

Teachers' Pedagogical Approaches, Motivation, and Time Management as Determinants of Mathematics Achievement among Malaysian Secondary School Students

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ABSTRACT

This study examines the extent to which teachers' pedagogical approaches, instructional-level suitability, motivational strategies, and classroom time management influence students' mathematics achievement in Malaysian secondary schools. Employing a quantitative research design, data were collected through a structured questionnaire administered to 591 Form 4 and Form 5 students across six schools in Masjid Tanah, Melaka. The data were analyzed using SPSS version 27, incorporating descriptive and correlational analyses to determine the strength and significance of the relationships among variables. Findings revealed statistically significant positive correlations between all teacher-related factors and students' mathematics achievement, with coefficients ranging from $r = 0.237$ to $r = 0.488$ ($p < 0.01$). Among students from Sekolah Menengah Agama (SMA), teacher delivery methods ($r = 0.488$), instructional-level suitability ($r = 0.422$), and motivational strategies ($r = 0.449$) demonstrated moderate associations with mathematical proficiency. In contrast, these relationships were weaker yet significant among students from Sekolah Menengah Kebangsaan (SMK) ($r = 0.237$ – 0.278). Teaching time management exhibited weak but positive relationships in both contexts. These outcomes underscore the crucial role of teachers in enhancing mathematical understanding through effective pedagogical delivery, alignment of instructional content with students' cognitive readiness, and sustained motivational engagement. The study provides empirical insights that reinforce the objectives of the Malaysia Education Blueprint (2013–2025) and contribute to the realization of Sustainable Development Goal 4, which emphasizes inclusive and equitable quality education.

Keywords: Teacher pedagogical approaches, instructional-level suitability, motivational strategies, time management, mathematics achievement, SPM, Malaysia

INTRODUCTION

The persistent underperformance of students in Mathematics, particularly among Sijil Pelajaran Malaysia (SPM) candidates, continues to be a major concern within Malaysia's education system. Despite extensive curriculum reforms and the integration of digital learning tools, Mathematics remains one of the subjects with the highest failure rates nationwide. This long-standing issue suggests that student achievement is not solely determined by curriculum content or student effort, but is also closely tied to teachers' teaching approaches, motivational strategies, and classroom time management. Teachers' ability to deliver lessons at appropriate levels, sustain student interest, and foster motivation plays a crucial role in shaping Mathematics learning outcomes across different schooling contexts.

Effective teaching in Mathematics hinges not only on curriculum content but also on how that content is delivered. Teachers' delivery methods ranging from lecture-based instruction to inquiry-driven learning have a significant impact on student understanding and engagement. However, many educators struggle to adapt these methods appropriately across different teaching levels, such as primary, lower secondary, or upper secondary, where cognitive development and learning styles vary (Gallagher, Parsons, & Vaughn, 2022). Compounding

this challenge is the role of teacher motivation strategies, including the ability to foster a positive emotional climate and promote student persistence through empathy, feedback, and peer support. In parallel, time management in lesson planning and delivery is often cited as a constraint that limits the implementation of student-centered strategies. Together, these factors can hinder teachers from delivering impactful Mathematics instruction, especially in diverse classrooms where learners have varying needs and levels of readiness. This study therefore seeks to explore the interplay among teachers' teaching approaches, grade-level suitability, motivational practices, and time management to better understand how to enhance both teaching effectiveness and student interest in Mathematics.

According to the *Laporan Analisis Keputusan Peperiksaan SPM 2022* (Malaysian Examination Board, 2023), 24.3% of the 373,974 candidates failed Mathematics, while another 29% obtained grades D and E meaning that more than half (54%) of all SPM candidates scored between grades D to G. Although there was a minor improvement of 1.2% from the previous year, the marginal progress indicates that the underlying causes of poor achievement remain unresolved. Mathematics continues to record the second-highest failure rate after Additional Mathematics (26.2%). These figures reflect a systemic challenge that cannot be addressed by syllabus reform alone, but requires deeper attention to how Mathematics is taught and how teachers are supported to manage instructional time, motivate students, and adapt lessons effectively.

In many schools, teachers face multiple constraints large class sizes, diverse student abilities, time limitations, and pressure to complete the syllabus which restrict their ability to provide personalized feedback or adopt differentiated teaching methods. As a result, students who struggle with abstract mathematical concepts often experience anxiety, low self-efficacy, and disinterest, further reducing their performance. Previous studies have highlighted that when teachers employ motivational techniques, interactive problem-solving sessions, and constructive feedback, students tend to demonstrate higher engagement and improved mathematical reasoning (Moron & Brun, 2019; Brandenberger et al., 2018).

