning outcomes, particularly in challenging subjects such as mathematics. Thus, self-efficacy is not only an internal psychological attribute but also a strategic factor that should be considered in the design of effective learning environments. Teachers, parents, and educational institutions must work collaboratively to cultivate and strengthen students' self-efficacy in order to optimize academic achievement.

Furthermore, the findings of this study reveal that productive disposition also has a significant direct effect on students' learning outcomes. This means that students who possess positive learning traits—such as perseverance, curiosity, responsibility, self-efficacy, and reflectiveness—tend to achieve higher academic performance. Productive disposition refers to a learner's tendency and readiness to engage effectively in learning tasks.

Students with strong productive dispositions do not merely focus on results; they value the process of learning, demonstrate persistence in overcoming difficulties, and take initiative in their academic pursuits. This result is supported by Rahman (2022), who argued that productive disposition is a key element of learning success. Students who exhibit such characteristics are better prepared to tackle complex problems due to their intrinsic motivation, self-evaluation skills, and mature reasoning. Awofala (2022) also found that students with high productive dispositions tend to be better independent learners and achieve higher academic results, as they are more proactive in seeking information, monitoring their progress, and setting realistic yet challenging goals.

Productive dispositions have been shown to have a direct and significant impact on students' learning outcomes. Students who exhibit strong productive dispositions are better equipped to face academic challenges and are more capable of managing their learning processes independently and effectively. Consequently, it is essential for educators to integrate the development of productive dispositions into the instructional process through strategies that promote student reflection, collaboration, and responsibility. By fostering productive dispositions from an early stage, learning outcomes can be sustainably improved, alongside the holistic development of students' character and essential life skills.

Conclusion

Based on the results of the analysis and discussion, it can be concluded that learning motivation, self-efficacy, and productive disposition each have a significant and direct influence on students' learning outcomes, particularly in mathematics. These findings suggest that students with high learning motivation tend to be more persistent, focused, and actively engaged in the learning process, which positively impacts their academic achievement. Furthermore, self-efficacy has been identified as a crucial internal factor that enables students to believe in their ability to understand and complete mathematical tasks, thereby directly enhancing their performance. Similarly, productive disposition—which encompasses traits such as responsibility, perseverance, and a willingness to learn—also plays a significant role in supporting academic success, as it fosters a positive and reflective attitude toward learning challenges. Collectively, these three variables represent essential psychological and character-related components that interact synergistically to shape the quality of student learning. Therefore, efforts to strengthen learning motivation, develop self-efficacy, and cultivate productive dispositions should be integrated into school learning strategies to enhance students' academic outcomes in a comprehensive and sustainable manner.

Recommendations

Based on these findings, it is recommended that teachers implement instructional strategies that not only focus on cognitive development but also actively nurture students' learning motivation, self-efficacy, and productive disposition. This can be achieved through the use of student-centered learning approaches, formative feedback, goal-setting activities, and reflective practices that encourage persistence and autonomy. Additionally, researchers are encouraged to further explore the interplay between affective variables and learning outcomes in diverse educational settings, including longitudinal studies or experimental designs to evaluate the long-term effects of interventions targeting these variables. Collaboration between educators and researchers will be essential in developing evidence-based practices that support both academic achievement and the holistic development of students.

References

Abd Algani, Y. M. (2022). Role, need and benefits of mathematics in the development of society. *Journal for the Mathematics Education and Teaching Practices*, *3*(1), 23-29.

Abdul Malik, M. (2022). Metacognitive-Based Mathematics Learning for 21st-Century Students' Higher Order Thinking Skills. *International Journal Of Artificial Intelegence Research*, *6*(17).

Agustyaningrum, N., Sari, R. N., Abadi, A. M., & Mahmudi, A. (2021). Dominant Factors That Cause Students' Difficulties in Learning Abstract Algebra: A Case Study at a University in Indonesia. *International Journal of Instruction*, *14*(1), 847-866.

Awofala, A. O., Lawal, R. F., Arigbabu, A. A., & Fatade, A. O. (2022). Mathematics productive disposition as a correlate of senior secondary school students' achievement in mathematics in Nigeria. *International Journal of Mathematical Education in Science and Technology*, *53*(6), 1326-1342.

Bandura, A. (2023). *Social cognitive theory: An agentic perspective on human nature*. John Wiley & Sons.

Chukwuyenum, A. N. (2013). Impact of critical thinking on performance in mathematics among senior secondary school students in Lagos State. *IOSR Journal of Research & Method in education*, *3*(5), 18-25.

Ciddi, M. L. (2025). Analysis of attitudes of undergraduate art students toward painting workshop lessons. *International Journal on Social and Education Sciences*, *7*(2), 195-204.

Damayanti, N. I., Misu, L., & Anggo, M. (2024). Formal Reasoning and Self-Efficacy, Their Influence on Students' Mathematical Problem-Solving Abilities. *Jurnal Amal Pendidikan*, *5*(2), 176-188.

Deci, E. L., & Ryan, R. M. (2012). Self-determination theory. *Handbook of theories of social psychology*, *1*(20), 416-436.

