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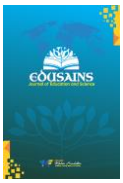

Learning Discipline as a Predictor of Mathematics Learning Outcomes among Grade VII Students

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A B S T R A C T

Learning discipline is widely assumed to support mathematics learning, yet evidence from Indonesian junior secondary classrooms that examines concrete discipline behaviors, rather than broad self-regulation constructs, remains limited. This study aimed to determine the extent to which learning discipline predicts the mathematics learning outcomes of Grade VII students. A quantitative ex post facto correlational design was employed at a public junior high school in Padang Panjang, West Sumatra, Indonesia, in the 2018/2019 academic year. From a population of 139 students in five classes, 28 students were selected by lottery-based simple random sampling. Learning discipline was measured with a 20-item, five-point Likert-type questionnaire covering managing study time at home, studying regularly, attending to instruction, and maintaining classroom order; the items were retained after expert review and item analysis of a 30-item try-out version. Mathematics learning outcomes were taken from odd-semester final examination scores. Data were analyzed using descriptive statistics, Pearson correlation, and simple linear regression. The mean discipline score was 76.07 (SD = 9.68) and the mean mathematics score was 63.61 (SD = 16.45). Learning discipline was positively and significantly correlated with mathematics learning outcomes (r = .58, $t(26)$ = 3.59, p = .001), and the regression model $\hat{Y}$ = −10.81 + 0.978X accounted for 33.1% of the variance in mathematics scores. More disciplined study behavior is thus associated with higher mathematics achievement, although the observational design precludes causal inference. The study supports integrating structured study routines and classroom order into mathematics teaching and student guidance in Indonesian junior high schools.

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1. Introduction

Mathematics achievement remains a central concern of school education because mathematical competence underpins further study, everyday problem solving, and participation in a knowledge-based society. International assessments show that mathematical proficiency differs widely across and within education systems and that these differences are shaped by learning opportunities, equity conditions, and students' learning strategies and attitudes (OECD, 2023a);(OECD, 2023b);(OECD, 2024). A systematic review of studies using PISA data identified a broad set of predictors of mathematics achievement, including student absence and lateness, misbehavior at school, and socioeconomic resources, while noting that the magnitude of these associations varies across contexts (Wang, 2023). In Indonesia, analysis of PISA 2022 data has similarly shown that instructional practices such as teachers' cognitive activation operate together with students' learning behaviors in explaining mathematics achievement (Earthadara & Kismiantini, 2025). Students' learning discipline is therefore a plausible, although not exclusive, contributor to mathematics learning outcomes.

In this study, learning discipline refers to students' self-control in following written and unwritten rules of learning, expressed in consistent behavior in managing study time,

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studying regularly, attending to instruction, and complying with classroom order. The construct overlaps with self-regulated learning, which describes how learners plan, monitor, and adapt their cognition, motivation, and behavior across cyclical phases of learning (Zimmerman, 2008). Meta-analytic evidence indicates that self-regulated learning strategies are positively related to academic achievement from childhood through adolescence (Dent & Koenka, 2016). In mathematics specifically, self-regulation has predicted performance among students in Grades 5 to 8 (Harding et al., 2019), and studies have linked regulation, emotion regulation, and engagement with mathematics achievement (Losenno et al., 2020); (Salma & Alsa, 2023). Of particular relevance, a study of secondary students in Shanghai found that discipline was associated with motivation and mathematics achievement (Ning, 2020). Research with primary, junior high, and senior high school students has further examined how regulatory dimensions relate to mathematics performance across curricula, developmental periods, measurement approaches, academic subjects, and genders (Arvatz & Dori, 2025); (Guo et al., 2023); (Mauer et al., 2023); (Říčan et al., 2022);(Zhidkikh et al., 2023).