The consequences of weak Mathematics performance extend far beyond the classroom. Students who fail Mathematics face limited access to tertiary education and restricted career pathways, especially in fields requiring analytical and quantitative reasoning such as finance, data analytics, engineering, and business. For instance, at Universiti Islam Melaka (UNIMEL), at least 15 academic programmes at the foundation, diploma, and bachelor's degree levels require students to achieve at least a pass in Mathematics as an entry prerequisite. Employers in Malaysia have also expressed concern about graduates' declining numeracy and problem-solving abilities (TalentCorp, 2024), aligning with the *World Economic Forum's Future of Jobs Report* (2023), which lists analytical and mathematical thinking among the top employability skills in the 21st-century workforce.

Given these realities, this study aims to examine how teachers' instructional approaches, motivational strategies, level-appropriate teaching methods, and classroom time management contribute to students' achievement in SPM Mathematics. The research focuses on Form 4 and Form 5 students from six secondary schools in Masjid Tanah, Melaka, employing a mixed-methods design that integrates both questionnaires and interviews.

This study aligns with Sustainable Development Goal (SDG) 4, which advocates for inclusive and equitable quality education, and supports Malaysia's *Dasar Pendidikan Digital (DPD)*, which seeks to strengthen digital literacy and teaching innovation. By identifying effective, teacher-driven strategies to improve Mathematics learning, this research contributes to national educational transformation efforts and Malaysia MADANI's aspiration to produce a mathematically capable generation prepared for Industry 4.0 and future socioeconomic challenges.

LITERATURE REVIEW

Teacher's Pedagogical Approaches

Teachers' pedagogical approaches serve as a core determinant of effective mathematics instruction and, consequently, student achievement. Contemporary studies emphasize the importance of inquiry based, collaborative, and technology supported methods that promote active engagement and deeper conceptual

understanding (Areepattamannil & Khine, 2021; Zhu & Kaiser, 2022; Lopez & Gurat, 2024). High instructional quality characterized by conceptual clarity, responsive feedback, and contextualized learning has been shown to strengthen mathematical reasoning and motivation. In Malaysian classrooms, however, many teachers continue to rely on conventional teacher-centered delivery, which limits opportunities for student participation and inquiry-based exploration (Rahman et al., 2023).

Teaching-level suitability

Teaching-level suitability refers to the alignment between instructional content and students' cognitive readiness. When lessons are pitched either too high or too low, disparities in understanding emerge, leading to reduced engagement and achievement. Teachers who effectively calibrate lesson complexity and incorporate differentiated strategies enable both high and low achievers to progress meaningfully (Rahman, Ismail & Yusof, 2021; Norazman & Hassan, 2023). Despite Malaysia's policy emphasis on adaptive instruction, implementation remains inconsistent across school types. SMA teachers, operating in more structured learning environments, tend to demonstrate stronger mastery in adjusting content to students' levels, while SMK teachers often face constraints related to class size and syllabus coverage.

Motivational approaches

Teachers' motivational practices such as empathy, encouragement, and growth-mindset reinforcement play a critical role in reducing mathematics anxiety and enhancing persistence (Wang, Xu & Fei, 2024; Boaler, 2022; Canning, White & Davis, 2024). Supportive classroom climates that foster trust and belonging have been linked to higher mathematics engagement (Chaffee et al., 2025). Nonetheless, variations in teacher student rapport and classroom culture may explain differences in motivation between SMK and SMA students, where the latter often report stronger peer support and teacher responsiveness.

Teaching time management

Effective time management determines the extent to which teachers can balance curriculum coverage with student centered learning. Allocating adequate time for formative assessment, feedback, and guided practice enhances comprehension and retention (König et al., 2021; Rahman et al., 2023). However, many Malaysian teachers face time constraints due to examination pressure, resulting in less emphasis on interactive or reflective learning activities (Teh & Mahmood, 2023). SMA classrooms, characterized by smaller student teacher ratios and stricter routines, may allow for more effective time use compared to SMK settings.

Students' Mathematics Achievement

Mathematics achievement serves as a key indicator of academic quality and national competitiveness, particularly at the SPM level. In Malaysia, consistent disparities in performance across schools raise concerns about teaching effectiveness and classroom practices (Malaysian Examinations Board, 2024). Previous studies have linked effective pedagogy, motivational strategies, and efficient time management to improved mathematical performance (Che Ahmad et al., 2023; García-García & Morales, 2021). Teachers who employ differentiated and student-centered instruction tend to foster deeper conceptual understanding, self-efficacy, and long-term retention (Zhang & Liu, 2022; Ibrahim et al., 2022).