Frommelt, M., Schiefele, U., & Lazarides, R. (2021). Teacher enthusiasm, supportive instructional practices, and student motivation in mathematics classrooms. *Interdisciplinary Education and Psychology*, *2*(3), 1-5.

Hadi, M. S., Setiawan, V., & Hidayah, P. M. (2024). The Effect of Implementing Deep Learning on Improving Students' Cognitive Abilities in the Independent Curriculum at Yogyakarta High Schools. *Journal of Research in Islamic Education*, *6*(2), 104-118.

Harefa, D. (2023). The Relationship Between Students'interest In Learning And Mathematics Learning Outcomes. *Afore: Jurnal Pendidikan Matematika*, *2*(2), 1-11.

Hayat, A. A., Shateri, K., Amini, M., & Shokrpour, N. (2020). Relationships between academic self-efficacy, learning-related emotions, and metacognitive learning strategies with academic performance in medical students: a structural equation model. *BMC medical education*, *20*, 1-11.

Hoidn, S., & Reusser, K. (2020). Foundations of student-centered learning and teaching. In *The Routledge international handbook of student-centered learning and teaching in higher education* (pp. 17-46). Routledge.

Jamil, M., Bokhari, T. B., & Iqbal, J. (2024). Incorporation of critical thinking skills development: A case of mathematics curriculum for grades I-XII. *Journal of Asian Development Studies*, *13*(1), 375-382.

Khan, M. (2023). Academic self-efficacy, coping, and academic performance in college. *International Journal of undergraduate research and creative activities*, *5*(1), 3.

Lei, W., Wang, X., Dai, D. Y., Guo, X., Xiang, S., & Hu, W. (2022). Academic self-efficacy and academic performance among high school students: A moderated mediation model of academic buoyancy and social support. *Psychology in the Schools*, *59*(5), 885-899.

Magaji, A. (2021). Promoting problem-solving skills among secondary science students through problem based learning. *International Journal of Instruction*, *14*(4), 549-566.

Makonye, L. E. A. H. (2019). Exploring the teaching of critical thinking skills to learners to promote mathematical literacy: A case of five schools in the Zaka District of Zimbabwe. *University of Kwazulu-Natal*.

Mariamah, M., Suastra, I. W., & Aryana, I. B. (2022). Analysis on why low learning outcome of mathematics and science in Elementary School at Bima District. *Jurnal Pijar MIPA*, *17*(1), 100-105.

Mega, C., Ronconi, L., & De Beni, R. (2014). What makes a good student? How emotions, self-regulated learning, and motivation contribute to academic achievement. *Journal of educational psychology*, *106*(1), 121.

Öztürk, Ö. T. (2023). Examination of 21st Century Skills and Technological Competences of Students of Fine Arts Faculty. *International Journal of Education in Mathematics, Science and Technology*, *11*(1), 115-132.

Oyedeji, S. O. (2017). The Effects of Students' Motivational Factors on Their Attitudes toward Mathematics. *International Journal of Evaluation and Research in Education*, *6*(4), 277-287.

Rahman, M. S., & Juniati, D. (2023). The Quality of Mathematical Proficiency in Solving Geometry Problem: Difference Cognitive Independence and Motivation. *Pegem Journal of Education and Instruction*, *13*(3), 255-266.

Rahman, M. S., Juniati, D., & Manuharawati. (2022, July). Strategic competence in solving-problem and productive disposition of high school students based on cognitive styles. In *AIP Conference Proceedings* (Vol. 2577, No. 1, p. 020053). AIP Publishing LLC.

Rahman, M., Hamid, A., & Asmaun, A. (2025). Enhancing Students' Strategic Competence with GeoGebra and Productive Disposition: Elevating Mathematics Learning in the Digital Age. *International Journal of Education in Mathematics, Science and Technology*, *13*(4), 930-946.

Schukajlow, S., Rakoczy, K., & Pekrun, R. (2017). Emotions and motivation in mathematics education: Theoretical considerations and empirical contributions. *ZDM*, *49*, 307-322.

Sivrikaya, A. H. (2019). The Relationship between Academic Motivation and Academic Achievement of the Students. *Asian Journal of Education and Training*, *5*(2), 309-315.

Supriadi, N., & Suherman, S. (2024). The role of learning anxiety and mathematical reasoning as predictor of promoting learning motivation: The mediating role of mathematical problem solving. *Thinking Skills and Creativity*, *52*, 101497.

Szabo, Z. K., Körtesi, P., Guncaga, J., Szabo, D., & Neag, R. (2020). Examples of problem-solving strategies in mathematics education supporting the sustainability of 21st-century skills. *Sustainability*, *12*(23), 10113.

Tang, K. H. D. (2023). Student-centered Approach in Teaching and Learning: What Does It Really Mean?. *Acta Pedagogia Asiana*, *2*(2), 72-83.

Voica, C., Singer, F. M., & Stan, E. (2020). How are motivation and self-efficacy interacting in problem-solving and problem-posing?. *Educational Studies in Mathematics*, *105*(3), 487-517.

Zimmerman, B. J., & Schunk, D. H. (2012). Motivation: An essential dimension of self-regulated learning. In *Motivation and self-regulated learning* (pp. 1-30). Routledge.

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