CONOCIMIENTO: Journal of Education and Social Sciences
Vol. 1, No. 1 (2026)
https://journal.ziacenter.org/index.php/conocimiento

Parental Education and Mathematics Achievement among Junior High School Students: A Comparative Study

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Abstract

Mathematics achievement is shaped by multiple individual, family, and school-related conditions, yet the extent to which parental e ducational attainment differentiates students' mathematics performance remains unclear, particularly at the junior high school level in Indonesia. This study aimed to examine whether mathematics achievement differed significantly among Grade IX students according to their parents' educational attainment. A quantitative comparative design was employed using secondary data from 80 students at SMP Negeri 1 Kolaka during the 2024/2025 academic year. Students were classified into four parental educational attainment groups elementary school, junior secondary school, senior secondary school, and higher education with 20 students in each group. Mathematics achievement was measured using Mathematics School Examination scores, while parental educational attainment was obtained from school administrative records in DAPODIK. Data were analyzed using descriptive statistics, the Shapiro-Wilk normality test, Levene's test for homogeneity of variance, and one-way analysis of variance (ANOVA) at the .05 significance level, with eta squared used to estimate effect magnitude. Descriptively, mean mathematics achievement increased from 79.62 among students whose parents had elementary education to 83.40 among those whose parents had higher education. However, the one-way ANOVA indicated no statistically significant difference in mathematics achievement across the four groups, $F(3, 76) = 1.343$, $p = .267$, with a small effect size ($\eta^2 = .050$). The findings indicate that parental educational attainment, considered as a single background characteristic, provides limited differentiation of mathematics achievement in this context. The study contributes empirical evidence that challenges a simple interpretation of parental educational attainment as a direct indicator of students' mathematics achievement and highlights the need to examine more proximal educational conditions, including instructional quality, student engagement, learning motivation, and forms of learning support. These findings have implications for mathematics education by directing attention toward modifiable learning conditions rather than relying primarily on students' family educational background.

Keywords: Comparative Study; Junior High School Students; Mathematics Achievement; Mathematics Education; Parental Educational Attainment.

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1. Introduction

Mathematics occupies a central position in school education because it develops students' capacity to reason logically, analyze relationships, solve problems, and make decisions based on quantitative information. Contemporary mathematics education increasingly emphasizes not only procedural proficiency but also students' ability to apply mathematical knowledge in unfamiliar and meaningful contexts. Recent literature highlights the importance of purposeful task design and instructional approaches that foster

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mathematical reasoning and active engagement (Canogullari & Radmehr, 2026; Himmi et al., 2025). Mathematics achievement is therefore relevant beyond classroom assessment, as it reflects students' development of competencies needed for further education and participation in increasingly data-oriented social and professional environments. At the same time, developments in mathematics education, including curriculum reform and technology-supported learning, have increased expectations for students to develop stronger mathematical competencies (Payadnya et al., 2025; Wibowo et al., 2025). Understanding the conditions associated with mathematics achievement consequently remains an important concern for educational researchers and practitioners.

This concern is particularly relevant in Indonesia, where students' mathematics performance continues to present substantial challenges. Evidence from PISA 2022 indicates that Indonesian students' mathematics score was 366, considerably below the OECD average of 472 (Ayu et al., 2025; Alfaruqi & Nurwahidah, 2025). Indonesian research has consequently emphasized the need to strengthen mathematics and numeracy-oriented learning as part of broader efforts to improve educational quality (Putrawangsa & Hasanah, 2022). Importantly, mathematics achievement cannot be understood exclusively through classroom instruction. A systematic review of factors predicting mathematics achievement in PISA identified a broad range of individual, family, school, and contextual characteristics associated with students' performance (Wang et al., 2024). This multidimensional perspective suggests that differences in students' mathematics achievement may reflect interactions among conditions inside and outside school rather than a single background characteristic.

One family characteristic that has received sustained attention is parental educational attainment. From an educational perspective, parents' educational background may be associated with the resources, expectations, knowledge, and forms of support available to children. Research on parental education has considered how educational attainment may shape educational judgments and practices (Dickert & Glock, 2025), while broader research on family socioeconomic status has consistently positioned parental characteristics as part of the social conditions surrounding students' educational development (Lee & Borgonovi, 2022; Liu et al., 2022). In mathematics specifically, parental characteristics may be expressed through opportunities for learning, communication about school, assistance with academic work, and the learning environment provided at home. Evidence from middle-school and broader educational research indicates that family support and parental involvement can be relevant to academic outcomes (Boonk et al., 2018; Hill & Tyson, 2009). Thus, parental education provides a plausible basis for examining whether students from different family educational backgrounds display systematically different levels of mathematics achievement.

