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Learners' Mathematics Performance in PISA-Style Questions

Gigi C. Lamata [1]
gigi.lamata1827@gmail.com/0009-0003-5913-1283

1 – STI West Negros University, Philippines

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Abstract

This study examined learners' mathematics performance on PISA-style questions during the School Year 2025 - 2026 as a basis for the development of supplementary materials. It focused on four mathematical areas: Quantity, Changes and Relationships, Space and Shapes, and Uncertainty and Data. The study also examined differences in learners' performance when grouped by sex, average monthly family income, parents' highest educational attainment, and access to ICT tools. A total of 263 learners participated in the study. Data were analyzed using frequencies and percentages, the mean, and an independent-samples t-test. Findings showed that the learners had a high level of mathematics performance, with an overall mean of 19.98. Among the four areas, Changes and Relationships obtained the highest mean of 5.19, while Space and Shapes obtained the lowest mean of 4.74, interpreted as Moderate. Significant differences were found in Quantity by sex ($p=0.046$) and in Uncertainty and Data by parents' highest educational attainment ($p=0.036$). However, no significant differences were found in the other areas when grouped according to family monthly income and access to ICT tools. Based on these findings, the study recommends developing contextualized, interactive PISA-style STEM supplementary materials, with a greater focus on Space and Shapes. The materials may include real-life problems, hands-on activities, visual tasks, and situations involving maps, designs, measurements, structures, graphs, and everyday decision-making to help learners strengthen their mathematical reasoning and problem-solving skills.

Keywords: *Learners' Mathematics Performance, PISA-Style Questions, Mathematical Literacy, Space and Shapes, STEM, Supplementary Materials*

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Volume 2 Issue 9 (2026)

INTRODUCTION

Mathematics is the most established of all sciences, and it has affected the nature of human existence on our planet. It is agreed that mathematics is the language of science, innovation, and technology. At the elementary and secondary level, the base in math ought to be laid to create mental perception, imagination, and creativity. Due to the lack of appropriate information in Mathematics, students suffer throughout their lives (Shah, 2023).

The Philippines scored 355 points in math tests, an improvement from its previous score of 353 in 2018. The overall result ranked the Philippines sixth-lowest among the 81 countries and economies participating in the study. In general, Filipino students thrive in acquiring knowledge but struggle in subjects that require higher-order thinking skills (Abalde, 2023). These results show that there is still a need to help Filipino students improve their math skills, especially in using math in everyday life (OECD, 2023).

This study is highly relevant to the Philippine education system, which continues to address challenges in mathematics achievement and mathematical literacy. The use of PISA-style questions assesses learners' ability to apply mathematics to real-life situations, reason mathematically, interpret information, and solve unfamiliar problems. The study is closely aligned with Sustainable Development Goal 4 (SDG 4): Quality Education, which promotes inclusive, equitable, and quality education. This is particularly important in the Philippines, given the challenges demonstrated by Filipino learners in PISA 2022 mathematics performance. The study supports Philippine basic education by identifying learners' mathematical strengths and areas for improvement. Ultimately, the development of PISA-style supplementary materials can help strengthen mathematical literacy and improve the quality of mathematics education in the country.

OBJECTIVES OF THE STUDY

This study aimed to determine the level of learners' mathematics performance in PISA-style questions in one of the large schools in a highly urbanized city in the Negros Island Region during the School Year 2025–2026 as a basis for the development of supplementary learning materials. Specifically, the study sought to determine the profile of the respondents in terms of sex, family monthly income, parents' highest educational attainment, and access to ICT tools; assess the level of learners' mathematics performance in PISA-style questions in the areas of Quantity, Changes and Relationships, Space and Shape, and Uncertainty and Data; determine the level of learners' mathematics performance in PISA-style questions when grouped according to the aforementioned profile variables; and ascertain whether there was a significant difference in learners' mathematics performance in PISA-style questions when grouped and compared according to sex, family monthly income, parents' highest educational attainment, and access to ICT tools.

LITERATURE REVIEW

Learners' mathematics performance in PISA has been examined in relation to sex and school gender composition, with findings varying across countries. Perry (2023) reported mixed evidence on the relationship between the proportion of girls in schools and mathematics achievement, with some studies showing no significant association, while others found positive

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https://journals.aloysianpublications.com
Volume 2 Issue 9 (2026)

or negative relationships across different PISA cycles. Similarly, the OECD (2023) reported that boys outperformed girls in mathematics by an average of nine points across OECD countries in PISA 2022, although girls outperformed boys in several countries and no statistically significant difference was observed in others. In the Philippines, however, OECD (2022) reported that girls outperformed boys in mathematics by 14 points, although performance remained relatively stable for both sexes between 2018 and 2022. These findings indicate that sex may be associated with mathematics performance, but the direction and magnitude of differences vary according to context.

Family socioeconomic conditions and parental educational attainment are also important factors associated with mathematics achievement. Wang (2023), through a systematic review of PISA studies, identified overall family socioeconomic status as positively associated with mathematics achievement, while factors such as absenteeism, school dropout, student misbehavior, and shortages of teachers and staff were negatively associated with performance. Lee (2022) found that parental education and parental occupational status were significant necessary conditions for mathematics achievement in more-developed OECD countries, although such relationships varied according to country development and measures of socioeconomic status. Similarly, Ghimire (2026) emphasized that parental educational background is associated with students' academic performance because it reflects access to learning resources, parental aspirations, and assistance with learning. Philippine evidence also supports the relevance of family background, as Pimentel (2023) found that parental education contributed substantially to educational inequality, while Piosang (2025) reported a significant association between socioeconomic status and mathematics scores among Filipino learners.

