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Determinants of Student Underperformance in PISA 2022: Mixed-Methods Analysis of Socioeconomic Status, Parental Involvement, Digital Access, and School Environment

Salwa Mohammed Omar Aqeel
Department of Mechanical and Industrial Engineering, College of Engineering, Qatar University, Doha, Qatar.

Abstract

This study examines key factors associated with low student performance in the 2022 PISA (Programme for International Student Assessment). The research employs an exploratory sequential mixed-methods design. The first phase involved a qualitative thematic analysis of key education documents, including policy analyses, OECD reports, and recent PISA-related case studies, to identify key themes influencing underperformance. The second phase involved a quantitative analysis of PISA 2022 microdata using multiple linear regression, Pearson correlation, and descriptive statistics methods. The findings revealed eight key themes associated with low student performance in the PISA 2022 assessments. At the family level, Parental involvement and socioeconomic status dominated. School resources/teacher training and learning environment represented institutional factors, Education policy and governance, teacher training, alongside student motivation represented system-level factors. Home and economic factors were determinable factors to success. The policy must focus on equity of resources and better learning conditions, particularly in disadvantaged communities.
Key Words: PISA 2022, Socioeconomic Status, Parental Involvement, Digital Access, School Environment, Mixed-Method Research.

1. Introduction

The PISA results consistently show large differences in students' learning outcomes across countries, especially in mathematics, reading, and science. These disparities were once again witnessed in the 2022 PISA cycle, with advantaged education systems scoring higher than under-resourced systems. It is hence imperative that policymakers understand the root causes of poor student performance in order to rectify the persistent educational inequalities. In the absence of a theoretically based explanation of such disparities, policy interventions may be disjointed or ineffective.

The paper is rooted in well-known theoretical views that elaborate on how both family and environmental contexts influence student performance. An underlying perspective on the significance of socioeconomic status (SES) is grounded in social reproduction theory (Bourdieu, 1986). It focuses on access to economic, cultural, and social capital and its impact on educational outcomes. Higher-SES students usually have more learning resources, academic support, and cultural capital that align with school expectations and, therefore, have a higher chance of succeeding on standardized tests such as PISA. Conversely, disadvantaged students are often constrained by structural factors that limit their educational opportunities.

Also in line with this view, Bronfenbrenner's ecological systems theory (1979) emphasizes the significance of different layers of the environment in students' development, especially the interaction between home and school environments. In this context, parental involvement is an essential aspect of the microsystem that has a direct impact on students' learning behaviours, motivation, and academic participation. According to the theory, strong

relationships between home and school environments can improve students' performance, and poor or unresponsive involvement might indicate underlying academic difficulties.

Drawing on these theoretical frameworks, this paper focuses on determinants of student performance, such as socioeconomic status and parental involvement. These variables are consistently found in previous empirical studies, not just in theory, but are the main mechanisms by which educational inequality is replicated or alleviated. This paper thus answers the research question: What are the key factors affecting students' low performance in PISA assessments worldwide?

The background of the PISA 2022 cycle is particularly significant. Most recent publications by the OECD focus on the impacts of equity, system design, and pandemic-related disruptions on learning outcomes (OECD, 2023; OECD, 2024). It has been shown that the more schools were shut down during the COVID-19 pandemic, the greater the learning losses were in different countries (OECD, 2024). Also, socioeconomic inequality remained a powerful factor in average performance levels (OECD, 2023). These trends highlight the importance of considering the structural and contextual factors that shape student performance.

The study will use a mixed-method design to answer this research question. The initial step consisted of a qualitative investigation of the latest policy and literature reports, such as PISA 2022 Results: The State of Learning and Equity in Education (OECD, 2023) and Learning During and From Disruption (OECD, 2023) and cross-national research on the topic of reading and mathematics performance (Liu, 2024; Wijaya et The sources recognized the factors of significant influence like school resources, family background, learning environment, and teacher quality, but also pointed to the more general factors such as COVID-related disruptions and education governance.

The second stage was an attempt to experiment with these factors using PISA 2022 microdata and quantitative analysis. The official dataset was used to calculate a composite performance score, which was evaluated based on variables such as home possessions, the ESCS index, school ICT resources, and parental involvement. Such a mixed-methods approach allows connecting theoretically grounded constructs with empirical evidence, enabling a more comprehensive view of the factors underlying student underperformance on PISA.