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However, the relationship should not be interpreted as straightforward or deterministic. Educational attainment is only one dimension of the family environment and may operate through other forms of support and socioeconomic resources. A systematic review of causal evidence found that family socioeconomic status is related to educational outcomes across primary and secondary education, while a meta-analytic review similarly documented associations between socioeconomic status and academic achievement (Song et al., 2025; Liu et al., 2022). Evidence specifically concerning mathematics also demonstrates the importance of family socioeconomic conditions, although the magnitude and nature of the relationship may differ across educational and national contexts (Lee & Borgonovi, 2022). Indonesian evidence provides an especially important perspective: family socioeconomic conditions have been examined in relation to mathematics learning outcomes, but findings do not necessarily imply that socioeconomic or parental characteristics alone determine students' performance (Ummah et al., 2025). These findings raise an important methodological issue: an observed association between parental background and achievement should not automatically be interpreted as evidence that parental education itself produces differences in mathematics performance.

The literature also suggests that what parents actually do may be more educationally consequential than their formal educational credentials alone. A review by Boonk et al. (2018) showed that different indicators of parental involvement are not uniformly related to academic achievement, indicating that the form and quality of involvement matter. Hill and Tyson (2009), focusing specifically on middle school, likewise examined which parental involvement strategies are associated with achievement. More recent evidence has extended this perspective to mathematics. Jiang et al. (2023), through a meta-analysis, examined parental homework involvement and students' mathematics achievement, while Hernandez-Padilla et al. (2023) investigated parental participation and support in relation to mathematics achievement using national assessment data. In a middle-school sample, İlter et al. (2025) further demonstrated that parental involvement and teacher support can operate alongside academic self-efficacy and academic buoyancy in explaining mathematics performance. Other research similarly indicates that parental involvement, parent–child relationships, and the nature of parental support are relevant dimensions of students' educational experiences (Cheung & Pomerantz, 2011; Chen et al., 2023; Oh et al., 2022). Collectively, these studies suggest that parental educational attainment should be examined cautiously as a background characteristic rather than treated as a direct proxy for the quality of educational support received by students.

Despite this growing body of evidence, an important gap remains. Previous studies have frequently examined parental involvement, socioeconomic status, or broader predictors of achievement, whereas fewer studies have directly compared mathematics

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achievement across clearly differentiated levels of parental educational attainment among junior high school students. Kodippili (2011), using eighth-grade data from the United States, reported a positive relationship between parents' education level and mathematics achievement and simultaneously considered school-level characteristics such as school climate, attendance, and instructional resources. Similarly, Morkoyunlu and Konyalioglu (2020) examined mathematics achievement among middle school students in relation to parental support. These studies demonstrate that family characteristics are relevant to mathematics achievement, but they also reinforce the importance of distinguishing parental educational attainment from parental support and from school-level conditions. Indonesian studies have provided additional evidence concerning family background and mathematics achievement (Ummah et al., 2025; Nope & Mulbar, 2025), yet the evidence remains insufficient to determine whether differences in formal parental education correspond to statistically meaningful differences in mathematics achievement at the junior high school level. The present study addresses this gap by examining four parental education categories within a single junior high school context and directly comparing students' mathematics achievement across these groups. This design provides a focused empirical test of whether a descriptive pattern associated with parental education translates into a statistically detectable difference.

Accordingly, this study aims to analyze differences in mathematics achievement among Grade IX students at SMP Negeri 1 Kolaka according to parental educational attainment. Specifically, students are compared across four parental education categories elementary school, junior high school, senior high school, and higher education using their Mathematics School Examination scores as the indicator of achievement. The study is guided by the following research question: Are there significant differences in mathematics achievement among Grade IX students at SMP Negeri 1 Kolaka based on their parents' educational attainment? By addressing this question through a comparative analysis, the study seeks to clarify whether parental educational attainment represents a meaningful differentiating characteristic of mathematics achievement in this particular junior high school context, thereby contributing evidence to the continuing discussion concerning the relationship between family background and students' mathematics performance.

2. Methodology

Research Design and Context

This study employed a quantitative comparative design to examine differences in students' mathematics achievement across groups defined by parental educational attainment. The study was conducted at SMP Negeri 1 Kolaka and used mathematics examination data from Grade IX students for the 2024/2025 academic year. A comparative

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design was considered appropriate because the primary purpose of the study was to examine whether mean mathematics achievement differed among students whose parents had different levels of formal education.