A second strand of research has examined whether regulatory behavior can be fostered through instruction. Quasi-experimental programs, self-scoring tasks, data-driven feedback, and self-instructional materials have shown that mathematics-related regulation can be supported in the classroom (Balan & Jönsson, 2025); (Caballero-Carrasco et al., 2021); (Huang et al., 2024); (Oudman et al., 2022); (Seferian et al., 2021). Technology-supported and online learning studies have extended this work to digital environments (Chimmalee & Anupan, 2024); (Letchumanan et al., 2024); (Purnomo et al., 2024), and recent syntheses confirm that regulatory strategies are related to performance across delivery modes (Noor et al., 2025); (Zhao et al., 2025). Classroom conditions also shape how students regulate their learning. Classroom management and mastery goal orientation have been associated with students' self-regulation in mathematics (Cahyani et al., 2019), and the disciplinary climate of classrooms and schools has been linked to achievement and gender differences (Liu et al., 2024); (Sortkær & Reimer, 2018). Teacher support, cognitive activation, and student motivation likewise contribute to mathematics outcomes (Alomiear, 2024);(Bloem et al., 2024);(Kitsantas et al., 2021); (Wang, 2023); (Zhang et al., 2021).

Indonesian research in mathematics education has largely concentrated on instructional models and affective variables. Correlational and ex post facto studies have reported that learning motivation (Yulia et al., 2024) as well as metacognitive awareness and mathematics anxiety (Setiawan & Medika, 2026) are related to students' mathematics outcomes, while classroom studies have evaluated the probing-prompting technique, the Formulate–Share–Listen–Create model, and Jigsaw cooperative learning (Akbar et al., 2023); (Oktaria et al., 2025);(Syafitri et al., 2023). Studies from West Sumatra have also linked students' personal and motivational characteristics to mathematics learning, showing that spiritual intelligence is significantly related to mathematics learning outcomes (Afrianti & Imamuddin, 2022) and that the use of ChatGPT as a learning medium increases students' motivation to learn mathematics (Mardhati & Medika, 2026). Other instructional studies have reported that the Pair Check cooperative model fosters active participation and better learning outcomes than conventional teaching (Widya et al., 2021), that the Think Pair Share model improves mathematical problem-solving ability (Sandri & Medika, 2026), and that web-based multimedia developed with Google Sites is valid, practical, and effective for teaching algebraic functions (Syarifa et al., 2026). A critical reading of this body of work shows that international evidence relies

mostly on broad self-regulation inventories, large-scale assessment data, or intervention designs, whereas comparatively little attention has been paid to the concrete, observable discipline behaviors that Indonesian junior high school teachers encounter daily, such as irregular study at home, inattention, and disruption during lessons.

This gap was evident at SMP Negeri 3 Padang Panjang, West Sumatra. Results of the second mathematics daily test in the 2018/2019 academic year showed that only 46 of 139 Grade VII students (33.09%) reached the minimum mastery criterion, with class-level mastery rates ranging from 11.11% in VII E to 53.57% in VII D. An interview with a Grade VII mathematics teacher indicated that many students played or chatted during lessons, did not attend to the teacher's explanations, were reluctant to take notes, and frequently asked permission to leave the classroom, so that they missed explanations and did not understand the material. The novelty of the present study lies in operationalizing learning discipline through four behavioral indicators that combine home study habits and classroom conduct, and in estimating their relationship with official semester examination scores in an Indonesian Grade VII setting, while interpreting the results within the wider self-regulated learning literature.

Accordingly, this study aimed to determine whether, and to what extent, learning discipline predicts the mathematics learning outcomes of Grade VII students. The research questions were: (1) Is there a significant positive relationship between learning discipline and mathematics learning outcomes? (2) How much of the variance in mathematics learning outcomes is accounted for by learning discipline? It was hypothesized that learning discipline would positively and significantly predict mathematics learning outcomes. The study is expected to contribute context-specific empirical evidence to the literature on learner regulation in mathematics and to offer practical guidance for mathematics teachers, homeroom teachers, and school counselors in fostering disciplined study routines.

2. Methods

2.1. *Research Design*

This study used a quantitative approach with an ex post facto correlational design. The design was chosen because learning discipline is an existing student characteristic that cannot be manipulated by the researcher; the study therefore examined naturally occurring variation in discipline and its relationship with mathematics outcomes without giving any treatment to the participants. Learning discipline served as the predictor variable (X) and mathematics learning outcomes as the criterion variable (Y). Because no treatment or random assignment was involved, the analysis estimates an association and a predictive relationship rather than a causal effect.