Access to information and communication technology (ICT) has likewise been examined as a factor related to mathematics achievement. Hristov (2026), using PISA 2022 data from Finland, found that ICT use for learning had limited practical significance across groups, although some positive effects on mathematics achievement were observed among girls. The study also noted that ICT use for leisure and ICT self-efficacy were associated with lower achievement across several subject areas. Similarly, Örnek (2026) found that academically oriented ICT use outside the classroom was positively associated with mathematics and science achievement, whereas leisure-oriented ICT use was negatively associated with achievement. In the Philippine context, Placigo (2026) found that the availability of ICT resources at home was strongly associated with mathematics performance even after controlling for family and school background variables. Martos (2025), however, reported diminishing marginal returns to academic achievement as students' ownership of technological devices increased. These findings suggest that access to ICT alone may not determine achievement, as its educational value may depend on how and for what purpose learners use technology.

Studies examining specific PISA mathematics content areas indicate that Filipino and other Asian learners continue to experience difficulties with contextualized and higher-order mathematical tasks. Mashuri (2023) found that Indonesian Grade 8 students had difficulty interpreting problem information, reasoning, and generalizing solutions in Quantity tasks. Mumfaza (2024) reported that students' mathematical literacy in Change and Relationships required improvement, although mathematical literacy was positively related to self-efficacy. Faizatunnisa (2024) similarly identified learning difficulties in Space and Shape, particularly in

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https://journals.aloysianpublications.com
Volume 2 Issue 9 (2026)

interpreting and evaluating solutions, while Sujadi (2023) found that students' ability to solve problems involving Uncertainty and Data remained moderate. In the Philippines, Bautista (2023) found that Grade 9 learners performed poorly on PISA-like problems compared with computational and simple-context items, indicating difficulty transferring procedural knowledge to complex and realistic situations. These findings emphasize the need to expose learners to contextualized mathematical problems that require interpretation, reasoning, application, and problem-solving.

Philippine studies have highlighted the importance of examining learners' mathematical difficulties and providing appropriate instructional interventions. Para and Guanzon (2026) investigated the difficulties encountered by Grade 7 learners in Mathematics, considering cognitive, affective, and motivational factors as a basis for developing an instructional intervention plan. Similarly, Rubica and Guanzon (2025) examined the effects of Project IDEAL on learners' arithmetic performance and found improvements in both traditional and tablet-assisted instructional groups, although the differences between groups were not statistically significant. Meanwhile, Caguan et al. (2025) identified moderate difficulties related to technological devices and learning environments among college students studying Mathematics online. Collectively, these studies provide contextual support for identifying learners' mathematical difficulties, considering technology-related learning conditions, and developing responsive supplementary materials. However, they did not directly examine performance across the four PISA mathematics content areas, which distinguishes the present investigation.

Philippine curriculum studies further demonstrate the importance of strengthening instruction across the four PISA mathematics content areas. Barba (2024) identified gaps in mathematical modeling and data analysis within the Philippine curriculum, although several competencies related to Change and Relationships, such as functions, equations, inequalities, geometry, growth, and decay, are present. Golla (2020) found limited coverage of PISA Space and Shape competencies in the Philippine K–12 Mathematics Curriculum, with only 23% of aligned competencies belonging to this area and limited explicit coverage in Grade 10. Balagtas (2021) reported that the Philippine BSEd Mathematics curriculum was aligned to some extent with the PISA Mathematics Literacy Framework, including Uncertainty and Data, but gaps remained in contextual application and 21st-century skills. Garcia (2024) also noted that developing PISA-like mathematics tasks is challenging because such items must simultaneously satisfy PISA content, context, and process requirements. These findings provide support for assessing learners using PISA-style questions and developing supplementary materials that address identified competency gaps.

Overall, the literature indicates that learners' mathematics performance in PISA-style questions is influenced by a combination of individual, family, technological, curricular, and instructional factors. Sex, family socioeconomic status, parents' educational attainment, and access to ICT resources have all been identified as relevant variables, although their relationships with achievement differ across contexts. Philippine learners have also demonstrated difficulties in applying mathematics to unfamiliar, contextualized, and real-world situations, particularly in areas requiring reasoning, interpretation, modeling, and data analysis. The OECD (2023) reported that only 16% of Filipino students reached at least Level 2 proficiency in mathematics in PISA 2022, while Bernardo (2022) found that a substantial proportion of Filipino learners

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Aloysian Interdisciplinary Journal of Social Sciences, Education, and Allied Fields
https://journals.aloysianpublications.com
Volume 2 Issue 9 (2026)

performed below Level 1. Thus, the existing literature supports the assessment of learners' performance across Quantity, Change and Relationships, Space and Shape, and Uncertainty and Data, as well as the examination of differences according to sex, family monthly income, parents' educational attainment, and access to ICT tools. Such assessment can provide an empirical basis for developing supplementary learning materials responsive to learners' identified needs.