2. Methodology

This study used an exploratory sequential mixed-methods design. A qualitative analysis was first conducted to identify themes, and a quantitative analysis was then conducted to empirically validate those themes. The first phase focused on document analysis. Several highly relevant sources were selected. These documents comprise OECD reports on PISA 2022 (OECD's PISA 2022 Results: The State of Learning and Equity in Education (OECD, 2023) report and Learning During and From Disruption (OECD, 2023) report) and recent cross-national studies (cross-national studies examining reading and mathematics achievement (Liu, 2024: Wijaya et al., 2024). The documents were selected for their direct engagement with educational outcomes and their credibility. The documents were reviewed systematically, with passages coded based on factors that affected student achievement. The thematic coding process revealed eight recurring themes: parental involvement, school resources/teacher quality, learning environment, socioeconomic status, COVID-19 impact, policy/governance, teacher training, and student motivation. The qualitative analysis helped make sense of the broader context and patterns from existing literature.

In the second phase, the PISA 2022 microdata were used to perform quantitative analysis (OECD 2023). Firstly, student-level performance scores were computed by averaging each student's plausible values in Mathematics, Reading, and Science (creating variables MATHAVERAGE_mean, READAVERAGE_mean, SCIEAVERAGE_mean), and then those domain scores were averaged into a composite OVERALAVG score. Secondly. These results were aggregated to the country level to produce descriptive statistics. Using SPSS with the PISA 2022 dataset, mean and standard deviation of Math, Reading, Science, and OVERALAVG for each country were calculated, then the countries were ranked by OVERALAVG. The top five and bottom five performers were identified as shown in Table 1.

Next, relationships among variables at the student level was examined. Descriptive statistics provided a baseline, but inferential tests were needed to explore associations. Pearson correlation analysis was conducted to measure linear relationships between OVERALAVG and key contextual predictors. The predictors chosen were: (1) School ICT availability (as a weighted index), (2) the ESCS (Economic, Social, Cultural Status) index measuring socioeconomic background, (3) Home possessions index (a proxy for educational and material resources at home), and (4) Parental involvement index (how often parents are engaged in schooling, WLE). These four variables corresponded to qualitative identified themes: including Socioeconomic status, and home resources. The overall average Score (OVERALAVG) sample size was about 613,000 students, indicating considerable statistical power. The statistical significance was compared at $p<.01$. The relative influence of the predictors was analysed through the multiple linear regression, where the overall average score was regarded as the dependent variable, and four variables (school ICT availability, a weighted index, economic, social, cultural status index, home possessions index and parental involvement index) were considered as independent variables. Listwise exclusion

was used to handle missing data, resulting in 63,07 valid cases (F(4,63072) = 7036.87, p <), indicating that the independent variables as a group significantly predicted the dependent variable, as compared to the effect of chance alone. R=.555 model statistics and adjusted 2=.309. The Standardized coefficients (b) showed the significance and effect size of each predictor. To establish model validity, the Assumption checks were used: VIFs were lower than 2.5, and Durbin-Watson was around 1.61.

The logic behind the mixed-methods approach was clear: qualitative analysis was used to identify themes to guide variable selection. These themes were then tested in a quantitative analysis of their predictive strength, thereby balancing generalizability and depth. In addition, statistical patterns were interpreted with the help of qualitative findings, whereas quantitative results confirmed the relationships hypothesized as a result of the quantitative review.

3. Results

Qualitative Findings

In the qualitative analysis phase, which involves thematic analysis, eight central themes that affect the performance of students were identified. These are eight themes obtained based on the OECD reports of PISA 2022 and other research, and include the following:

1. **Socioeconomic Status:** The socioeconomic status of a family influences student performance in a tremendous manner. AlAli & Wardat (2024) and the OECD (2023) report that high-income family students are better equipped with learning materials, such as books, technology, and tutoring, which enhances their performance. Students from households with less economic resources lack these enrichment opportunities. The OECD (2023), highlighted that socioeconomic status explains about 5% of math score variation within countries, although some countries records over 20% of math score variation. Immigrant status compounds socioeconomic status effects thought economic and language barriers. (OECD 2023). Wealthier nations spend more on education, leading to higher outcomes (OECD 2023). To address these disparities, equitable policies are needed to ensure all students reach their potential regardless of background.