2.2. *Research Setting and Participants*

The study was conducted at SMP Negeri 3 Padang Panjang, a public junior high school located on Jalan Ahmad Yani, Padang Panjang, West Sumatra Province, Indonesia, during the odd semester of the 2018/2019 academic year. The population consisted of all 139 Grade VII students distributed across five classes: VII A (n = 30), VII B (n = 26), VII C (n = 28), VII D (n = 28), and VII E (n = 27). Before sampling, the mid-semester mathematics scores of the five classes were examined. The population scores were normally distributed according to the Lilliefors test ($L_0 = 0.0729 < L_{table} = 0.075$) and the MINITAB normality test ($p = .102$), and the

class variances were homogeneous according to Bartlett's test ($\chi^2(4) = 1.02 < 9.49$) and the MINITAB test for equal variances ($p = .910$).

2.3. *Sampling Procedures*

Because the population was relatively large, a sample of 20% of the population, or 28 students, was drawn, in line with the common guideline that 10–25% of a large population may be sampled when time and resources are limited. Simple random sampling was implemented with a lottery: every Grade VII student was listed and given a code number, each code was written on a slip of paper, and the rolled slips were shuffled in a container and drawn until 28 students had been selected. The resulting sample comprised 4 students from VII A, 2 from VII B, 17 from VII C, 3 from VII D, and 2 from VII E. Because student outcomes in comparable studies are shaped by school and contextual factors, drawing the sample from a single school restricts generalization to similar settings (Karn et al., 2023); (Ortega-Rodríguez, 2025).

2.4. *Research Instruments*

Learning discipline was measured with a closed-ended questionnaire developed by the researchers on the basis of four indicators: (a) managing study time at home, (b) studying regularly and diligently, (c) paying attention during lessons, and (d) maintaining orderly conduct in the classroom. Descriptors included having a study schedule at home, attending lessons on time, bringing learning materials, using free time for study, attending to and following the teacher, and keeping order during lessons and while completing assignments. Items were written as positive and negative statements and answered on a five-point scale (always, often, sometimes, rarely, never), scored 5 to 1 for positive statements and 1 to 5 for negative statements. The try-out version contained 30 items; after item analysis, 20 items were retained, distributed as follows: three items for managing study time at home, four for studying regularly, four for attention during lessons, and nine for classroom order. Total scores could therefore range from 20 to 100. The questionnaire instructions informed students that their responses would not affect their grades.

Mathematics learning outcomes were obtained through documentation of students' odd-semester final examination (ujian akhir semester) scores in mathematics for the 2018/2019 academic year. The examination was prepared, administered, and scored by the Grade VII mathematics teacher, and the researchers obtained the scores from the teacher's grade book; the researchers did not construct or administer the test. Separating self-reported learning behavior from an independent performance indicator in this way follows recommendations from research on learning strategies and mathematics regulation (Arcoverde et al., 2022); (Gürel et al., 2022); (Lahdenperä et al., 2022);(Landa et al., 2024).

2.5. *Data Collection Procedures*

The study proceeded in three stages. In the preparation stage, research permits were obtained from the institute and from the Padang Panjang city government, the sample was drawn, the questionnaire blueprint and items were developed, the items were reviewed by experts, and the try-out version was administered on 29 November 2018. In the implementation stage, the final 20-item questionnaire was administered to the 28 sampled students on 18 December 2018, and their odd-semester final examination scores were collected

from the mathematics teacher. In the final stage, the data were scored, tabulated, and analyzed statistically.

2.6. *Validity and Reliability*

Content validity was established through expert judgment by three lecturers in guidance and counseling at the Institut Agama Islam Negeri (IAIN) Bukittinggi, who reviewed the questionnaire blueprint and items before the try-out. Item validity was then examined using the Pearson product–moment correlation between each item score and the total score of the try-out data (N = 23), with rtable = 0.413 at α = .05. Twenty items met the criterion (r = 0.438–0.796), of which seven were in the high category (r = 0.61–0.80) and thirteen in the moderate category (r = 0.41–0.60); the remaining ten items (r = 0.085–0.407) were discarded. Internal consistency was examined with Cronbach's alpha on the try-out data. However, the coefficient reported in the original analysis exceeded the admissible upper bound of 1.00 because of an error in computing the total-score variance, and the item-level try-out data needed to recompute it were not available; reliability evidence for the final 20-item version is therefore treated as a limitation of this study. The final examination was the school's official instrument for assessing students' semester achievement in mathematics.