The independent variable was parental educational attainment, while the dependent variable was students' mathematics achievement, operationalized through their Mathematics School Examination (*Ujian Sekolah* [US]) scores. Parental educational attainment was classified into four categories: elementary school, junior secondary school, senior secondary school, and higher education. Mathematics achievement was represented by students' US Mathematics scores obtained from school records.

Participants and Sampling

The study involved 80 Grade IX students from SMP Negeri 1 Kolaka. Participants were selected using purposive sampling based on the availability and completeness of the required secondary data. Students were eligible for inclusion when both their Mathematics School Examination scores and information on parental educational attainment were available in the school records. Students whose data did not meet these completeness criteria were not included in the analysis.

The resulting sample was distributed equally across the four parental education categories, with 20 students in each group: primary school (n = 20), junior secondary school (n = 20), senior secondary school (n = 20), and higher education (n = 20). Equal group sizes provided a balanced structure for the comparative analysis. The total sample therefore consisted of 80 students.

Data Sources and Measurement

The study relied exclusively on documentary data. Mathematics achievement data were obtained from the students' Mathematics School Examination records, whereas information on parental educational attainment was obtained from the school's *Data Pokok Pendidikan* (DAPODIK) records. The parental education information originated from student admission and administrative records maintained in DAPODIK and was subsequently classified into the four educational categories used in the analysis.

The Mathematics School Examination was used as the indicator of mathematics achievement because it represents a summative assessment administered after students have completed the learning process at the junior secondary level. The manuscript describes the examination as an assessment of students' mathematics competencies at the end of their schooling at this level. Thus, the recorded examination score served as the outcome measure in the comparative analysis.

The study did not involve the direct administration of questionnaires, tests, or experimental treatments. Instead, all variables were derived from existing institutional

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records. This approach allowed the analysis to be based on documented academic achievement and officially recorded parental educational information.

Ethical Considerations and Data Protection

Permission to use the academic and administrative records was obtained from SMP Negeri 1 Kolaka. The data were treated as secondary data and analyzed without including students' personal identities. According to the manuscript, the records were used solely for academic purposes, with confidentiality and student privacy maintained throughout the research process.

Data Analysis

Data analysis was conducted using JASP version 0.96. Descriptive statistics were first calculated for each parental education group, including the sample size, mean, median, standard deviation, minimum, and maximum scores. These statistics were used to describe the distribution and central tendency of mathematics achievement within each group.

Before conducting the comparative analysis, assumptions relevant to the parametric procedure were examined. Normality within each group was assessed using the Shapiro–Wilk test, while homogeneity of variance was evaluated using Levene's test. These procedures were used to assess the distributional characteristics of the mathematics achievement scores and whether the variability of scores was comparable across the four parental education groups.

Differences in mean mathematics achievement across the four parental educational attainment groups were examined using a one-way analysis of variance (ANOVA) with an alpha level of .05. The analysis tested whether the mean achievement scores differed across the four independent groups. When interpreted in relation to the research question, a statistically significant omnibus result would indicate evidence of differences in mathematics achievement among at least two of the parental education groups.

The manuscript also reports Tukey's honestly significant difference (HSD) procedure for pairwise comparisons among the four groups. The stated analytical procedure specifies that Tukey HSD would be used when the omnibus ANOVA was statistically significant, allowing identification of specific group pairs that differed.

Finally, the magnitude of the group effect was assessed using eta squared (η^2). This measure was used to quantify the proportion of variation in mathematics achievement associated with parental educational attainment in the sample. The manuscript interprets η^2 using the stated thresholds of .01 for a small effect, .06 for a moderate effect, and .14 for a large effect.

The analytical procedure therefore proceeded in five stages: descriptive analysis, assessment of normality, assessment of variance homogeneity, one-way ANOVA, and

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estimation of effect size. Pairwise comparisons were also reported using Tukey HSD in accordance with the statistical output presented in the manuscript. The inferential analysis was conducted at the .05 significance level, and statistical conclusions were based on the observed test statistics and corresponding *p* values.

3. Results and Discussion

Results

This study examined differences in students' mathematics achievement across levels of parental educational attainment. A total of 80 Grade IX students were included in the analysis and classified into four groups according to parental educational attainment: elementary school (SD), junior secondary school (SMP), senior secondary school (SMA), and higher education, with 20 students in each group. The analysis included descriptive statistics, assumption tests, and a one-way analysis of variance (ANOVA).

Table 1 summarizes students' mathematics achievement by parental educational attainment.