METHODOLOGY

This section presents the discussion of the research methodology used, the subjects and respondents of the study, the research instruments used, the validity and reliability of the instruments, the procedure for data gathering, and the statistical tools and procedure for data analysis.

Research Design

This study employed a descriptive research design to determine learners' mathematics performance in PISA-style questions as a basis for developing supplementary materials. The design was appropriate because it enabled the researcher to systematically describe the characteristics, distribution, patterns, and trends of the variables, as well as compare groups based on the study variables. Descriptive research is intended to observe, document, and analyze the characteristics and conditions of a phenomenon systematically (Singh, 2023). Thus, the use of this design was considered appropriate for addressing the objectives of the study and providing a clear description of learners' mathematics performance in PISA-style questions.

Study Respondents

A sample of 263, 15-year-old learners in the school year 2025-2026 in one of the large schools in a highly urbanized city in Negros Island Region was the sample of the study. The total population of 15-year-old learners is 823, and the Cochran Formula was used to determine the sample size.

Instruments

The study used a researcher-made instrument to determine learners' mathematics performance in PISA-style questions as a basis for developing supplementary materials in a large school in a highly urbanized city in the Negros Island Region during School Year 2025–2026. The instrument consisted of two parts: Part I gathered the respondents' profiles in terms of sex, family monthly income, and parents' highest educational attainment, while Part II contained a 32-item mathematics test, with eight items in each area, designed to assess performance in PISA-style questions. The respondents were given 45 minutes to complete the test and were instructed to answer all items except the optional name field; parental and learner consent were secured prior to administration, and confidentiality of responses was ensured. For validity, the instrument was reviewed item by item by five qualified experts, including master teachers and mathematics educators with graduate-level qualifications and research experience. The items were organized according to a Table of Specifications (TOS), and the experts' recommendations were incorporated to ensure appropriateness and alignment with the intended constructs. Using Lawshe's Content Validity Ratio (CVR), the instrument obtained a value of 0.99, indicating that

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https://journals.aloysianpublications.com
Volume 2 Issue 9 (2026)

all 32 items were valid and retained. For reliability, the researcher administered the test to 30 fifteen-year-old learners who were not included in the actual respondents, and Cronbach's alpha yielded a reliability coefficient of 0.710, indicating acceptable internal consistency and supporting the suitability of the researcher-made test for the study.

Data Gathering Procedure

The researcher wrote a letter to the School Principal regarding the study's implementation, and a duly approved copy was provided to the school's Grade 9 advisers. Later, the selected respondents were provided with the research instruments, and they all returned the completed instruments on the same day. The return rate for the instruments was 100%. The researcher had administered the instruments to the respondents with the help of class advisers. After the questionnaires were retrieved, they were checked and scored. Scores were tallied, tabulated, analyzed, and interpreted in accordance with the specific problem and hypotheses outlined in this investigation. The researcher assured the respondents that their identities and responses were kept confidential. Once test instrument administration is complete, the raw data will be tabulated and prepared for statistical interpretation. Computation was performed using SPSS.

Data Analysis and Statistical Treatment

The study employed analytical schemes based on the nature of the research questions and objectives. A descriptive-analytical scheme using frequency counts and percentages was utilized to describe the respondents' characteristics in terms of sex/gender, monthly family income, and parents' highest educational attainment. The same descriptive-analytical scheme, using the mean, was employed to determine the level of learners' mathematics performance in PISA-style questions according to the identified profile variables. Finally, a comparative analytical scheme using the Independent Samples t-test was applied to determine whether significant differences existed in learners' mathematics performance in PISA-style questions when grouped according to sex/gender, monthly family income, and parents' highest educational attainment.

Ethical Consideration

The safety of the participants in the study was guaranteed, as the study did not cause any harm or damage to their image. The respondents were assured that the researcher carefully protected their privacy. Moreover, no information about the respondents was revealed or disclosed to the public. Confidentiality was strictly maintained, particularly regarding the respondents' personal information. Instead, pseudonyms were used to protect their identities. The respondents were fully informed about the nature of the study and were given the freedom to participate voluntarily or decline. Before test administration, respondents were identified and provided with parental and learner consent forms, which were obtained before participation.

RESULTS AND DISCUSSION

This section deals with the presentation, analysis and interpretation of data gathered to carry out the objectives of this study. All these were made possible by following certain appropriate procedures so as to give the exact data and solution to each specific problem.