Despite extensive research on instructional quality, limited empirical work has explored how these relationships vary between different types of Malaysian secondary schools. SMK and SMA differ significantly in institutional culture, teacher supervision, and student learning discipline. SMA environments often characterized by smaller classes and stronger motivational climates may enable more effective pedagogical implementation compared to the larger, exam driven SMK classrooms. Yet, few studies have systematically compared these dynamics to determine whether such contextual differences meaningfully influence student achievement.

Addressing this gap, the present study investigates how teachers' instructional approaches, level appropriate teaching, motivation, and time management collectively shape mathematics achievement, while explicitly comparing outcomes between SMK and SMA students. This focus provides nuanced insights into the

contextual factors underpinning performance variations and contributes evidence to guide differentiated pedagogical practices and targeted educational interventions.

METHODOLOGY

Research Design

This study adopted a quantitative correlational research design, considered appropriate for examining the interrelationships among psychological and social determinants namely teachers' teaching approaches, teaching-level suitability, motivational approaches, teaching time management and mathematics achievement without experimental manipulation of variables. In contrast to experimental designs that necessitate controlled environments, the correlational approach facilitates the natural observation of associations within authentic classroom contexts. Although a mixed-methods design was initially considered, it was ultimately excluded, as the primary objective of the study centered on identifying statistical relationships rather than exploring qualitative perspectives. This methodological choice aligns with prior educational research employing correlational frameworks to investigate similar constructs (Creswell & Creswell, 2023).

Population and Sampling

The study population comprised Form 4 and Form 5 students enrolled in six secondary schools located in Masjid Tanah, Melaka, encompassing both Sekolah Menengah Kebangsaan (SMK) and Sekolah Menengah Agama (SMA). A total of 591 students participated in the study, consisting of 444 from SMK and 147 from SMA, representing both male and female students. The inclusion criteria specified that participants must be current Form 4 or Form 5 students who had completed at least one internal mathematics examination during the 2024 academic year. Students with incomplete questionnaire responses or without documented parental consent were excluded from the analysis to ensure data validity and ethical compliance.

Table 1: Demographic Distribution of Respondents

Demographic Variable	Category	Frequency (n)	Percentage (%)
School Type	SMK	444	75.1
	SMA	147	24.9
Form Level	Form 4	247	41.8
	Form 5	344	58.2
Gender	Male	276	46.7
	Female	315	53.3

A convenience sampling technique was employed, primarily based on accessibility and administrative approval obtained from the participating schools. Although non-probabilistic in nature, this approach was deemed appropriate for educational research settings characterized by practical constraints such as limited time, institutional access, and logistical considerations (Etikan & Bala, 2017).

Research Instrument

A structured questionnaire was used, comprising five main constructs:

Table 2: Cronbach Alpha for main constructs

Constructs	No. of item, n	Cronbach Alpha,
Teachers' Teaching Approaches	10	0.909
Teaching-Level Suitability	6	0.847
Teachers' Motivational Approaches	6	0.897
Teaching Time Management	4	0.882
Mathematics Achievement	10	0.891

Each construct was measured using a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The questionnaire was adapted from validated scales used in Shamsuddin et al. (2024), Rahim et al. (2024),

and Abd Karim et al. (2023). Content validity was confirmed through expert review by three educational psychologists, ensuring that items aligned with the theoretical constructs. Cronbach's alpha values for all five constructs exceeded 0.70, indicating satisfactory internal consistency (Nunnally & Bernstein, 1994).

Data Collection Procedure

Data collection was conducted over three weeks in October 2024, after receiving approval from the Alor Gajah District Education Office and formal permission from the participating schools. Questionnaires were distributed and collected by the school teachers during class sessions. All participants and their teachers were informed about the study's objectives, confidentiality, and voluntary participation. No personal identifiers were collected to maintain anonymity and ethical compliance.

Data Analysis

All data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 27. Descriptive statistics, including means, standard deviations, and frequencies, were computed to summarize respondents' demographic characteristics and overall responses for each construct.

Inferential analyses were conducted in two sequential stages to address the study objectives. In the first stage, Pearson's correlation analysis was utilized to examine the direction and magnitude of relationships between the four independent variables Teachers' Teaching Approaches, Teaching-Level Suitability, Teachers' Motivational Approaches, and Teaching Time Management and Mathematics Achievement. This analysis provided an initial overview of how each pedagogical determinant was associated with student performance across both school types.