Table 1. Descriptive Statistics of Students' Mathematics Achievement

Parental Educational Attainment	N	Mean	Median	SD	Minimum	Maximum
Elementary school (SD)	20	79.62	80.19	5.463	71.70	94.34
Junior secondary school (SMP)	20	81.79	81.13	5.058	73.58	94.34
Senior secondary school (SMA)	20	81.32	78.31	6.562	71.70	94.34
Higher education	20	83.40	81.13	6.723	73.58	96.23

The mean mathematics achievement scores varied across the four parental education groups (Table 1). Students whose parents had completed higher education obtained the highest mean score (M = 83.40, SD = 6.723), followed by students in the SMP group (M = 81.79, SD = 5.058) and SMA group (M = 81.32, SD = 6.562). The lowest mean score was observed among students whose parents had completed elementary education (M = 79.62, SD = 5.463). Overall, the group means differed to some extent, but the observed differences were relatively small.

The Shapiro–Wilk test was then used to examine the distribution of mathematics achievement within each group. Table 2 presents the results.

Table 2. Shapiro–Wilk Test of Normality

Parental Educational Attainment	p-value	Decision
Elementary school (SD)	.116	No significant deviation from normality
Junior secondary school (SMP)	.071	No significant deviation from normality
Senior secondary school (SMA)	.059	No significant deviation from normality
Higher education	.015	Significant deviation from normality

As indicated in Table 2, the Shapiro–Wilk test produced p-values of .116, .071, and

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.059 for the SD, SMP, and SMA groups, respectively. These values were greater than .05, indicating no statistically significant deviation from normality in these three groups. In contrast, the higher-education group yielded p = .015, indicating a statistically significant deviation from normality. This finding was taken into account when interpreting the subsequent analysis.

Levene's test was used to assess whether variance was comparable across the four groups. The results appear in Table 3.

Table 3. Test of Homogeneity of Variance

Test	F	df1	df2	p-value	Decision
Levene's test	1.376	3	76	.257	Homogeneous variances

The Levene's test yielded $F(3, 76) = 1.376$, $p = .257$. Since the p-value was greater than .05, there was no statistically significant evidence of differences in variance among the four groups. Thus, the homogeneity of variance assumption was supported.

A one-way ANOVA was subsequently conducted to determine whether mathematics achievement differed significantly across the parental educational attainment groups. Table 4 reports the ANOVA results.

Table 4. One-Way ANOVA of Mathematics Achievement by Parental Educational Attainment

Source	Sum of Squares	df	Mean Square	F	p	η^2
Between groups	144.80	3	48.25	1.343	.267	.050
Within groups	2730.00	76	35.92			
Total	2874.80	79				

The one-way ANOVA yielded $F(3, 76) = 1.343$, $p = .267$. Because the p-value exceeded the .05 significance level, the analysis did not identify a statistically significant difference in mathematics achievement among students across the four parental education groups. Accordingly, the null hypothesis that there was no statistically significant difference in mathematics achievement based on parental educational attainment was not rejected.

The analysis produced an effect size of $\eta^2 = .050$, indicating that group membership based on parental educational attainment accounted for approximately 5.0% of the variance in mathematics achievement in this sample.

Because the omnibus ANOVA did not yield a statistically significant result, the pairwise comparisons did not provide evidence of statistically significant differences between the individual groups. The pairwise results available in the analysis are presented in Table 5.

Table 5. Pairwise Comparisons of Mathematics Achievement

Comparison	p-value	Decision
SD – SMP	.662	Not significant
SD – SMA	.807	Not significant

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SD – Higher education	.200	Not significant
SMP – SMA	.994	Not significant
SMP – Higher education	.833	Not significant
SMA – Higher education	.694	Not significant

Table 5 indicates that none of the pairwise comparisons reached statistical significance at the .05 level. The p-values ranged from .200 to .994, indicating that the observed differences between each pair of parental education groups were not statistically significant.

Taken together, the findings show some descriptive variation in mathematics achievement across parental educational attainment groups, with the highest mean among students whose parents had higher education; however, the one-way ANOVA did not indicate a statistically significant difference among the four groups. The statistical analysis therefore provides insufficient evidence to conclude that students' mathematics achievement differed according to parental educational attainment in the sample examined.