Online ISSN: 3082-5121
Aloysian Interdisciplinary Journal of Social Sciences, Education, and Allied Fields
https://journals.aloysianpublications.com
Volume 2 Issue 9 (2026)

Profile of the Respondents in terms of Sex, Family Monthly Income, Parents' Highest Educational Attainment, and Access to ICT Tools

Table 1

Profile of Respondents

Variables	Categories	Frequency	Percentage (%)
Sex	Male	93	35.36
	Female	170	64.64
	Total	**263**	**100.00**
Family Monthly Income	Lower (below P14, 560)	156	59.32
	Higher (P 14, 560 and above)	107	40.68
	Total	**263**	**100**
Parents' Highest Educational Attainment	Lower (Elementary and High School Graduate)	132	50.19
	Higher (College Graduate)	131	49.81
	Total	**263**	**100**
Access to ICT Tools	Have Access	197	74.90
	No Access	66	25.10
	Total	**263**	**100**

Table 1 presents the respondents' profile in terms of sex, family monthly income, parents' highest educational attainment, and access to ICT tools. The respondents were predominantly female, comprising 64.64% (170), while 35.36% (93) were male. In terms of family monthly income, 59.32% (156) belonged to families earning below ₱14,560 per month, while 40.68% (107) had an income of ₱14,560 and above, indicating that most respondents came from relatively lower-income households. Regarding parents' highest educational attainment, 50.19% (132) reported Elementary or High School graduates, while 49.81% (131) reported College graduates or higher, reflecting an almost balanced distribution. Meanwhile, 74.90% (197) had access to ICT tools, whereas 25.10% (66) had no access. These findings provide important context for examining learners' Mathematics performance, as previous studies have indicated that sex, socioeconomic conditions, parental educational attainment, and access to ICT resources may be associated with Mathematics achievement, although their effects vary across contexts and do not

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https://journals.aloysianpublications.com
Volume 2 Issue 9 (2026)

necessarily determine learners' performance. Thus, the respondents' demographic and resource-related characteristics provide a basis for analyzing differences in Mathematics performance on PISA-style questions according to these variables.

Descriptive Analysis at the Level of Learners' Mathematics Performance in Pisa-Style Questions in Quantity, Changes and Relationship, Space and Shapes, and Uncertainty and Data

Table 2

Learners' Mathematics Performance in Pisa-Style Questions in the Areas

Areas	Mean	Interpretation
a. Quantity	5.08	High
b. Changes and Relationship	5.19	High
c. Space and Shapes	4.74	Moderate
d. Uncertainty and Data	4.97	High
Overall Mean	**19.98**	**High**

Table 2 presents the learners' Mathematics performance in PISA-style questions across four content areas: Quantity, Changes and Relationships, Space and Shapes, and Uncertainty and Data. The overall mean of 19.98 was interpreted as High, indicating generally good performance. Among the areas, Changes and Relationships obtained the highest mean of 5.19 (High), followed by Quantity at 5.08 (High) and Uncertainty and Data at 4.97 (High), demonstrating learners' ability to work with quantities, identify patterns and relationships, interpret data, and apply mathematical concepts in contextualized situations. These findings are consistent with literature noting that Philippine mathematics curricula develop competencies related to numbers, quantities, functions, equations, data, and other mathematical concepts, although opportunities for applying these skills to authentic, real-life problems remain important. In contrast, Space and Shapes obtained the lowest mean of 4.74 (Moderate), suggesting greater difficulty in tasks involving geometry, measurement, spatial visualization, and interpretation of shapes and diagrams. This finding supports studies indicating that learners may have limited exposure to PISA-related competencies in Space and Shapes and may experience challenges when applying geometric concepts to unfamiliar or real-world situations.

Overall, the results indicate that learners demonstrate stronger performance in Changes and Relationships, Quantity, and Uncertainty and Data, while Space and Shapes represents an area requiring further development. The findings suggest that supplementary materials should build on learners' existing strengths while providing targeted activities to strengthen spatial visualization, geometric reasoning, measurement, and interpretation of

Online ISSN: 3082-5121
Aloysian Interdisciplinary Journal of Social Sciences, Education, and Allied Fields
https://journals.aloysianpublications.com
Volume 2 Issue 9 (2026)

diagrams. Across all content areas, learning materials should move beyond routine computation and include authentic, contextualized, and higher-order tasks involving reasoning, problem-solving, interpretation, decision-making, and justification of answers. For Quantity and Changes and Relationships, activities may focus on estimation, rates of change, trends, functions, graphs, and relationships, while Uncertainty and Data may incorporate real-life data, statistics, probability, and evidence-based decision-making. For Space and Shapes, practical activities involving maps, distances, areas, room planning, geometric figures, and hands-on visualization may provide meaningful opportunities for learners to develop mathematical literacy and achieve more balanced performance across the PISA-style content areas.

Descriptive Analysis of the Level of Learners' Mathematics Performance in PISA-style questions

Table 3

Level of Learners' Mathematics Performance in Pisa-Style Questions in Quantity, Changes and Relationship, Space and Shapes, and Uncertainty and Data when grouped according to Sex

Areas	Male		Female	
a. Quantity	4.74	Moderate	5.27	High
b. Changes and Relationship	5.03	High	5.28	High
c. Space and Shapes	4.62	Moderate	4.80	High
d. Uncertainty and Data	4.74	Moderate	5.09	High
Overall Mean	19.14	Moderate	20.44	High

Table 3 presents learners' Mathematics performance on PISA-style questions when grouped by sex. Female learners obtained higher mean scores than male learners across all four content areas, with an overall mean of 20.44 (High) compared with 19.14 (Moderate) for males. In Quantity, female learners scored 5.27 (High) versus 4.74 (Moderate) for males; in Changes and Relationships, 5.28 (High) versus 5.03 (High); in Space and Shapes, 4.80 (High) versus 4.62 (Moderate); and in Uncertainty and Data, 5.09 (High) versus 4.74 (Moderate). These descriptive findings indicate higher performance among female learners, particularly in Quantity and Uncertainty and Data, while both groups demonstrated relatively strong performance in Changes and Relationships. The results are consistent with Philippine PISA findings reported by the OECD (2022) and with Jahari (2025), although international literature has shown that sex differences in Mathematics performance vary across educational and social contexts.