In the second stage, multiple linear regression analysis was performed to assess the combined and individual predictive effects of these teacher-related factors on Mathematics Achievement. This procedure enabled the identification of the most influential predictors after accounting for intercorrelations among variables. Separate regression models were estimated for Sekolah Menengah Kebangsaan (SMK) and Sekolah Menengah Agama (SMA) to facilitate comparative interpretation across different school contexts.

Prior to analysis, the statistical assumptions of normality, linearity, multicollinearity, and homoscedasticity were examined using skewness kurtosis indices, scatterplots, and variance inflation factor (VIF) values. All assumptions were satisfied within acceptable limits. Statistical significance was interpreted at $p < 0.05$ (significant) and $p < 0.01$ (highly significant).

The integration of both correlation and regression analyses enhanced the methodological rigor of the study. While correlation analysis identified general patterns of association among the teacher-related factors and Mathematics Achievement, regression analysis provided deeper insights into their unique and collective predictive power. Together, these analytical techniques offered a comprehensive understanding of how pedagogical and managerial factors interact to influence students' mathematical performance.

RESULTS & FINDINGS

Comparison between SMK and SMA

Table 3. Summary Table for the Comparison of the Teachers' Teaching Approaches in Mathematics between SMK and SMA.

School Type	Mean (M)	Standard Deviation	Interpretation	Remarks
SMK	4.0167	0.5740	High	Teachers' teaching approaches in SMK are generally effective, though slightly less dynamic compared to SMA.
SMA	4.2796	0.6236	High	SMA teachers demonstrate stronger use of student-centered and inquiry-based approaches.

Both SMK and SMA reported high mean scores for teaching approaches, indicating that teachers in both settings apply sound instructional methods. However, SMA ($M = 4.28$) scored marginally higher than SMK ($M = 4.02$), suggesting that SMA teachers tend to integrate more varied, interactive, and student-engaging techniques in their mathematics instruction. The smaller standard deviation in SMK implies greater uniformity among teachers, while the higher variability in SMA may reflect more diverse pedagogical practices. Overall, SMA teachers appear more adaptable in applying teaching strategies aligned with students' learning needs.

Table 4. Summary Table for the Comparison of the Teaching-Level Suitability between SMK and SMA.

School Type	Mean (M)	Standard Deviation	Interpretation	Remarks
SMK	4.0758	0.5653	High	Teaching content is generally well-aligned with students' learning levels.
SMA	4.2789	0.5943	High	SMA teachers demonstrate stronger adaptation of instructional content to student readiness.

Both groups display high mean values, indicating that teachers effectively match instructional content to students' cognitive and academic levels. The slightly higher mean in SMA ($M = 4.28$) suggests greater sensitivity to student differences and better differentiation in lesson design. This may reflect the more structured and smaller class settings typical of SMA schools, which facilitate individualized instruction. Conversely, larger class sizes and syllabus constraints in SMK may limit teachers' flexibility in adjusting teaching levels.

Table 5. Summary Table for the Comparison of the Teachers' Motivational Approaches between SMK and SMA.

School Type	Mean (M)	Standard Deviation	Interpretation	Remarks
SMK	4.1595	0.6076	High	Teachers provide motivational support, though less personalized compared to SMA.
SMA	4.4082	0.6390	High	SMA teachers show stronger motivational engagement and student rapport.

Motivational approaches were rated highly in both school types, with SMA teachers scoring higher ($M = 4.41$). This indicates that SMA teachers employ more consistent encouragement, empathy, and reinforcement strategies to sustain student interest in mathematics. The higher standard deviation in SMA suggests diverse motivational styles among teachers. In contrast, SMK teachers also exhibit positive motivation practices, but possibly in a more standardized or directive manner. These findings align with previous research suggesting that school environment and teacher student rapport influence motivational climate and student engagement.

Table 6. Summary Table for the Comparison of the Teaching Time Management between SMK and SMA.

School Type	Mean (M)	Standard Deviation	Interpretation	Remarks
SMK	4.2078	0.6641	High	Teachers manage time effectively but face syllabus and workload constraints.
SMA	4.3333	0.7530	High	SMA teachers demonstrate more structured and efficient classroom time management.

Both SMK and SMA teachers show strong time management skills, though SMA obtained a slightly higher mean ($M = 4.33$). This indicates that SMA teachers are generally more consistent in organizing lessons, pacing instruction, and allocating time for feedback and student interaction. The broader variability in SMA's SD value (0.75) suggests a range of practices influenced by teaching experience or institutional expectations. SMK teachers' slightly lower mean may reflect systemic challenges such as larger classes, limited instructional periods, and examination driven pacing.