Discussion

The present study examined whether mathematics achievement differed among Grade IX students at SMP Negeri 1 Kolaka according to parental educational attainment. The findings provide a relatively clear answer to this question: the observed differences in mean mathematics achievement across the four parental-education groups were not statistically significant. Although students whose parents had higher education levels tended to obtain higher mean scores, the difference was insufficient to establish that mathematics achievement systematically varied across the groups. The descriptive pattern is nevertheless worth considering because the highest mean was observed among students whose parents had higher education, whereas the lowest mean occurred among students whose parents had elementary-level education. The relatively small separation between the group means indicates that the descriptive gradient should not be interpreted as evidence of a meaningful group effect. Rather, the finding suggests that parental educational attainment, when considered as a categorical background characteristic in this particular school context, does not by itself provide a strong basis for distinguishing students' mathematics achievement.

This finding contributes to the broader literature by qualifying the assumption that higher parental educational attainment necessarily corresponds to higher academic achievement. Previous research has provided theoretical and empirical reasons for expecting such a relationship. Family socioeconomic status is consistently associated with educational outcomes, and parental education constitutes one important dimension of socioeconomic background (Lee & Borgonovi, 2022; Liu et al., 2022). Similarly, a recent systematic review of causal evidence indicates that family socioeconomic conditions can shape educational outcomes across primary and secondary education (Song et al., 2025).

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From this perspective, students whose parents possess higher levels of formal education may have greater access to educational resources, academic knowledge, and forms of support that facilitate learning. Indonesian studies have also reported relationships between family socioeconomic conditions, parental background, and students' academic or mathematics outcomes (Ummah et al., 2025; Winarsih & Jannati, 2025). The descriptive tendency observed in the present study is therefore compatible with this general expectation. However, the nonsignificant ANOVA indicates that the tendency did not translate into a statistically detectable difference among the four groups. This distinction is important because it demonstrates that a directional descriptive pattern and a statistically meaningful group difference are not equivalent conclusions.

One possible explanation is that parental educational attainment represents a relatively distal characteristic of students' learning experiences. Educational attainment may create opportunities or dispositions that can support learning, but it does not directly describe how parents interact with their children's education. Research on parental involvement suggests that the nature, frequency, and quality of parental engagement may be more closely connected with academic outcomes than parental background alone. Hill and Tyson's (2009) meta-analysis, for example, showed that different forms of parental involvement are not equally related to achievement among middle school students. Similarly, Jiang et al. (2023) demonstrated the relevance of parental homework involvement to mathematics achievement, while Hernandez-Padilla et al. (2023) examined parental participation and support specifically in relation to mathematics achievement. These findings suggest that two parents with substantially different educational backgrounds may nevertheless provide comparable forms of academic support. Conversely, parents with similar educational attainment may differ considerably in the extent to which they monitor learning, communicate with teachers, encourage persistence, or assist with academic tasks. Thus, the absence of a significant difference in the present study may reflect the limited extent to which formal educational attainment captures the actual educational processes occurring within students' homes.

The same interpretation is supported by more recent research distinguishing parental involvement from other forms of support surrounding mathematics learning. İlter et al. (2025) found that parental involvement and teacher support were positively related to middle school students' mathematics performance, with academic self-efficacy and academic buoyancy providing important pathways in these relationships. This evidence is particularly relevant to the present findings because the current study examined parental education without directly measuring parental involvement, teacher support, self-efficacy, or academic buoyancy. The comparison therefore suggests that the educational level of parents may be an incomplete indicator of the mechanisms through which family circumstances become

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associated with mathematics achievement. The absence of significant differences across parental-education categories should consequently not be interpreted as evidence that family support is irrelevant. Instead, it indicates that the specific background characteristic examined here may not sufficiently capture the processes that are most proximal to students' mathematics learning.

The finding can also be interpreted through the ecological perspective adopted in the manuscript. Bronfenbrenner's ecological framework positions children's development within multiple, interconnected environmental systems rather than attributing developmental outcomes to a single context (Ni'mah & Mawardi, 2026). Within this framework, the family is important, but students simultaneously experience the influence of teachers, peers, classroom practices, school climate, and broader social environments. The current result is consistent with such a multidimensional interpretation. All students in the study attended the same school and were drawn from the same Grade IX educational context. Consequently, common school-level experiences may have reduced the extent to which differences in parental educational attainment were reflected in mathematics examination scores. This possibility should be regarded as an interpretation rather than a tested mechanism, because the study did not measure classroom quality, teacher practices, peer relationships, or school climate. Nevertheless, the result illustrates why family background should be interpreted within the broader educational ecology in which achievement develops.

