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Psychological And Environmental Predictors Of Mathematics Achievement: An Ordinal Logistic Regression Analysis

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Abstract
This study aims to analyze the simultaneous and partial effects of discipline, learning motivation, and parental support on the mathematics learning outcomes of high school students at SMA Negeri 1 Grati, Pasuruan Regency. Previous educational studies heavily relied on linear ordinary least squares regression, which is methodologically flawed when treating ordinal categorical academic achievements. Addressing this research and scope gap, this study employs an ordinal logistic regression framework to model the probabilities of achieving higher mathematics competency categories (low, medium, and high). A quantitative explanatory research design was adopted using cross-sectional data collected from 104 students selected via simple random sampling. Data were gathered using a validated 4-point Likert scale questionnaire and official academic documentation of cumulative mathematics scores. The empirical findings reveal that discipline, learning motivation, and parental support simultaneously exert a significant positive effect on mathematics achievements (Chi-Square = 218.584, $p < 0.001$). Individually, all three variables significantly predict higher academic categories ($p < 0.05$). Learning motivation emerged as the most dominant psychological predictor, with an odds ratio of 5.88, followed closely by learning discipline (OR = 5.65) and parental support (OR = 5.31). The Nagelkerke Pseudo R-Square indicated that the model explains 100% of the variance; however, this must be explicitly framed as a statistical artifact of complete separation due to highly structured predictive attributes. These insights emphasize the critical integration of internal psychological triggers (*Niyyah* and *Istiqamah*) and external environmental support structures (*Tarbiyah Islamiyah*) in reinforcing secondary mathematics education frameworks in Indonesia.

Keywords:
Academic achievement; Assessment in mathematics; Learning discipline; Learning motivation; Ordinal logistic regression

A. INTRODUCTION

Education plays a crucial role in improving the quality of human resources, where success is evaluated not merely by procedural engagement but fundamentally reflected by student learning outcomes. In secondary education, this empirical threshold is typically anchored to the Minimum Completeness Criteria (KKM), which indicates student mastery over abstract and logical competencies. However, instructional realities frequently mirror a persistent gap where a substantial proportion of students struggle to satisfy national baseline performance levels. This problem is observed at SMA Negeri 1 Grati, Pasuruan Regency, where secondary mathematics outcomes remain suboptimal, necessitating an inquiry into the underlying psychological and socio-environmental factors.

Theoretically, mathematics achievement does not emerge in a vacuum; rather, it is shaped by the interaction between internal cognitive-affective factors and external

environmental microstructures. In the paradigm of Islamic education, this interaction aligns with the cultivation of holistic character (Akhlaq). Learning discipline represents a behavioral manifestation of self-regulated learning (SRL) that guides how students allocate time, control impulses, and manage academic workloads (Dignath & Büttner, 2018; Zimmerman & Schunk, 2011). In an Islamic pedagogical context, this discipline closely mirrors the principle of Istiqamah (consistency and steadfastness) commanded in Surah Hud [11:112], which mandates believers to remain steadfast on the right course. Concurrently, learning motivation acts as the psychological catalyst that drives cognitive engagement and sustains effort when facing rigorous, abstract problem-solving processes (Kim & Park, 2023). This intrinsic motivation resonates deeply with the concept of Niyyah (pure intention) and the pursuit of academic excellence highlighted in Surah Al-Mujadila, where Allah promises to exalt in degree those who are granted knowledge. Externally, parental support functions as a critical microstructure providing both logistical learning facilities and emotional safety nets. This reflects the essence of Tarbiyah Islamiyah (Islamic nurturing) and the foundational parental responsibility mandated in Surah At-Tahrim [66:6] to protect and guide one's family, buffering students against math anxiety and stress (Moè et al., 2021; Rahmawati & Suryadi, 2024).

From an epistemological standpoint, evaluating these factors within mathematics instruction requires a clear focus on the hierarchical nature of mathematical knowledge. Mathematics learning requires continuous cumulative scaffolding; when a student compromises learning discipline (Istiqamah) on prerequisite competencies, their cognitive architecture for absorbing advanced numerical structures fails systematically (Boekaerts, 2020). Furthermore, parental support (Tarbiyah) is vital in reducing mathematics-specific anxiety, allowing optimal utilization of students' working memory during academic tasks (Dowker et al., 2016).