2.7. *Data Analysis*

Data were analyzed in three stages. First, descriptive statistics (total, mean, standard deviation, median, minimum, and maximum) were computed, and scores were classified into four categories based on the sample mean (M) and standard deviation (SD): very high (> M + SD), high (M to M + SD), low (M − SD to M), and very low (≤ M − SD). Second, normality was tested with the Lilliefors test and confirmed with the MINITAB normality test, and linearity was tested with the lack-of-fit F test. Third, Pearson product–moment correlation was used to assess the strength and direction of the relationship, and simple linear regression of the form $\hat{Y} = a + bX$ was used to estimate the predictive relationship. The significance of the relationship was tested with a t test at α = .05 (df = n − 2 = 26), and the coefficient of determination (R^2) expressed the proportion of variance in mathematics scores accounted for by learning discipline. The 95% confidence interval for r was estimated using Fisher's z transformation. Calculations were performed manually and verified with MINITAB.

2.8. *Ethical Considerations*

The study was conducted with official research permission from the institute and the Padang Panjang city government and with the cooperation of the school and its Grade VII mathematics teacher. Students were informed in the questionnaire instructions that their answers would not affect their grades, and the mathematics scores used were existing school records; no intervention was administered. In this article, all student data are reported anonymously and only in aggregate form.

3. Results

3.1. *Descriptive Statistics*

Table 1 presents the descriptive statistics for learning discipline and mathematics learning outcomes of the 28 sampled students.

Table 1. Descriptive statistics of learning discipline and mathematics learning outcomes (n = 28)

Statistic	Learning discipline (X)	Mathematics learning outcomes (Y)
Total score	2,130	1,781
Mean	76.07	63.61
Standard deviation	9.68	16.45
Median	77.00	61.50
Minimum	56	33
Maximum	94	93
Range	38	60

As shown in Table 1, learning discipline scores ranged from 56 to 94 on a possible range of 20 to 100, with a mean of 76.07 (SD = 9.68). Mathematics scores ranged from 33 to 93, with a mean of 63.61 (SD = 16.45); the larger dispersion of mathematics scores indicates considerable variation in achievement within the sample. Table 2 shows the distribution of students across the four score categories.

Table 2. Distribution of students by score category (n = 28)

Category	Discipline score range	*f* (%)	Mathematics score range	*f* (%)
Very high	> 86	3 (10.7)	> 80	4 (14.3)
High	77–86	11 (39.3)	65–80	8 (28.6)
Low	67–76	9 (32.1)	49–64	10 (35.7)
Very low	≤ 66	5 (17.9)	≤ 48	6 (21.4)

Note. Category limits were derived from the sample mean and standard deviation (discipline: M ≈ 76, SD ≈ 10; mathematics: M ≈ 64, SD ≈ 16).

Half of the students (50.0%) obtained discipline scores in the high or very high categories, whereas 17.9% fell in the very low category. For mathematics, 42.9% of students were in the high or very high categories and 57.1% were in the low or very low categories, which is consistent with the low mastery rate observed in the school's daily test records.

3.2. *Prerequisite Tests*

The Lilliefors test showed that both variables were normally distributed: learning discipline, $L_0 = 0.0878$, and mathematics learning outcomes, $L_0 = 0.0874$, both below Ltable = 0.167 for n = 28 at α = .05. The MINITAB normality test yielded the same conclusion (p = .613 for learning discipline and p = .443 for mathematics learning outcomes). The lack-of-fit test indicated that the relationship between the two variables was linear, F(18, 8) = 0.40, p = .95. The data therefore met the assumptions for correlation and simple linear regression analysis.

3.3. *Relationship between Learning Discipline and Mathematics Learning Outcomes*

Table 3 summarizes the results of the correlation and simple linear regression analyses.