Across all four constructs, SMA teachers consistently outperformed SMK teachers, with differences ranging between 0.20 and 0.27 in mean values. These results imply that SMA environments foster more adaptive pedagogy, better instructional alignment, stronger motivation, and efficient time management. The findings also suggest that institutional culture and class size may contribute significantly to variations in teaching effectiveness and, consequently, students' mathematics achievement.

Correlation Analysis

Table 7: Strength of Variable Relationships (Davis, 1971)

Correlation Coefficient, r	Description of strength
0.70 and above	Very strong
0.50 to 0.69	Strong
0.30 to 0.49	Moderate
0.10 to 0.29	Weak
0.01 to 0.09	Negligible

Sekolah Menengah Kebangsaan

Table 8: Strength of Variable Relationships with Mathematics Proficiency Level (Sekolah Menengah Kebangsaan)

Variables	Correlation Coefficient, r	Description of strength
Teacher Delivery Methods	0.257	Weak
Teaching Level Suitability	0.278	Weak
Teacher Motivation Strategies	0.257	Weak
Teaching Time Management	0.237	Weak

The analysis presented in the table demonstrates the relationships between teacher delivery methods, teaching level suitability, teacher motivational strategies, teaching time management, and students' mathematics proficiency. Overall, the findings indicate that all independent variables exhibit weak correlations with mathematics proficiency, as classified under Davis' (1971) strength scale. A significant positive correlation was found between teaching-level suitability and mathematics proficiency ($r = 0.257$, $p < 0.01$). Although the strength of association is weak, the result implies that when teachers adopt instructional approaches appropriate to students' cognitive and academic levels, learners tend to demonstrate higher proficiency in mathematics. This supports the first hypothesis, confirming that teaching level suitability has a significant positive relationship with mathematics proficiency.

Similarly, a significant positive correlation was observed between teacher delivery methods and mathematics proficiency ($r = 0.278$, $p < 0.05$). Based on Davis' scale, this relationship is also weak but meaningful, suggesting that varied and effective instructional delivery enhances student understanding and performance. The result validates the second hypothesis, which posits that teacher delivery methods are positively related to mathematics proficiency.

Furthermore, teacher motivational strategies exhibited a significant positive correlation with mathematics proficiency ($r = 0.257$, $p < 0.01$). Though weak, this association indicates that students benefit academically when teachers employ motivational approaches such as encouragement, feedback, and goal setting. This finding supports the third hypothesis that teacher motivational strategies contribute positively to mathematics achievement.

Lastly, a significant positive relationship was identified between teaching time management and mathematics proficiency ($r = 0.237$, $p < 0.01$). Despite the weak strength of correlation, the finding suggests that effective allocation and utilization of instructional time can enhance learning outcomes. Hence, the fourth hypothesis that teaching time management significantly influences mathematics proficiency is also supported.

Sekolah Menengah Agama

Table 9: Strength of Variable Relationships with Mathematics Proficiency Level (Sekolah Menengah Agama)

Variables	Correlation Coefficient, r	Description of strength
Teacher Delivery Methods	0.488	Moderate
Teaching Level Suitability	0.422	Moderate
Teacher Motivation Strategies	0.449	Moderate
Teaching Time Management	0.294	Weak

The analysis reveals a significant positive correlation between teacher delivery methods and mathematics proficiency ($r = 0.488$, $p < 0.01$). Based on Davis' (1971) scale, this represents a moderate correlation, indicating that effective instructional delivery such as the use of interactive techniques, clear explanations, and varied teaching media is associated with higher student proficiency in mathematics. This finding supports the first hypothesis, which posits that teacher delivery methods have a positive impact on mathematics performance.

A moderate correlation was also identified between teaching-level suitability and mathematics proficiency ($r = 0.422$, $p < 0.01$). According to Davis' classification, this suggests that aligning instructional content and complexity with students' learning readiness and cognitive levels contributes meaningfully to improved achievement. Thus, the second hypothesis, asserting that teaching-level suitability positively correlates with mathematics proficiency, is supported.

In addition, a significant positive correlation was found between teacher motivational strategies and mathematics proficiency ($r = 0.449$, $p < 0.01$). This moderate relationship indicates that students tend to perform better when teachers employ motivational approaches such as praise, encouragement, and constructive feedback. The result affirms the third hypothesis, which proposes that teacher motivational strategies exert a positive influence on mathematics proficiency.