2. **School Resources & Teacher Quality:** There was a moderate direct effect of school resources on performance, although the school resources policy is critical. Liberalisation of school choice, such as this one, is likely to separate schools by SES, thereby increasing inequality. Institutions located in wealthy regions tend to be better qualified and equipped with learning materials, whereas institutions in disadvantaged regions tend to have less experienced teachers and fewer learning materials. This kind of social stratification exacerbates performance differences between high- and low-socioeconomic status students (OECD 2023). Although inputs do not necessarily result in success, resources and teacher quality can have a drastic impact on student outcomes through equity processes (OECD 2023).

3. **Parental Involvement:** Engaged parents and supportive homes are crucial for learning. According to OECD (2023), parents who read with their children and encourage learning improve achievement. Further, Wijaya et al. (2024) confirm that parental support enhances academic achievement. Nearly half of teachers surveyed recognize parent involvement as an important factor for mathematics, but many parents still underappreciate their role (Wijaya et al., 2024). Parental support, including extra tutoring, can help struggling students close learning gaps. Recent trends, however, show a concerning decline in parental-school engagement. Between 2018 and 2022, the proportion of students whose parents often communicate with teachers decreased by 10 percentage points across OECD countries (OECD 2023). Also, OECD (2023) report noted that the education system maintaining or increasing parental involvement showed improved student achievement, especially among disadvantaged students. Therefore, revitalizing parent-school partnerships could be an effective mechanism for addressing the high achievement disparities, especially among socioeconomically disadvantaged learners.

4. **Learning Environment:** The emotional and physical school environment strongly influences students' engagement. Positive school cultures, where students enjoy good relationships with peers and teachers, are associated with better academics and higher life satisfaction (OECD 2023). Further, modern, interactive classrooms integrating technology are recommended to enhance motivation (Wijaya et al., 2024). Schools' leadership and culture are also important. Principals who foster a caring, inclusive learning environment help students thrive (OECD 2023). Stratified school systems, however, often place disadvantaged students in lower-quality environments that limit the students' opportunities (OECD 2023). Teacher professional development connects to this theme; well-trained teachers create more engaging and supportive classrooms, thus benefiting all students (Wijaya et al., 2024). Therefore, a comprehensive learning environment requires infrastructure, culture, and emotional support to work together to improve performance and narrow achievement gaps.

5. Impact of COVID-19 on Education: The pandemic was a significant issue. Globally, schools were closed (in many cases for more than 3 months), interrupting the learning process, particularly for students who were

already vulnerable (OECD 2024). The poor and disadvantaged students were the worst affected because they could not afford the resources to support remote learning (OECD 2024). Those countries that rapidly enacted safety measures and remained open reduced achievement loss. The distortion highlighted the importance of teachers: systems with high teacher numbers were better positioned to provide support during lockdowns, and teacher availability showed a positive correlation with math performance even during COVID (OECD 2024). However, the crisis led to highly negative scores in math and reading in many countries. Nevertheless, other education systems proved resilient and restored equity and excellence through interventions (e.g., accelerated learning programs) (OECD 2024).

6. Education Policy & Governance: The level of performance is influenced by system-level decisions. In situations where school autonomy is properly managed, it is associated with higher outcomes (OECD 2023). Nevertheless, autonomy is not sufficient, and its advantages are influenced by the general allocation of resources and policy models. Better results are associated with increased investment in education, which is possible in high-income countries (OECD 2023). Hence, fairness is one of the central policy objectives: the provision of equal opportunities irrespective of background is regarded as the antidote to improving average performance. Balancing academic excellence and fairness (e.g., funding formulas, inclusive curricula) is highlighted as a way to overcome global differences in achievement (OECD 2023).