The findings suggest that supplementary materials should provide equitable learning opportunities while addressing specific areas of need for both groups. Male learners may benefit from additional contextualized activities involving numerical reasoning, spatial visualization, geometric reasoning, data interpretation, and real-life problem-solving, while female learners may be provided with more challenging and higher-order tasks to further develop their existing competencies. Across both groups, supplementary materials should emphasize authentic PISA-

Online ISSN: 3082-5121
Aloysian Interdisciplinary Journal of Social Sciences, Education, and Allied Fields
https://journals.aloysianpublications.com
Volume 2 Issue 9 (2026)

style situations requiring learners to analyze, interpret, reason, explain, and apply mathematical concepts rather than rely solely on routine computation. However, since the results in Table 4 are descriptive, the observed differences in mean scores should not be interpreted as statistically significant without an appropriate inferential test.

Table 4

Level of Learners Mathematics Performance in Pisa-Style Questions in Quantity, Changes and Relationship, Space and Shapes, and Uncertainty and Data when grouped according to Family Monthly Income

Areas	Lower		Higher	
a. Quantity	4.99	High	5.21	High
b. Changes and Relationship	5.24	High	5.12	High
c. Space and Shapes	4.65	Moderate	4.86	High
d. Uncertainty and Data	4.82	High	5.19	High
Overall Mean	**19.71**	**High**	**20.38**	**High**

Table 4 presents the learners' Mathematics performance on PISA-style questions when grouped according to family monthly income. Both lower-income and higher-income groups obtained an overall High performance, with mean scores of 19.71 and 20.38, respectively, indicating only a 0.67-point difference. In Quantity, the lower- and higher-income groups obtained means of 4.99 and 5.21, respectively, both interpreted as High. In Changes and Relationships, the lower-income group slightly outperformed the higher-income group, with means of 5.24 and 5.12, both High. In Space and Shapes, the lower-income group obtained 4.65 (Moderate) compared with 4.86 (High) for the higher-income group, while in Uncertainty and Data, both groups performed at a High level, with means of 4.82 and 5.19, respectively. These findings indicate that although the higher-income group generally obtained slightly higher scores, learners from lower-income families also demonstrated strong Mathematics performance, consistent with studies showing that socioeconomic status may be associated with achievement but does not necessarily determine learners' academic outcomes.

The findings suggest that supplementary materials should promote equitable learning opportunities for learners regardless of family income. Particular attention should be given to Space and Shapes, especially among lower-income learners, through accessible activities involving spatial visualization, geometry, measurement, diagrams, and real-life applications. Both groups should also be provided with contextualized PISA-style tasks involving quantitative reasoning, patterns, functions, data interpretation, statistics, probability, and problem-solving. Since some activities may require resources that are not equally available to all learners, supplementary materials should include low-cost or resource-independent tasks that can be completed using readily available materials. Overall, the results indicate that family income provides an important context for understanding learners' Mathematics performance, while the generally High performance of both groups demonstrates that lower family income does not necessarily prevent learners from achieving strong outcomes.

Online ISSN: 3082-5121
Aloysian Interdisciplinary Journal of Social Sciences, Education, and Allied Fields
https://journals.aloysianpublications.com
Volume 2 Issue 9 (2026)

Table 5

Level of Learners Mathematics Performance in Pisa-Style Questions in Quantity, Changes and Relationship, Space and Shapes, and Uncertainty and Data when grouped according to Parents' Highest Educational Attainment

Areas	Lower		Higher	
a. Quantity	4.96	High	5.21	High
b. Changes and Relationship	4.95	High	5.43	High
c. Space and Shapes	4.55	Moderate	4.92	High
d. Uncertainty and Data	4.69	Moderate	5.25	High
Overall Mean	**19.16**	**Moderate**	**20.81**	**High**

Table 5 presents the learners' Mathematics performance in PISA-style questions when grouped according to parents' highest educational attainment. Learners whose parents had higher educational attainment obtained a higher overall mean of 20.81 (High) compared with 19.16 (Moderate) among those whose parents had lower educational attainment. The higher group also obtained higher mean scores in all four areas: Quantity (5.21 vs. 4.96), Changes and Relationships (5.43 vs. 4.95), Space and Shapes (4.92 vs. 4.55), and Uncertainty and Data (5.25 vs. 4.69). The largest differences were observed in Uncertainty and Data (0.56) and Changes and Relationships (0.48), while the smallest was in Quantity (0.25). These findings are consistent with literature indicating that parental educational attainment may be associated with learners' academic achievement by influencing educational resources, learning support, and opportunities at home. However, the descriptive results should not be interpreted as statistically significant without an appropriate inferential test.