Finally, the findings demonstrate a significant positive correlation between teaching time management and mathematics proficiency ($r = 0.294$, $p < 0.01$). Although the relationship is weak, it nonetheless implies that efficient allocation and management of instructional time can enhance students' learning outcomes. This supports the fourth hypothesis, confirming that teaching time management has a significant effect on mathematics achievement.

Regression Analysis

Sekolah Menengah Kebangsaan

Table 10: Results from Regression Analysis (Sekolah Menengah Kebangsaan)

Dependent Variable	Independent Variables	β	BETA	t	Sig.
Mathematics Achievement (Y)	Constants	1.990		9.111	<0.001
	Teacher Delivery Methods (X_1)	0.073	0.070	0.956	0.339
	Teaching Level Suitability (X_2)	0.166	0.156	2.220	0.027
	Teacher Motivation Strategies (X_3)	0.050	0.051	0.659	0.510
	Teaching Time Management (X_4)	0.059	0.065	0.958	0.338
R^2	0.090				
F	10.854				
Sig F	<0.001				

Table 10 presents the regression results examining the combined influence of teachers' effort factors, Teachers' Teaching Approaches, Teaching-Level Suitability, Teachers' Motivational Approaches, and Teaching Time Management on Mathematics achievement among SMK students. The model yielded an R^2 value of 0.090, indicating that approximately 9.0% of the variance in Mathematics achievement is explained

by these four predictors. Although the overall model was statistically significant ($F = 10.854$, $p < 0.001$), the relatively lower R^2 suggests that teacher-related factors exerted a modest collective influence on Mathematics achievement among SMK students.

Among the predictors, only Teaching-Level Suitability ($\beta = 0.166$, $t = 2.220$, $p = 0.027$) demonstrated a significant positive effect, implying that SMK students performed better when instructional content and delivery were aligned with their learning capabilities and cognitive readiness. In contrast, Teachers' Teaching Approaches ($\beta = 0.073$, $p = 0.339$), Teachers' Motivational Approaches ($\beta = 0.050$, $p = 0.510$), and Teaching Time Management ($\beta = 0.059$, $p = 0.338$) were not statistically significant predictors. These findings indicate that although teaching quality, motivation, and time use are relevant pedagogical aspects, their direct contributions to achievement appear less pronounced within the SMK context.

This outcome suggests that effective differentiation of lesson difficulty and pacing to suit diverse student abilities is the most critical determinant of success in SMK classrooms. The limited impact of other teaching factors may be attributed to contextual challenges such as large class sizes, heavy curriculum demands, and examination-oriented practices that constrain individualized engagement. Consistent with previous research (Rahman et al., 2023; Norazman & Hassan, 2023), differentiated instruction enhances understanding and retention, particularly for heterogeneous learning groups. Hence, strengthening teachers' capacity for adaptive instruction could significantly enhance learning outcomes in SMK settings.

Sekolah Menengah Agama

Table 11: Results from Regression Analysis (Sekolah Menengah Agama)

Dependent Variable	Independent Variables	β	BETA	t	Sig.
Mathematics Achievement (Y)	Constants	1.322	0.342	3.860	<0.001
	Teacher Delivery Methods (X_1)	0.409	0.149	2.750	0.007
	Teaching Level Suitability (X_2)	0.058	0.141	0.408	0.684
	Teacher Motivation Strategies (X_3)	0.157	0.132	1.192	0.235
	Teaching Time Management (X_4)	-0.115	0.087	-1.315	0.191
R^2	0.256				
F	12.185				
Sig F	<0.001				

Table 11 presents the regression results analyzing the influence of the same four teacher related predictors on Mathematics achievement among SMA students. The model produced an R^2 value of 0.256, indicating that 25.6% of the variance in Mathematics achievement is explained by Teachers' Teaching Approaches, Teaching-Level Suitability, Teachers' Motivational Approaches, and Teaching Time Management collectively. The model was statistically significant ($F = 12.185$, $p < 0.001$), suggesting a stronger predictive power compared to the SMK model.

Among the independent variables, Teachers' Teaching Approaches ($\beta = 0.409$, $t = 2.750$, $p = 0.007$) emerged as the only significant positive predictor, highlighting the critical role of delivery quality in shaping Mathematics achievement among SMA students. Effective instructional delivery characterized by clarity, interactive engagement, and the use of diverse teaching techniques was positively associated with higher performance. Conversely, Teaching-Level Suitability ($\beta = 0.058$, $p = 0.684$), Teachers' Motivational Approaches ($\beta = 0.157$, $p = 0.235$), and Teaching Time Management ($\beta = -0.115$, $p = 0.191$) were not statistically significant, suggesting that while these factors contribute to the learning environment, their direct effects are secondary when delivery quality is strong.