Despite these clear links, a critical methodological and substantive gap persists in existing literature. Recent literature on Islamic education reform indicates a distinct theoretical gap: most secondary mathematics diagnostics rely heavily on secular-quantitative frameworks without integrating Islamic character-building perspectives. Methodologically, previous studies have leaned heavily on standard Ordinary Least Squares (OLS) linear regression. This linear approach introduces severe misspecification biases because academic achievements are inherently measured or classified as bounded, ordinal categories. To bridge this research gap, this study deploys an ordinal logistic regression framework to compute explicit odds ratios for category-to-category student achievement transitions under the joint influence of internal and external drivers. The objectives of this research are to analyze the simultaneous and partial effects of discipline (Istiqamah), learning motivation (Niyyah), and parental support (Tarbiyah) on the mathematics learning outcomes of high school students, providing actionable empirical insights for localized educational assessment integrated with Islamic values.

B. METHODS

This study implemented a quantitative explanatory research design using a cross-sectional approach to investigate the causal mechanisms and predictive strengths between the independent constructs and the dependent categorical outcomes. The research was conducted at SMA Negeri 1 Grati, Pasuruan Regency, a public secondary institution. While this setting provides a diverse demographic for baseline analysis, the reliance on a single secular state school (N = 104) serves as a scope limitation regarding the generalizability of fully integrated Islamic educational frameworks. Future research should extend this sampling to Madrasah Aliyah (Islamic Senior High Schools) to better capture the nuanced integration of these variables within formal Islamic curricula. The target population encompassed all active high school students during the 2026/2027 academic year, selected via probability simple random sampling to satisfy the minimum requirements for event-per-variable stability in categorical regression models.

The structural architecture of this research consists of three independent variables: Learning Discipline (X1), Learning Motivation (X2), and Parental Support (X3). These constructs were operationalized through a self-administered questionnaire utilizing a 4-point Likert scale (4 = Always, 3 = Often, 2 = Sometimes, 1 = Never). This 4-point design intentionally omitted a neutral midpoint to minimize central tendency bias among respondents. The dependent variable (Y) is Mathematics Learning Outcomes, captured using historical documentation of final official cumulative grades. To mirror authentic curriculum proficiency tiers, these raw scores were mapped onto an ordinal scale: Low (Y = 0, scores ≤ 65), Medium (Y = 1, scores 66 - 80), and High (Y = 2, scores > 80). The complete measurement framework is presented in Table 1.

Table 1. *Operational Framework of Variables and Measurement Scales*

Variable	Indicators	Item Code	Total Items	Measurement Scale
Learning Discipline (X1)	Time management (*Inthidham*), compliance with schedules, task persistence (*Istiqamah*).	D1-D8	8 items	Ordinal (Likert 1-4)
Learning Motivation (X2)	Goal orientation driven by pure intention (*Niyyah*), cognitive engagement, failure resilience (*Raghbah*).	M1-M8	8 items	Ordinal (Likert 1-4)
Parental Support (X3)	Islamic nurturing (*Tarbiyah Islamiyah*), emotional scaffolding, material facilities, parental monitoring.	O1-O8	8 items	Ordinal (Likert 1-4)
Mathematics Outcomes (Y)	Official institutional cumulative test scores.	-	-	Ordinal Tier (Y=0,1,2)

Source: Primary data processed, 2026

To guarantee data quality, the data underwent psychometric and econometric validation. Construct validation was executed using the Pearson Product-Moment Correlation formula against a critical table value. Internal consistency was evaluated utilizing Cronbach's Alpha coefficients calculated for each separate scale. Multicollinearity diagnostic checks were conducted by computing the Variance Inflation Factor (VIF) and Tolerance limits to prevent variance inflation during parameter estimation. The primary model estimation was performed through Ordinal Logistic Regression using the cumulative logit link function. Model validation was tested using Pearson and Deviance Goodness-of-Fit tests alongside the proportional odds assumption verified via the Test of Parallel Lines. Hypotheses testing was set at alpha = 0.05.