7. Teacher Training: Investing in teacher training enhances student performance. Quality training improves the quality of instruction and better prepares teachers to evaluate students' needs (OECD 2023). Once PISA scores reveal areas of weakness, specific teacher upskilling (such as reading or math instruction) has been frequently implemented (Wijaya et al., 2024). In the context of COVID-19 recovery, the majority of OECD countries increased teacher training to support student well-being and mitigate learning loss (OECD 2024). Interventions (such as social-emotional learning) that are strengthened by teacher training through school-based interventions have also been encouraged. Overall, it is evident that professional development and continuous observation of teaching quality are means of increasing achievement and adapting to new challenges.

8. Student Motivation: Lastly, results reflect not only leaners' academic abilities but also non-academic factors such as student motivation and effort during the test process, which influences a students' test-taking behaviour significantly and hence their results too (OECD 2023). For example, disengaged or unmotivated students may fail to accurately demonstrate their true academic potential. Further, OECD (2023) takes note of the fact that cross-country differences in student motivation and test familiarity exist and must be factored in when interpreting test results. This emphasises the importance of careful interpretation of test results because non-academic factors can affect the quality of the data, leading to misinterpretation of students' capabilities. Therefore, understanding these crucial eternal influences is important for accurately assessing the effectiveness of education policies and systems.

All these themes provide a background for students' performance. Combined, they imply that achievement development is a complex combination of socioeconomic, institutional, family, and individual factors, all of which inform the quantitative analysis that will follow.

Quantitative Findings

Descriptive Statistics (Top/Bottom Countries). The initial ranking of countries was based on students' overall performance (the mean of math, reading, and science scores). The top multinationals are indicated in Table 1 by the top five most performing countries and the bottom five least performing countries, respectively. The top systems are those in East Asia (Singapore, Macao, Japan, Korea, and Hong Kong) with high mean scores in all areas (e.g., the math mean in Singapore ≈573.98). These high performers also show relatively high within-country variance (e.g., the SD of math in Korea = 101.82), suggesting wide ranges of student scores.

Conversely, those in the bottom five (Philippines, Dominican Republic, Uzbekistan, Kosovo, Cambodia) are significantly lower (with a mean of approximately 327-363). For example, Cambodia has a math mean of only 327.41 and a reading mean of 345.81 in the Philippines. They have a smaller standard deviation (e.g., science SD in Cambodia = 45.55) as their level of performance is even lower. This is the problem of equity in the world because it bring sharp contrasts, they provide the dominant countries with better-funded systems and quality education, and the bottom countries with limited resources and socioeconomic hardships.

Table 1. Top 5 and Bottom 5 countries in PISA 2022 by mean scores (Mathematics, Reading, Science, and Overall average). (Data aggregated from the PISA 2022 dataset as described in methods.)

PISA 2022 TOP 5 COUNTRIES									
COUNTRY	RANK	MATHAVERAGE_mean	MATHAVERAGE_sd	READAVERAGE_mean	READAVERAGE_sd	SCIEAVERAGE_mean	SCIEAVERAGE_sd	OVERALAVG_mean	OVERALAVG_sd
SINGAPORE	1	573.98	99.34	542.48	99.15	560.98	93.92	559.15	94.12
MACAO (CHINA)	2	552.05	88.76	510.36	83.09	543.15	82.78	535.19	80.78
JAPAN	3	534.93	90.14	515.08	90.84	546.26	89.23	532.09	87.12
KOREA	4	531.09	101.82	517.98	93.19	531.34	97.02	526.8	92.8
HONG KONG (CHINA)	5	546.03	100.44	504.42	91.24	524.42	86.34	524.96	88.45
	PISA 2022 BOTTOM 5 COUNTRIES								
	RANK	MATHAVERAGE_mean	MATHAVERAGE_sd	READAVERAGE_mean	READAVERAGE_sd	SCIEAVERAGE_mean	SCIEAVERAGE_sd	OVERALAVG_mean	OVERALAVG_sd
PHILLIPINES	76	354.17	60.08	345.81	80.49	355.28	71.48	351.75	68.65
DOMINICAN REPUBLIC	77	339.83	49.25	353.16	77.59	361.73	62.7	351.57	60.34
UZBEKISTAN	78	363.91	61.11	335.69	60.1	355.06	56.37	351.55	55.67
KOSOVO	79	352.41	57.74	338.17	61.25	353.75	60.3	348.11	57.15
CAMBODIA	80	327.41	67.47	321.2	52.55	341.15	45.55	329.92	52.62

Correlation Analysis.