The finding also provides an important qualification to a cultural-capital interpretation. Bourdieu's perspective suggests that families may transmit educationally valuable forms of knowledge, dispositions, language practices, and resources that can facilitate academic success (Mansur & Hakim, 2026). From this perspective, higher parental education might be expected to correspond with advantages in students' educational trajectories. Yet cultural capital is not synonymous with formal educational attainment. The possession of a particular educational credential does not necessarily determine how educational resources are mobilized within the home or how effectively they are translated into students' learning experiences. The present findings therefore do not contradict the possibility that cultural capital matters; rather, they indicate that formal parental education alone may be insufficient to reveal its educational consequences. This distinction is particularly important in interpreting the relatively small effect size observed in the study.

The effect-size estimate strengthens this interpretation. The η^2 value of .050 indicates that approximately 5% of the observed variance in mathematics achievement was accounted for by differences among the parental-education groups. The magnitude is below the manuscript's stated threshold for a medium effect, suggesting that the practical explanatory value of parental educational attainment as a grouping variable was limited in this sample.

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This finding is compatible with evidence that mathematics achievement is shaped by a combination of individual, family, school, and contextual characteristics. Wang et al. (2024), in their systematic review of predictors of mathematics achievement in PISA, similarly emphasized the multidimensional nature of mathematics performance. The implication is not that the other 95% of variation can be attributed to any particular set of variables, since those variables were not measured in the present study. Rather, the result indicates that substantial individual differences in mathematics achievement remained within and across the parental-education groups and cannot be adequately characterized by parental educational attainment alone.

This interpretation also helps reconcile the present findings with studies reporting stronger relationships between family background and mathematics achievement. Ummah et al. (2025), for example, examined family socioeconomic factors in relation to mathematics learning outcomes, while Lee and Borgonovi (2022) documented relationships between family socioeconomic status and mathematics achievement across OECD and non-OECD settings. Such findings demonstrate that family background can matter, but they do not imply that every individual dimension of family background will produce statistically significant differences in every educational context. Differences in population characteristics, socioeconomic structures, school environments, measures of achievement, and operational definitions of family background can all contribute to variation across studies. The present study therefore adds contextual evidence from a junior high school setting in Indonesia in which formal parental educational attainment did not significantly differentiate mathematics achievement. Rather than viewing this result as inconsistent with the broader literature, it may be understood as evidence that the relationship between family background and mathematics achievement is conditional on how family characteristics are defined and situated within particular educational environments.

The result has methodological significance as well. Much of the literature discussed in the manuscript examines relationships between parental involvement, socioeconomic status, and academic achievement using correlational, meta-analytic, or multivariable approaches. The present study instead used a direct group-comparison framework, placing students into four parental-education categories and testing whether their mean mathematics scores differed. This approach provides a straightforward empirical test of whether the categorical distinction itself corresponds to meaningful differences in achievement. The absence of a significant omnibus difference, together with the consistently nonsignificant pairwise comparisons, suggests that the four-category classification did not produce a sufficiently differentiated achievement profile in this sample. The contribution therefore lies less in establishing another positive association and more in demonstrating the limits of parental educational attainment as a standalone explanatory classification for

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mathematics achievement among these students.

Several practical implications follow from this interpretation. The findings caution against using parents' educational attainment as a primary basis for anticipating students' mathematics performance or designing educational support. Such an approach could unintentionally overlook students whose parents have lower formal education but who provide strong emotional, motivational, and academic support. Conversely, higher parental education should not be assumed to guarantee effective educational involvement. The literature on parental involvement indicates that the quality and form of engagement are important considerations (Hill & Tyson, 2009; Jiang et al., 2023), while research involving teacher support and student self-efficacy highlights the importance of school-based and student-level processes in mathematics performance (İlter et al., 2025). For schools, this suggests that improvement efforts should prioritize factors that can be directly influenced through educational practice, including the quality of mathematics instruction, opportunities for active student engagement, meaningful feedback, and support for students' learning processes. Family partnerships should likewise be developed inclusively, without assuming that parental educational credentials determine parents' capacity to support their children.

The study should nevertheless be interpreted within the boundaries of its design. The analysis was conducted with 80 Grade IX students from one junior high school, with 20 students represented in each parental-education category. The data were based on Mathematics School Examination scores and parental education recorded in school administrative data. Accordingly, the findings provide context-specific evidence rather than a basis for generalizing to all Indonesian junior high school students. In addition, parental education was examined as a categorical variable, while potentially relevant dimensions such as household socioeconomic resources, parental involvement, students' prior mathematics achievement, motivation, self-regulated learning, teacher support, and classroom conditions were not included in the analysis. Future research could therefore move beyond the question of whether parental education groups differ by examining the mechanisms through which family and school environments are associated with mathematics achievement. Such research would provide a more nuanced understanding of why students with different family backgrounds may nevertheless achieve comparable mathematics outcomes.