C. RESULTS AND DISCUSSION

The mathematical distribution of the independent scores and the ordinal proportions of the dependent variable were evaluated. Out of 104 respondents, the descriptive parameters are presented in Table 2.

Table 2. *Descriptive Statistics of Predictor Scales*

Variable	Mean	Median	Std. Dev	Minimum	Maximum	Cronbach's alpha
Learning Discipline (X1)	23.59	24.00	3.82	13.00	31.00	0.812
Learning Motivation (X2)	26.41	27.00	4.58	13.00	32.00	0.845
Parental Support (X3)	23.31	24.00	5.41	8.00	32.00	0.829

Source: Primary data processed, 2026

The descriptive data in Table 2 demonstrate that student learning motivation recorded the highest mean value (26.41, SD = 4.58), showing strong intrinsic and extrinsic push vectors within the mathematics cohort. Conversely, parental support exhibited the largest standard deviation (SD = 5.41), signaling high variance in the domestication of home learning environments. The ordinal categorization of mathematics outcomes (Y) showed balanced proportions across the sample: Low competence (Y = 0) accounted for 25 students (24.0%), Medium competence (Y = 1) accounted for 50 students (48.1%), and High competence (Y = 2) comprised 29 students (27.9%). Psychometric instrument validation confirmed that every single item (D1-D8, M1-M8, O1-O8) achieved a Pearson correlation value significantly higher than the critical r table value of 0.195 ($p < 0.05$), validating all items. Scale reliability evaluations yielded isolated Cronbach's Alpha coefficients of 0.812 (X1), 0.845 (X2), and 0.829 (X3), with a combined full instrument alpha of 0.894, confirming strong psychometric reliability. Multicollinearity evaluation showed safe values: Learning Discipline achieved a Tolerance of 0.780 and a VIF of 1.282; Learning Motivation showed a Tolerance of 0.892 and a VIF of 1.121; Parental Support showed a Tolerance of 0.840 and a VIF of 1.191. The maximal Condition Index was bounded at 18.180, far below the critical collinear boundary of 30.00, confirming the absence of linear dependencies.

The structural coefficients, standard errors, Wald statistics, and corresponding confidence limits derived via Maximum Likelihood Estimation (MLE) are compiled in Table 3.

Table 3. *Parameter Estimates of the Ordinal Logistic Regression Model*

Parameter	Estimate (b)	Std. Error	Wald	df	Sig.	95% Lower Bound	95% Upper Bound
Threshold [Y = 0]	113.183	32.190	12.363	1	0.000	50.091	176.275
Threshold [Y = 1]	138.501	39.384	12.367	1	0.000	61.310	215.691
Location: X1	1.732	0.503	11.837	1	0.001	0.745	2.718

Location: X2	1.771	0.522	11.504	1	0.001	0.748	2.795
Location: X3	1.670	0.479	12.159	1	0.000	0.731	2.609

Source: Primary data processed, 2026

The statistical indices in Table 3 indicate that all three independent variables function as significant positive predictors of higher mathematics performance. Based on these estimations, the parallel cumulative logit functions are structurally defined by equations (1) and (2):

$$\boldsymbol{Y \leq 0 = \log\left(\frac{P(Y \leq 0)}{P(Y > 0)}\right) = 113.183 + 1.732\, X_1 + 1.771 X_2 + 1.670 X_3} \quad (1)$$

$$\boldsymbol{Y \leq 1 = \log\left(\frac{P(Y \leq 1)}{P(Y > 1)}\right) = 138.501 + 1.732\, X_1 + 1.771 X_2 + 1.670 X_3} \quad (2)$$

Macro model diagnostics confirmed excellent fit. The Pearson chi-square statistic yielded a value of 6.798 (df = 203, p = 1.000) and the Deviance chi-square stood at 11.527 (df = 203, p = 1.000). These values support the null hypothesis that the empirical observations align with the fitted model. The Cox and Snell Pseudo R2 was 0.878, while the Nagelkerke and McFadden indices both converged to 1.000. The Test of Parallel Lines confirmed slope invariance across categories (Chi-Square = 0.000, df = 3, p = 1.000). Simultaneous parameter evaluation via the Omnibus Likelihood Ratio Test yielded a total model chi-square of 218.584 (df = 3, p < 0.001), confirming a highly significant simultaneous predictive capacity.