The findings suggest the need for equitable and differentiated instructional support, particularly for learners whose parents have lower educational attainment. Supplementary materials should provide contextualized activities involving mathematical reasoning, patterns, functions, graphs, geometry, spatial visualization, data interpretation, statistics, and probability, with additional guidance in areas where performance was relatively lower. At the same time, the relatively strong performance of the lower parental-education group in Quantity and Changes and Relationships demonstrates that learners can achieve well despite differences in family educational background, highlighting the importance of school support, parental involvement, and academic resilience. Thus, schools should ensure accessible learning resources, meaningful PISA-style activities, differentiated instruction, and opportunities for parental engagement to help minimize learning disparities and support Mathematics achievement across diverse family backgrounds.

Online ISSN: 3082-5121
Aloysian Interdisciplinary Journal of Social Sciences, Education, and Allied Fields
https://journals.aloysianpublications.com
Volume 2 Issue 9 (2026)

Table 6

Level of Learners' Mathematics Performance in Pisa-Style Questions in Quantity, Changes and Relationship, Space and Shapes, and Uncertainty and Data when grouped according to Access to ICT Tools

Areas	Have Access		No Access	
a. Quantity	4.99	High	5.35	High
b. Changes and Relationship	5.13	High	5.38	High
c. Space and Shapes	4.63	Moderate	5.05	High
d. Uncertainty and Data	4.98	High	4.92	High
Overall Mean	**19.74**	**High**	**20.70**	**High**

Table 6 presents learners' Mathematics performance on PISA-style questions when grouped according to access to ICT tools. Learners with ICT access obtained an overall mean of 19.74 (High), with the highest performance in Changes and Relationships (5.13), followed by Quantity (4.99) and Uncertainty and Data (4.98), while Space and Shapes was Moderate (4.63). Interestingly, learners without ICT access obtained a higher overall mean of 20.70 (High), with high performance in all four areas, particularly Changes and Relationships (5.38) and Quantity (5.35). The findings indicate that ICT access alone does not necessarily result in higher Mathematics performance, consistent with studies suggesting that the effect of technology depends on how it is used and integrated into meaningful, academically oriented learning activities. Therefore, teachers should provide equitable learning opportunities through purposeful ICT-based activities such as digital graphs, simulations, and virtual geometry tasks for learners with access, while offering printed PISA-style materials, manipulatives, diagrams, and teacher-guided activities for those without access. Particular attention should be given to Space and Shapes, where learners with ICT access demonstrated only Moderate performance, while contextualized problem-solving activities should continue to be integrated across all PISA Mathematics content areas.

Comparative Analysis in the Level of Learners Mathematics Performance in Pisa-Style Questions

Table 7

Difference in the Level of Learners' Mathematics Performance in Pisa-Style Questions in Quantity when grouped and compared according to Variables

Variable	Category	N	Mean Rank	t-test	p-value	*Sig. level*	Interpretation
Sex	Male	93	4.74	-2.001	0.046	0.05	Significant
	Female	170	5.27				
Family Monthly	Lower	156	4.99	-0.856	0.393		Not Significant
	Higher	107	5.21				

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Aloysian Interdisciplinary Journal of Social Sciences, Education, and Allied Fields
https://journals.aloysianpublications.com
Volume 2 Issue 9 (2026)

Income						
Parents' Highest Educational Attainment	Lower	132	4.96	-0.960	0.338	Not Significant
	Higher	131	5.21			
Access to ICT Tools	Have Access	197	4.99	1.208	0.228	Not Significant
	No Access	66	5.35			

Table 7 presents the differences in learners' Mathematics performance in PISA-style Quantity questions when grouped according to sex, family monthly income, parents' highest educational attainment, and access to ICT tools. The Independent Samples t-test revealed a statistically significant difference by sex, with male learners obtaining a mean of 4.74 and female learners 5.27 ($t = -2.001$, $p = .046$). Thus, the null hypothesis for sex was rejected. In contrast, no significant differences were found according to family monthly income ($t = -0.856$, $p = .393$), parents' highest educational attainment ($t = -0.960$, $p = .338$), or access to ICT tools ($t = 1.208$, $p = .228$), as all p-values exceeded the 0.05 significance level. Although slight differences in mean scores were observed across these groups, the results suggest that these factors did not significantly differentiate learners' performance in Quantity within the study sample.

The findings indicate that sex was the only examined variable significantly associated with performance in Quantity, while family income, parents' educational attainment, and ICT access did not produce statistically significant differences. This suggests that learners' quantitative performance may also be influenced by factors such as quality of instruction, prior knowledge, motivation, learning strategies, and opportunities for mathematical problem-solving. The findings further support the need for supplementary materials that are accessible and appropriate for all learners, regardless of socioeconomic background, parental educational attainment, or ICT access. Materials should include contextualized PISA-style problems, visual representations, guided examples, real-life and STEM-related situations, and activities that can be completed using both digital and non-digital resources, while providing appropriate support to learners who demonstrate lower performance.