Overall, the principal contribution of this study is to show that higher parental educational attainment was associated with a descriptive tendency toward higher mathematics scores but did not constitute a statistically significant differentiating characteristic of mathematics achievement among the sampled Grade IX students. This finding challenges a simplified assumption that formal parental education necessarily

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translates into measurable differences in students' mathematics performance. At the same time, it does not diminish the potential importance of families in educational development. Instead, it shifts attention from parental credentials toward the educational processes through which support is enacted and experienced. In this respect, the study adds a useful contextual qualification to the existing literature: the relationship between family background and mathematics achievement should be understood as multidimensional and context-dependent, and formal parental educational attainment alone may provide only limited explanatory value for students' mathematics achievement.

4. Conclusion

This study examined whether students' mathematics achievement differed according to parental educational attainment among Grade IX students at SMP Negeri 1 Kolaka. The findings indicate that parental educational attainment was not associated with a statistically significant difference in students' mathematics achievement. Although the descriptive results showed a tendency toward higher mean achievement among students whose parents had higher educational attainment, with the highest mean observed in the higher-education group, the one-way ANOVA did not provide sufficient evidence of a significant difference among the four parental education groups. The effect size was also limited, indicating that parental educational attainment accounted for only a small proportion of the observed variation in mathematics achievement. These findings suggest that formal parental educational attainment, when considered as a single background characteristic, should not be regarded as a sufficient basis for explaining differences in mathematics achievement among students in this context.

The study contributes empirical evidence from a junior high school context in Indonesia by distinguishing parental educational attainment from broader forms of family support and other educational conditions. Nevertheless, the findings should be interpreted within the limitations of the study. The analysis was conducted with 80 Grade IX students from a single school, using purposive sampling and secondary institutional records; therefore, the findings should not be generalized beyond comparable contexts without further evidence. In addition, the study focused on parental educational attainment and mathematics examination scores and did not directly measure other potentially relevant dimensions, such as parental involvement, students' learning motivation, self-regulated learning, socioeconomic conditions, quality of instruction, or learning support at home. Future research should therefore employ larger and more diverse samples across schools and regions and incorporate these variables to develop a more comprehensive explanation of variation in mathematics achievement. From a practical perspective, the findings support educational efforts that prioritize the quality of classroom instruction, student engagement,

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academic support, and constructive school–parent collaboration rather than relying on parental educational background as an indicator of students' mathematical potential.

5. References

Alfaruqi, A. Z., & Nurwahidah, N. (2025). Reflection on Indonesia's PISA scores and the 2024 madrasah teacher competency assessment results: Challenges in enhancing teacher competence. *Jurnal Pendidikan IPS*, *15*(1), 11–19.

Ayu, G. N., Putri, C. A., Riyanto, A. R., & Koto, I. (2025). The scientific literacy competence of students in Indonesia and Mexico based on PISA 2022: An international comparative study. *TOFEDU: The Future of Education Journal*, *4*(5), 1033–1038.

Boonk, L., Gijselaers, H. J., Ritzen, H., & Brand-Gruwel, S. (2018). A review of the relationship between parental involvement indicators and academic achievement. *Educational Research Review*, *24*, 10–30.

Canogullari, A., & Radmehr, F. (2026). Task design principles in mathematics education: A literature review. *International Journal of Mathematical Education in Science and Technology*, *57*(4), 615–647.

Cheung, C. S. S., & Pomerantz, E. M. (2011). Parents' involvement in children's learning in the United States and China: Implications for children's academic and emotional adjustment. *Child Development*, *82*(3), 932–950.

Dickert, J., & Glock, S. (2025). Exploring the role of parental education level in preservice teachers' judgments. *The Journal of Experimental Education*, 1–16.

Hernandez-Padilla, E., Bazan-Ramirez, A., Bazan-Ramirez, W., & Solano-Gutierrez, J. (2023). Parental participation and parents' support: Effects on mathematics achievement, 2018 national assessment of learning, Mexico. *Frontiers in Psychology*, *14*.

Hill, N. E., & Tyson, D. F. (2009). Parental involvement in middle school: A meta-analytic assessment of the strategies that promote achievement. *Developmental Psychology*, *45*(3), 740–763.