The results indicate that SMA students benefit most when teachers implement varied and student centered delivery strategies that foster understanding and sustain engagement. This finding supports Areepattamannil and Khine (2021) and Lopez and Gurat (2024), who reported that dynamic, interactive pedagogy enhances conceptual mastery and interest in Mathematics. The higher R^2 value demonstrates that teacher related

practices have a more substantial impact in SMA settings, possibly due to smaller class sizes, stronger academic culture, and closer teacher–student relationships that facilitate effective delivery.

Overall, the regression outcomes for SMA emphasize that pedagogical excellence rather than structural or motivational factors plays a decisive role in promoting Mathematics success within religious school contexts. Continuous professional development focusing on instructional innovation and reflective teaching practices may further enhance student outcomes in these environments.

Comparative Analysis of Correlation and Regression Results between Sekolah Menengah Kebangsaan (SMK) and Sekolah Menengah Agama (SMA)

The comparative analysis between SMK and SMA reveals distinct patterns in how teacher related factors, Teachers' Teaching Approaches, Teaching-Level Suitability, Teachers' Motivational Approaches, and Teaching Time Management relate to and predict students' Mathematics achievement. The findings integrate both the correlation and regression analyses to provide a comprehensive understanding of these relationships across school contexts.

Correlation Analysis

The correlation results indicate that all four teacher-related factors were positively and significantly correlated with Mathematics achievement in both SMK and SMA schools, although the strength of association varied across contexts. Among SMA students, the correlations were generally stronger, ranging from moderate to high ($r = 0.422$ – 0.488 , $p < 0.01$), compared to SMK students, whose correlations were relatively weaker ($r = 0.237$ – 0.278 , $p < 0.01$). Specifically, Teachers' Teaching Approaches ($r = 0.488$) and Teachers' Motivational Approaches ($r = 0.449$) showed the strongest relationships in SMA, while Teaching-Level Suitability ($r = 0.278$) was the most prominent factor in SMK.

These results suggest that in SMA settings, effective pedagogical delivery and motivational engagement are more closely linked to improved Mathematics performance, likely reflecting more structured environments and smaller class sizes that enable personalized teaching. In contrast, SMK students' achievement is more strongly associated with how well instructional content matches their learning level, emphasizing the importance of differentiated teaching practices in more heterogeneous classroom settings.

Regression Analysis

The regression findings further refine these relationships by identifying the unique contribution of each factor when examined simultaneously. For SMK, the regression model was significant ($F = 10.854$, $p < 0.001$) but explained only 9.0% of the variance in Mathematics achievement ($R^2 = 0.090$). Among the predictors, only Teaching-Level Suitability ($\beta = 0.166$, $p = 0.027$) emerged as a significant positive contributor, confirming that appropriately structured lessons that align with students' cognitive readiness are essential for achievement in SMK. The other factors, Teaching Approaches, Motivational Approaches, and Time Management were not statistically significant, indicating that their direct effects were limited in this context.

Conversely, the SMA model demonstrated a stronger explanatory power ($R^2 = 0.256$, $F = 12.185$, $p < 0.001$), where Teachers' Teaching Approaches ($\beta = 0.409$, $p = 0.007$) was the only significant predictor. This finding indicates that the quality of instructional delivery: clarity, interactivity, and creativity in teaching plays a decisive role in enhancing SMA students' Mathematics achievement. The remaining variables were not significant, although their positive coefficients suggest a supportive but indirect influence on performance outcomes.

Collectively, these findings highlight a fundamental difference in the pedagogical dynamics of SMK and SMA. In SMK, Mathematics achievement depends more on *how well the lesson content fits the students' learning level*, reflecting the importance of curriculum differentiation in larger and more academically diverse classrooms. In SMA, performance is primarily driven by *the quality of teachers' delivery methods*, emphasizing active learning, effective communication, and teacher–student engagement within smaller, more disciplined environments.

The stronger correlations and higher R^2 value in SMA (25.6%) compared to SMK (9.0%) indicate that teacher-related factors exert a greater overall influence on achievement within religious school settings. This may be attributed to contextual advantages such as smaller class sizes, consistent behavioral expectations, and closer teacher–student relationships that enhance instructional effectiveness. In contrast, the weaker predictive strength in SMK implies that other unmeasured factors such as peer influence, socio-economic background, or student motivation may play a larger role in shaping outcomes in mainstream public schools.