Online ISSN: 3082-5121
Aloysian Interdisciplinary Journal of Social Sciences, Education, and Allied Fields
https://journals.aloysianpublications.com
Volume 2 Issue 9 (2026)

Table 8

Difference in the Level of Learners Mathematics Performance in Pisa-Style Questions in Changes and Relationship when grouped and compared according to Variables

Variable	Category	N	Mean Rank	T-test	p-value	*Sig. level*	Interpretation
Sex	Male	93	5.03	-0.937	0.349		Not Significant
	Female	170	5.28				
Family Monthly Income	Lower	156	5.24	0.456	0.649		Not Significant
	Higher	107	5.12				
Parents' Highest Educational Attainment	Lower	132	4.95	-1.908	0.057	0.05	Not Significant
	Higher	131	5.43				
Access to ICT Tools	Have Access	197	5.13	-0.877	0.382		Not Significant
	No Access	66	5.38				

Table 8 presents the differences in learners' Mathematics performance in PISA-style questions under the Changes and Relationships domain when grouped according to sex, family monthly income, parents' highest educational attainment, and access to ICT tools. The Independent Samples t-test revealed no statistically significant differences across all four variables, as all p-values were greater than 0.05. By sex, male learners obtained a mean of 5.03, while female learners obtained 5.28 (t = -0.937, p = .349), indicating comparable performance despite the slightly higher female mean. Similarly, learners from lower-income families obtained a mean of 5.24 compared with 5.12 among those from higher-income families (t = 0.456, p = .649), suggesting that family income did not significantly differentiate performance. In terms of parents' educational attainment, learners whose parents had lower educational attainment obtained a mean of 4.95, while those with higher educational attainment obtained 5.43 (t = -1.908, p = .057). Although this was the closest result to statistical significance, the p-value remained above the 0.05 level; hence, the null hypothesis was not rejected. Finally, learners with ICT access obtained a mean of 5.13, compared with 5.38 among those without access (t = -0.877, p = .382), indicating that ICT access was likewise not a significant differentiating factor. These findings suggest that sex, socioeconomic status, parental educational attainment, and ICT access alone do not determine learners' performance in Changes and Relationships, which may instead be influenced by factors such as prior knowledge, mathematical confidence, problem-solving strategies, quality of instruction, and opportunities for contextualized mathematical learning.

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https://journals.aloysianpublications.com
Volume 2 Issue 9 (2026)

The findings underscore the need for inclusive and equitable supplementary Mathematics materials that can support learners regardless of their demographic, socioeconomic, parental, or technological background. Since Changes and Relationships involves recognizing patterns, interpreting graphs and tables, analyzing relationships, understanding rates of change, and applying mathematical reasoning to real-life situations, supplementary materials should emphasize contextualized, problem-based, and higher-order activities that strengthen reasoning, confidence, and problem-solving skills. Materials should be accessible through both ICT-based and non-ICT formats so that learners without digital resources can participate equally, while technology should be integrated purposefully rather than treated as a prerequisite for learning. The near-significant result for parents' educational attainment (p = .057) also suggests an area for further investigation, particularly by examining parental engagement and learning support at home. Overall, the results support the development of learner-centered and equitable supplementary resources designed to strengthen mathematical thinking and enable learners to apply concepts involving changes and relationships to authentic, everyday situations.

Table 9

Difference in the Level of Learners' Mathematics Performance in Pisa-Style Questions in Space and Shapes when grouped and compared according to Variables

Variable	Category	N	Mean Rank	T-test	p-value	*Sig. level*	Interpretation
Sex	Male	93	4.62	-0.670	0.503		Not Significant
	Female	170	4.80				
Family Monthly Income	Lower	156	4.65	-0.804	0.422	0.05	Not Significant
	Higher	107	4.86				
Parents' Highest Educational Attainment	Lower	132	4.55	-1.477	0.141		Not Significant
	Higher	131	4.92				
Access to ICT Tools	Have Access	197	4.63	-1.420	0.157		Not Significant
	No Access	66	5.05				

Table 9 presents the differences in learners' Mathematics performance on PISA-style questions in Space and Shapes when grouped according to sex, family monthly income, parents' highest educational attainment, and access to ICT tools. The Independent Samples t-Test revealed no statistically significant differences across all four variables, as all p-values exceeded the 0.05 level of significance. Female learners obtained a slightly higher mean score than males (4.80 vs. 4.62; p = .503), higher-income learners scored slightly higher than lower-income learners (4.86 vs. 4.65; p = .422), learners whose parents had higher educational attainment obtained a higher mean than those with lower parental educational attainment (4.92 vs. 4.55; p

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https://journals.aloysianpublications.com
Volume 2 Issue 9 (2026)

= .141), and learners without ICT access had a slightly higher mean than those with access (5.05 vs. 4.63; p = .157). These findings indicate that the observed differences were insufficient to establish statistically significant variations in Space and Shapes performance.

The results suggest that learners' performance in spatial and geometric tasks may not be explained solely by demographic or access-related variables. Although slight differences were observed across groups, other factors such as prior mathematical knowledge, classroom instruction, problem-solving strategies, self-regulation, motivation, and the quality and purpose of ICT use may contribute more directly to performance. This interpretation is consistent with PISA-related research emphasizing that Mathematics achievement varies across content areas and contexts, while the effects of socioeconomic background and technology access depend on how learning opportunities and resources are utilized. Studies on PISA Space and Shapes tasks likewise highlight the importance of formulating, employing, and interpreting mathematical information, as well as learners' self-regulation and reasoning processes. Overall, the null hypothesis is not rejected for all four variables, indicating that sex, family monthly income, parental educational attainment, and ICT access did not significantly differentiate learners' performance in Space and Shapes.