Table 3. Correlation and simple linear regression of mathematics learning outcomes on learning discipline

Statistic	Value	Interpretation
Pearson correlation (*r*)	.575	Positive, large
95% CI for *r*	[.26, .78]	Excludes zero
Coefficient of determination (R^2)	.331	33.1% of variance
Adjusted R^2	.305	—
Regression equation	$\hat{Y} = -10.81 + 0.978X$	—
Slope *b* (*SE*)	0.978 (0.273)	—

Statistic	Value	Interpretation
95% CI for *b*	[0.418, 1.539]	Excludes zero
Standard error of estimate	13.71	—
t test	$t(26) = 3.59$, $p = .001$	Significant
F test for model	$F(1, 26) = 12.87$, $p = .001$	Significant

Note. The 95% CI for r was computed using Fisher's z transformation. Regression sums of squares: regression = 2,418.9, residual = 4,887.8, total = 7,306.7.

Learning discipline was positively and significantly correlated with mathematics learning outcomes, r = .575, 95% CI [.26, .78], p = .001. The correlation exceeded the critical value (rtable = .374 at α = .05, n = 28) and represents a large effect by conventional benchmarks. The regression equation $\hat{Y} = -10.81 + 0.978X$ indicates that each one-point increase in the learning discipline score was associated with an average increase of approximately 0.98 points in the mathematics examination score. The relationship was statistically significant, t(26) = 3.59, p = .001, exceeding the critical value of 1.71 for the one-tailed test; thus, the null hypothesis was rejected. The coefficient of determination ($R^2 = .331$) shows that learning discipline accounted for 33.1% of the variance in mathematics scores in this sample, whereas the remaining 66.9% was associated with factors not included in the model.

4. Discussion

The principal finding of this study is that Grade VII students who reported more disciplined study behavior tended to obtain higher mathematics examination scores, and that learning discipline accounted for roughly one-third of the variance in those scores. The four indicators measured here describe behaviors that plausibly translate into greater opportunities to learn. Allocating time to study at home and studying regularly increase the amount of deliberate practice, whereas attention and orderly conduct during lessons protect instructional time and enable students to follow explanations and complete tasks. The classroom behaviors described by the mathematics teacher, such as chatting, inattention, and leaving the room during lessons, are precisely the behaviors that reduce such opportunities. Because mathematical knowledge is cumulative, irregular study and inattention may create gaps that accumulate across topics, which helps to explain why discipline was relevant to performance on a semester examination.

The direction and size of the relationship are consistent with evidence linking self-regulated learning to achievement (Dent & Koenka, 2016);(Zimmerman, 2008) and, more specifically, to the mathematics performance of middle-grade students (Harding et al., 2019). The finding also corroborates research in Shanghai showing that discipline is associated with mathematics achievement alongside motivation (Ning, 2020), as well as studies reporting that self-regulation, classroom context, and engagement jointly support mathematics achievement (Kitsantas et al., 2021);(Salma & Alsa, 2023). The present study extends this literature by showing that a relatively simple behavioral measure, rather than a comprehensive self-regulation inventory, longitudinal tracking, or digital trace data (Mauer et al., 2023); (Říčan et al., 2022);(Zhidkikh et al., 2023), can still capture a meaningful share of the variation in examination results within an Indonesian junior high school.

At the same time, the results refine rather than simply replicate earlier work. The discipline indicators used in this study focus on observable routines and conduct; they do not directly capture strategic planning, metacognitive monitoring, or help-seeking, which are central to broader models of self-regulation. Studies of regulatory profiles across subjects,

learner groups, and learning environments show that these components can function differently (Arvatz & Dori, 2025);(Göller et al., 2026);(Guo et al., 2023);(Landa et al., 2024), and evidence from online and blended learning indicates that the strength of strategy–performance relationships varies by task and setting (Letchumanan et al., 2024); (Lyakhova & Joubert, 2022);(Zhao et al., 2025). The present result is therefore best understood as evidence for the role of behavioral discipline, which may serve as a foundation on which more strategic forms of self-regulation are developed.

The remaining two-thirds of the variance indicates that discipline is only one of many determinants of mathematics achievement. Classroom disciplinary climate and perceived instructional quality (Liu et al., 2024); (Sortkær & Reimer, 2018) teachers' need-supportive practices and cognitive activation (Alomiear, 2024); (Bloem et al., 2024); (Earthadara & Kismiantini, 2025); (Wang, 2023); (Zhang et al., 2021), teachers' efforts to develop mathematical reasoning (Mukuka et al., 2023), and the combined support of teachers and parents (Hallarte et al., 2024) have all been shown to contribute to mathematics learning. Large-scale analyses also identify socioeconomic and gender-related factors (Karn et al., 2023); (Ortega-Rodríguez, 2025); (Wang, 2023). In Indonesia, motivation, metacognitive awareness, and mathematics anxiety have been associated with achievement (Setiawan & Medika, 2026); (Yulia et al., 2024), and instructional models such as probing-prompting, Formulate–Share–Listen–Create, and Jigsaw have been used to improve outcomes (Akbar et al., 2023);(Oktaria et al., 2025);(Syafitri et al., 2023). Because these studies differ in samples, measures, and designs, their results cannot be compared numerically with the present coefficient; taken together, however, they suggest that discipline operates within a wider system of learner, teacher, and family conditions.