The comparative results suggest differentiated intervention strategies for the two school types. For SMK, professional development should focus on *adaptive instruction*, *curriculum alignment*, and *classroom differentiation* to address students' varied proficiency levels. For SMA, continuous emphasis on *innovative pedagogical delivery* and *instructional engagement* can further optimize performance. Future research may incorporate mixed-method approaches to explore the contextual mechanisms such as classroom culture and teacher–student interaction that mediate these statistical relationships.

Overall, the integration of correlation and regression results provides robust evidence that, while both SMK and SMA teachers significantly influence Mathematics achievement, the pathways of influence differ. SMK success is contingent upon instructional suitability, whereas SMA success is driven by teaching delivery quality, reflecting distinct pedagogical ecologies within Malaysia's dual secondary school system.

CONCLUSIONS & RECOMMENDATIONS

This study provides compelling evidence that teachers' pedagogical practices, specifically teaching delivery methods, teaching-level suitability, motivational strategies, and time management exert a measurable yet varying influence on students' mathematics achievement at the SPM level. The results indicate that while all teacher-related factors have positive correlations with mathematics performance, the strength of these relationships differs notably between school types. SMA students, for instance, demonstrate stronger associations across most variables, particularly in teacher delivery methods and motivational strategies, whereas SMK students show weaker but still significant correlations. These findings suggest that effective teaching is not merely about delivering content but about adapting pedagogy to students' cognitive readiness, managing instructional time strategically, and maintaining consistent motivation throughout the learning process.

The overall weak to moderate correlations also reveal that improving mathematics proficiency requires more than isolated teaching adjustments; it necessitates systemic attention to the broader instructional ecosystem. Teacher preparation, classroom culture, school leadership, and institutional support must work in tandem to cultivate effective teaching practices. The disparities observed between SMK and SMA further point to structural inequities in instructional environments possibly related to class size, school management styles, or emphasis on discipline and accountability. Hence, while teachers' efforts are central, these must be reinforced through a coherent educational infrastructure that prioritizes professional growth, adequate teaching resources, and pedagogical innovation.

Overall, this study answers its main research question by confirming that teacher-related factors particularly teaching-level suitability in SMK and delivery methods in SMA are significant determinants of students' mathematics achievement. Theoretically, it contributes to pedagogical discourse by illustrating how school context moderates the relationship between teacher factors and student performance. Practically, it emphasizes the necessity of differentiated instruction, time management, and motivational engagement in sustaining mathematical achievement. From a policy perspective, the findings align with national education reforms under the Malaysia Education Blueprint (2013–2025) and Sustainable Development Goal 4, reinforcing the centrality of teacher quality to equitable education. In conclusion, effective teacher practices remain the cornerstone of mathematics success, requiring ongoing investment in teacher training and systemic support to ensure sustainable educational improvement.

While the study provides valuable empirical insights, several limitations should be acknowledged. The use of convenience sampling within a single district (Masjid Tanah, Melaka) limits the generalizability of findings to other regions. The moderate sample size and reliance on self-reported data may also introduce response bias or

overestimation of certain constructs. Recognizing these limitations demonstrates critical reflexivity and strengthens the interpretation of findings. Future research should therefore include larger, more diverse samples and adopt mixed-methods or longitudinal designs to capture the evolving nature of teacher–student interactions and their cumulative impact on mathematics achievement.

Based on the study's outcomes, several key recommendations are proposed. At the classroom level, teachers should prioritize adaptive teaching strategies that match students' cognitive readiness, utilize varied instructional delivery methods, and integrate motivational techniques to sustain engagement. Students, in turn, should adopt self-regulated learning habits, reflecting greater ownership and accountability for their progress. At the institutional level, schools should strengthen professional learning communities (PLCs), facilitate peer observation, and provide structured feedback to encourage reflective practice among teachers. Continuous professional development focusing on differentiated instruction, time management, and motivational pedagogy should be institutionalized. At the policy level, the Ministry of Education should enhance teacher training curricula by embedding modules on adaptive pedagogy and formative assessment, while also granting greater instructional autonomy to teachers to manage classroom pacing according to student needs. Policymakers are encouraged to integrate measures of teaching quality and classroom climate into national evaluation frameworks and to provide incentives for pedagogical innovation.

Collectively, these recommendations underscore that raising mathematics achievement requires a multi-layered approach empowering teachers, engaging students, and supporting schools through coherent policy and resources. With deliberate attention to these dimensions, Malaysia can strengthen mathematics education in alignment with its broader educational transformation goals.

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Conflict Of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

Data Availability

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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