The empirical results confirm that secondary mathematics achievement is driven by a combination of internal psychological conditions and external micro-environmental support structures. Learning Motivation (X2) emerged as the most dominant psychological predictor (b = 1.771, OR = 5.88). Controlling for other covariates, every unit increase in a student's learning motivation increases their odds of transitioning into a higher mathematics achievement category by a factor of 5.88. This empirical finding correlates strongly with the Islamic pedagogical principle of Niyyah (pure intention) and the pursuit of knowledge as an act of worship (Ibadah), deeply rooted in Surah Al-Mujadila. Students driven by such intentions tend to perceive abstract algebraic or geometric tasks as opportunities for intellectual and spiritual elevation rather than anxiety-inducing challenges, optimizing their working memory efficiency during complex problem-solving (Kim & Park, 2023).

Learning Discipline (X1) also demonstrated strong predictive power (b = 1.732, OR = 5.65). Within the context of Islamic education, discipline is the direct realization of Istiqamah (steadfastness) as instructed in Surah Hud [11:112]. Istiqamah acts as the mechanism that converts motivational intent into consistent learning behaviors, such as deliberate practice and systematic study schedules (Baars et al., 2022). Because mathematical competency is cumulative, this steadfast self-regulation prevents cognitive gaps that could hinder the acquisition of subsequent mathematical concepts (Boekaerts, 2020).

Similarly, Parental Support (X3) provides an essential external push factor (b = 1.670, OR = 5.31). This reinforces the concept of Tarbiyah Islamiyah within the household, reflecting the protective educational mandate of parents outlined in Surah At-Tahrim [66:6]. Active parental scaffolding and the pursuit of Ridhal Walidain (parental blessing) create a secure emotional foundation that significantly reduces mathematics anxiety, allowing students to approach complex assignments with greater confidence and resilience (Moè et al., 2021; Rahmawati & Suryadi, 2024).

From a statistical perspective, the attainment of a Nagelkerke Pseudo R2 value of 1.000 and an ultimate log-likelihood value converging to absolute zero requires critical methodological reflection. This extreme scenario confirms the occurrence of the complete separation (or perfect prediction) phenomenon within the sample data (Albert & Anderson, 1984). Complete separation occurs when a single predictor or a specific linear combination of independent variables splits the ordinal response categories perfectly, preventing any overlay within the sample space vector (Heinze & Schemper, 2002). Consequently, the true

Maximum Likelihood parameters tend toward infinity, causing the standard errors to inflate artificially (Agresti, 2013).

Research Limitations: The occurrence of complete separation indicates that the predictive variables may be highly structured within the sample. Therefore, the findings should be interpreted cautiously and validated using larger and more heterogeneous populations. This condition may indicate a degree of sample homogeneity at SMA Negeri 1 Grati, or suggest that the localized instrument captured highly deterministic behavioral archetypes within this specific cohort (Allison, 2012). Future replication studies should expand sample collections across multiple regions and integrate penalized estimation frameworks such as Firth's Penalized Likelihood Logistic Regression to control parameter inflation and enhance generalizability (Firth, 1993; Heinze & Puhr, 2010).

D. CONCLUSION

This study demonstrates that learning discipline, learning motivation, and parental support exert significant positive predictive effects on the mathematics achievement categories of secondary school students. The findings confirm that motivation (Niyyah) acts as the primary psychological driver (OR = 5.88), followed by discipline (Istiqamah) (OR = 5.65) and parental support (Tarbiyah) (OR = 5.31).

Practically, these results demand concrete pedagogical strategies in the classroom. Mathematics teachers should explicitly integrate intention-setting (Niyyah) at the beginning of rigorous mathematical tasks and foster Istiqamah through consistent, low-stakes daily math drills rather than focusing solely on high-stakes testing. Furthermore, structural interventions must align parental communication channels to mitigate math anxiety. For future research, it is highly recommended to expand the sample beyond public schools to include Madrasah Aliyah (Islamic Senior High Schools) to better capture these dynamics within fully integrated Islamic educational environments and to mitigate statistical anomalies such as complete separation using penalized likelihood methods.

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