Theoretically, this study contributes context-specific evidence that behavioral discipline, an accessible and teacher-observable construct, is meaningfully related to mathematics achievement in the first year of junior high school. Practically, the findings suggest that mathematics teachers, homeroom teachers, and school counselors can support achievement by helping students establish regular study schedules, setting clear routines for attention and participation, and managing classrooms in ways that minimize disruption. Intervention research indicates that regulatory skills can be developed through structured feedback, self-scoring, explicit regulation training, time-management support, and technology-enhanced learning (Balan & Jönsson, 2025); (Caballero-Carrasco et al., 2021); (Chimmalee & Anupan, 2024); (Huang et al., 2024); (Khiat, 2022); (Oudman et al., 2022); (Purnomo et al., 2024);(Seferian et al., 2021), and such approaches could be adapted to strengthen the discipline indicators examined here. Teacher education programs may also benefit from preparing teachers to cultivate students' self-regulation (Arcoverde et al., 2022);(Gürel et al., 2022);(Lahdenperä et al., 2022), drawing on systematic reviews of effective practices (Noor et al., 2025).

Several limitations should be considered when interpreting these findings. First, the sample consisted of 28 students from a single school, and the lottery produced an uneven distribution across classes, with 17 of the 28 students coming from VII C; this limits the precision of the estimates and their generalizability. Second, the ex post facto design with a single predictor did not control for prior mathematics achievement, socioeconomic background, or teacher and class differences; therefore, the relationship cannot be interpreted as causal. Third, learning discipline was measured through self-report, which may be affected by social desirability, and although the questionnaire showed content and item validity, its internal-consistency reliability could not be verified. Fourth, the data were collected in the

2018/2019 academic year, before the disruptions to schooling documented in recent international assessments (OECD, 2023b), so current cohorts may differ. Future studies should use larger multi-school samples, instruments with verified reliability, additional covariates such as prior achievement and motivation, and longitudinal or experimental designs to test whether improvements in discipline precede gains in mathematics achievement.

5. Conclusion

This study concludes that learning discipline is a significant positive predictor of the mathematics learning outcomes of Grade VII students at SMP Negeri 3 Padang Panjang, accounting for approximately one-third of the variance in semester examination scores. Students who managed their study time, studied regularly, paid attention during lessons, and behaved in an orderly manner tended to achieve higher mathematics scores. The study contributes context-specific evidence from an Indonesian junior high school that a concrete behavioral conception of discipline is meaningfully associated with mathematics achievement and complements broader models of self-regulated learning. These findings imply that cultivating consistent study routines and an orderly classroom environment should form part of efforts to improve mathematics learning in junior high schools. Given the single-school sample, the correlational design, and the unverified reliability of the questionnaire, the results should be generalized with caution, and future research should employ larger samples, instruments with established reliability, additional predictors, and longitudinal or intervention designs. Overall, disciplined learning behavior emerges as a modifiable and practically relevant foundation for mathematics achievement in early adolescence.

Declarations

Author Contribution Statement

Jumadil Hidayatul Taufiq: conceptualization of the article, formal analysis (re-analysis of the data), writing—original draft of the manuscript, and correspondence with the journal. Arina Mana Sikana: investigation, including fieldwork at the school, instrument try-out, questionnaire administration, and data collection; data curation; and initial data analysis. Zebbil Billian Tomi: literature review and writing—review and editing. Fifian Fitra Janeva: verification of data and references, preparation of tables, and writing—review and editing. All authors read and approved the final manuscript.

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Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request. Individual student records are not publicly available in order to protect the privacy of minors.

Declaration of Interests Statement

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

Additional Information

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