Table 2 gives the Pearson correlation between the overall performance score (OVERALAVG) and the predictors. The correlations were all statistically significant ($p<.001$) because they were based on large samples. The best positive relationship exists between OVERALAVG and Home possessions ($r =.505$), and this shows that students who have more resources in their homes are likely to score better. Socioeconomic status (ESCS index) also correlates positively with performance ($r = .466$). In contrast, Parental involvement has a moderate negative correlation ($r = –.245$), and ICT availability shows only a very weak positive correlation ($r = .038$). These results suggest that material and cultural capital at home are associated with better outcomes, whereas increased parental involvement (as measured by frequency of teacher contact) tends to occur when students struggle, yielding the observed negative link.

Table 2. Pearson correlation coefficients between OVERALAVG and predictor variables.

Predictor	Pearson r with OVERALAVG	P-value
ICT Availability (WLE)	0.038**	<.001
Socioeconomic Status	0.466**	<.001
Home Possessions (WLE)	0.505**	<.001

Parental Involvement (WLE)	–0.245**	<.001

(Note: p<.01 for all coefficients.)

Regression Analysis.

A multiple linear regression was fitted with OVERALAVG as the outcome and the four predictors above. The model was statistically significant overall ($F(4, 63072) = 7036.87$, $p < .001$) and explained about 30.9% of the variance ($R^2 = .309$). The coefficients are summarized in Table 3. Of the predictors, Home possessions had the largest positive effect ($B = 43.641$, $\beta = .468$, $p < .001$). A one-unit increase in the home possessions index is associated with a 43.6-point increase in OVERALAVG (controlling for other factors). Socioeconomic status also had a small but significant positive effect ($B = 4.743$, $\beta = .049$, $p < .001$). In contrast, Parental involvement had a significant negative effect ($B = –15.925$, $\beta = –.170$, $p < .001$). This aligns with the correlation result, implying that higher reported parental involvement often accompanies lower student performance (discussed below). Finally, ICT availability at school was not a significant predictor ($B = –0.164$, $\beta = –.002$, $p = .552$). The Durbin-Watson statistic (~1.61) and collinearity diagnostics (VIFs < 2.5) indicated no major violations of regression assumptions.

Table 3. Multiple regression predicting OVERALAVG from selected factors (N = 63,077).

Predictor	Unstandardized coefficient Beta	Std.Error	Standardized coefficient Beta	P-Value
(Constant)	483.325	0.340		<.001
ICT Availability (WLE)	–0.164	0.276	–.002	.552
Socioeconomic Status (ESCS)	4.743	0.491	.049	<0.001
Home Possessions (WLE)	43.641	0.477	.468	<0.001
Parental Involvement (WLE)	–15.925	0.314	–.170	<0.001

($R = 0.555$, $R^2 = .309$ (Adjusted $R^2 = .309$); $F(4,63072) = 7036.87$, $p < .001$.)

Regression analysis presented in Table 4 indicates that household resources and SES have the greatest predictive power for student performance, with parental involvement showing a significant negative relationship and school ICT having no direct impact on student performance, even after controlling for other variables. These quantitative findings give an organized perspective of RQ, which will be construed within the context in the following section.

4. Discussion and Conclusion

The mixed-methods research design will provide a holistic perspective on the factors linked to poor student achievement in PISA 2022, using both qualitative and quantitative data. The integrated results underscore the importance of socioeconomic and home-related variables in determining student outcomes. In line with previous studies (Liu, 2024), the home possessions index ($r = 0.468$) and the ESCS index ($r = 0.049$) were strong predictors of performance, indicating that the material and cultural resources to which students were exposed strongly determined performance. The qualitative results support this reading by demonstrating how the advantaged households offer stable learning conditions, access to learning resources, and additional support. These findings overlap and reinforce the conclusion that equity in household resources is the key to improving student performance.