Himmi, N., Armanto, D., & Amry, Z. (2025). Implementation of project-based learning (PjBL) in mathematics education: A systematic analysis of international practices and theoretical foundations. *Science Insights Education Frontiers*, *26*(2), 4305–4321.

İlter, İ., Aksoy, N. C., & Ceylan, M. (2025). The relationships between parental involvement, teacher support, and mathematics performance: Mediating roles of academic self-efficacy and academic buoyancy. *BMC Psychology*, *13*(1), Article 1222. https://doi.org/10.1186/s40359-025-03547-6

Jiang, Q., Shi, L., Zheng, D., & Mao, W. (2023). Parental homework involvement and students' mathematics achievement: A meta-analysis. *Frontiers in Psychology*, *14*, Article 1218534. https://doi.org/10.3389/fpsyg.2023.1218534

Kodippili, A. (2011). Parents' education level in students' mathematics achievement: Do school factors matter? *Academic Leadership*, *9*(1).

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Lee, J., & Borgonovi, F. (2022). Relationships between family socioeconomic status and mathematics achievement in OECD and non-OECD countries. *Comparative Education Review*, *66*(2), 199–227. https://doi.org/10.1086/718930

Liu, J., Peng, P., Zhao, B., & Luo, L. (2022). Socioeconomic status and academic achievement in primary and secondary education: A meta-analytic review. *Educational Psychology Review*, *34*(4), 2867–2896. https://doi.org/10.1007/s10648-022-09710-7

Mansur, M., & Hakim, D. (2026). Analisis peran modalitas Bourdieu dalam membentuk identitas merek (brand identity) sekolah. *Dirasah: Jurnal Studi Ilmu dan Manajemen Pendidikan Islam*, *9*(1), 50–61.

Morkoyunlu, Z., & Konyalioglu, A. (2020). An investigation of mathematics achievements of middle school students in terms of parental support. *E-Kafkas Journal of Educational Research*, *7*(1), 16–27.

Ni'mah, A. F., & Mawardi, K. (2026). Teori sistem ekologi Bronfenbrenner dan implementasinya dalam model pendidikan integratif. *Jurnal Ilmu Keislaman dan Pendidikan*, *7*(1), 283–291.

Nope, R. F. T., & Mulbar, U. (2025). Literature review: Analisis peran orang tua terhadap prestasi belajar matematika siswa. *PESHUM: Jurnal Pendidikan, Sosial dan Humaniora*, *5*(1), 1069–1079.

Oh, D. D., Barger, M. M., & Pomerantz, E. M. (2022). Parents' math anxiety and their controlling and autonomy-supportive involvement in children's math learning: Implications for children's math achievement. *Developmental Psychology*, *58*(11), 2158–2170.

Payadnya, I. P. A. A., Putri, G. A. M. A., Suwija, I. K., Saelee, S., & Jayantika, I. G. A. N. T. (2025). Cultural integration in AI-enhanced mathematics education: Insights from Southeast Asian educators. *Journal for Multicultural Education*, *19*(1), 58–72.

Putrawangsa, S., & Hasanah, U. (2022). Analisis capaian siswa Indonesia pada PISA dan urgensi kurikulum berorientasi literasi dan numerasi. *EDUPEDIKA: Jurnal Studi Pendidikan dan Pembelajaran*, *1*(1), 1–12.

Song, Q., Liu, Y., & Tan, C. Y. (2025). Effects of family socioeconomic status on educational outcomes in primary and secondary education: A systematic review of the causal evidence. *Educational Psychology Review*, *37*(2), 29–35.

Ummah, N. R., Qodariyah, N. A., & Nurtamam, M. E. (2025). Faktor sosial ekonomi keluarga: Analisis pada hasil belajar matematika siswa sekolah dasar. *Jurnal Inovasi Pendidikan dan Teknologi Informasi (JIPTI)*, *6*(1), 227–237.

Wang, X. S., Perry, L. B., Malpique, A., & Ide, T. (2024). Factors predicting mathematics achievement in PISA: A systematic review. *Large-scale Assessments in Education*, *12*, Article 2. https://doi.org/10.1186/s40536-023-00174-8

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Wibowo, W. A., Suryatama, H., & Siswanto, D. H. (2025). Exploring the impact of the Merdeka Curriculum on mathematics education in elementary schools. *International Journal of Learning Reformation in Elementary Education*, *4*(1), 27–38.

Winarsih, N., & Jannati, U. (2025). Analisis deskriptif hubungan antara latar belakang orang tua dengan pencapaian akademik anak studi di Desa Alassumur Kulon. *Contemporary Education Review*, *1*(1), 1–9.

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