Table 10

Difference in the Level of Learners' Mathematics Performance in Pisa-Style Questions in Uncertainty and Data when grouped and compared according to Variables

Variable	Category	N	Mean Rank	T-test	p-value	*Sig. level*	Interpretation
Sex	Male	93	4.74	-1.256	0.210		Not Significant
	Female	170	5.09				
Family Monthly Income	Lower	156	4.82	-1.343	0.180		Not Significant
	Higher	107	5.19				
Parents' Highest Educational Attainment	Lower	132	4.69	-2.109	0.036	0.05	Significant
	Higher	131	5.25				
Access to ICT Tools	Have Access	197	4.98	0.195	0.845		Not Significant
	No Access	66	4.92				

Table 10 presents the differences in learners' Mathematics performance on PISA-style questions in Uncertainty and Data when grouped according to sex, family monthly income, parents' highest educational attainment, and access to ICT tools. The Independent Samples t-Test showed that parents' highest educational attainment was the only variable with a statistically significant difference. Learners whose parents had higher educational attainment obtained a

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https://journals.aloysianpublications.com
Volume 2 Issue 9 (2026)

significantly higher mean score than those whose parents had lower educational attainment (5.25 vs. 4.69; t = -2.109, p = .036). In contrast, sex (4.74 vs. 5.09; p = .210), family monthly income (4.82 vs. 5.19; p = .180), and ICT access (4.98 vs. 4.92; p = .845) did not produce significant differences. Thus, the null hypothesis is rejected for parental educational attainment but not for sex, family income, and ICT access.

The findings suggest that parental educational attainment may be associated with learners' performance in interpreting data, analyzing uncertainty, and solving PISA-style problems, possibly through differences in academic assistance, learning resources, and opportunities for reasoning and problem solving at home. However, the significant difference does not establish that parental education directly caused the higher performance. Meanwhile, the non-significant results for sex, family income, and ICT access indicate that these factors alone did not significantly differentiate learners' performance in Uncertainty and Data. The nearly identical scores of learners with and without ICT access further suggest that access to technology alone may not improve achievement unless digital tools are purposefully integrated into Mathematics instruction. Overall, the results highlight the importance of strengthening classroom-based support, particularly through guided activities, worked examples, and scaffolded PISA-style tasks that can help address differences in learning opportunities outside the classroom.

CONCLUSIONS

The findings revealed that learners generally demonstrated high performance in PISA-style Mathematics questions, with Changes and Relationships obtaining the highest performance and Space and Shapes the lowest, interpreted as moderate. Female learners, higher-income learners, and those whose parents had higher educational attainment generally obtained higher mean scores, while learners with and without ICT access both demonstrated high performance, indicating that access to technology alone did not necessarily correspond to higher achievement. Comparative analysis using the independent-samples t-test showed significant differences only in Quantity when grouped by sex and in Uncertainty and Data when grouped by parents' highest educational attainment, while no significant differences were found for the other variables and mathematical areas. Overall, the findings suggest that demographic characteristics alone do not sufficiently explain learners' Mathematics performance and that instructional quality, prior knowledge, problem-solving strategies, learner engagement, and learning opportunities may also contribute to achievement. The lower performance in Space and Shapes highlights the need for greater instructional attention through hands-on, visual, contextualized, PISA-style, and STEM-based activities that develop spatial reasoning, visualization, geometry, measurement, and problem-solving skills. Supplementary materials should also provide both ICT-based and non-ICT activities to ensure accessibility and should build on learners' strengths while addressing identified learning needs to strengthen mathematical literacy and the practical application of Mathematics in everyday situations.

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https://journals.aloysianpublications.com
Volume 2 Issue 9 (2026)

RECOMMENDATIONS

Mathematics teachers are encouraged to provide contextualized, PISA-style, and problem-solving activities, with greater emphasis on Space and Shapes through geometry, measurement, spatial visualization, diagrams, models, and real-life applications. Learners should actively participate in Mathematics activities, regularly practice contextualized problems, and develop reasoning, critical-thinking, and problem-solving skills. School administrators should support teachers by providing appropriate learning resources, manipulatives, visual materials, ICT tools, professional development, and intervention programs that address identified learning needs. Parents are encouraged to provide consistent academic support, motivation, and encouragement regardless of their educational or financial background and to maintain communication with teachers. The proposed supplementary materials should focus particularly on Space and Shapes while reinforcing Quantity, Changes and Relationships, and Uncertainty and Data through guided examples, visual representations, hands-on, STEM-based, contextualized PISA-style activities, and formative assessments. Before implementation, the materials should undergo expert validation and pilot testing and should be evaluated through appropriate measures such as pretests and posttests to determine their effectiveness. Future researchers may conduct studies with larger and more diverse samples and examine additional factors such as motivation, study habits, parental support, teaching strategies, mathematical confidence, prior achievement, and the quality of ICT use, including experimental or quasi-experimental evaluations of the supplementary materials.

Conflict of Interest

The author declares the absence of any conflict of interest that could have influenced the content or conclusions of this paper. She affirms that no financial, personal, or professional relationships with other individuals or organizations have compromised the objectivity, integrity, or impartiality of the research work. As a final point, no external parties influenced the study design, data collection, analysis, or interpretation.

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