One of the significant contributions of this study is that it helps address the seeming contradiction in the parental involvement variable. Although the qualitative analysis repeatedly found that parental engagement was positively associated with student learning, the quantitative findings showed that parental involvement had a negative relationship with performance, which was statistically significant. The mixed-methods approach is useful in overcoming this contradiction. The findings of the qualitative research provide critical contextual clarification, indicating that more parental involvement is likely to be reactive when students have already poor performance and unlikely to be an achievement driver. Therefore, the negative coefficient does not mean that parental involvement is harmful; rather, it indicates underlying academic problems that prompt increased parental involvement. Due to the lack of the qualitative part, this relationship might be assumed to be causal and deceptive. The combination of the two approaches thus adds significant interpretive value, as it elucidates the directionality and meaning of the statistical relationship. This shows the special power of mixed-methods research to reveal subtle relations that cannot be exhaustively understood through a single methodological perspective.

The same trend holds for ICT resources. Although qualitative data reveal the value of technology-enhanced learning spaces and digital pedagogy (Wijaya et al., 2024), the quantitative study shows that the availability of ICT is not a strong predictor of performance when other factors are held constant. The synthesis of the mixed methods helps to understand that the success of ICT lies in its integration in the teaching practice and its underpinning by teacher training and curriculum design. This also highlights the need to interpret statistical results within a broader framework.

Qualitative themes concerning education policy, governance, and learning environments, at the system level, offer further explanation of cross-country performance variation. Well-functioning systems are likely to integrate fair resource allocation with viable governance systems, robust teacher support, and robust responses to disruptions such as the COVID-19 pandemic (OECD, 2023; OECD, 2024). Even though the variables related to the pandemic were not directly included in the regression model, the qualitative data contribute to explaining the performance decreases in countries with worse results, highlighting the significance of systemic resilience and support systems.

In general, the research shows that the mixed-methods approach is not complementary; rather, it is critical to answering the research question. Quantitative analysis establishes the intensity and direction of relationships among variables, whereas qualitative analysis clarifies the mechanisms and realities on the ground that give rise to those relationships. This synthesis is more essential for resolving intricate or even conflicting results, as in the case of parental involvement. The combination of the two methods provides the study with a more precise, nuanced, and policy-relevant understanding of the factors contributing to poor student performance in PISA 2022.

Implications

The results have several policy and practice implications. To begin with, the role of SES and home resources is strong, and their concentration in the richer countries highlights the urgency of equity-based interventions. Interventions like special grants, tutoring services or enrichment learning contents for low-SES students might be used to reduce disparities. The literature reports academic benefits of parental involvement in low-income neighbourhoods (OECD, 2023); therefore, the community initiative to engage families at a young age might be successful. Second, the deterioration in parental-school communication over recent years suggests that these mechanisms need to be reestablished, particularly in underprivileged communities, where they can compensate for systemic disparities (OECD 2023). Third, ICT provision is currently a trend in education policy, but our findings indicate it need not be at the expense of more productive investments in teaching quality and student support. Lastly, cross-national learning is required in the global context. Performing countries, particularly the high ones, tend to integrate high standards with equity. The research suggests that material and emotional learning environments should be taken into account in the international bodies and national governments. For example, teacher training programs are required to focus on inclusive pedagogy (according to themes 4 and 7) so that technology and other resources can be used by every student.

In conclusion, the qualitative and quantitative analyses developed in the current paper provide a nuanced response to RQ: the underperformance of students in PISA 2022 is strongly conditioned by socioeconomic and home factors, and policies at the system level influence the situation. Primarily, this work demonstrates that the concepts of parental support and ICT support should be understood in the context of larger socio-educational processes. Mixed method was used in this research, yielding valuable insights that could not have been obtained with a single approach. This level of understanding is essential for formulating specific reforms to enhance excellence and equity in education.

Declarations

Availability of data and materials:
The PISA 2022 microdata analyzed during this study are publicly available in the OECD repository: https://www.oecd.org/pisa/data/2022database/. The documentary sources used in the qualitative analysis are all publicly cited.

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The author declare that they have no competing interests.

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Author's contributions
The sole author was responsible for all aspects of this work including: conceptualization, methodology, formal analysis, investigation, data curation, writing – original draft, writing – review & editing, and visualization.

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