Journal of Curriculum Studies Research

https://curriculumstudies.org

E-ISSN: 2690-2788

Volume: 8 Issue: 1 2026

pp. 61-82

Exploring Factors Behind Jordanian Students' PISA 2022 Mathematics Decline: A Mixed-Methods Study of Teacher and Supervisor Perspectives

Majed Mahmoud Aljoudeh[a] & Reem Mohammad Elyan[b]

* Corresponding author
Email: majed_jodeh@hotmail.com
a. Department of Education and Psychology, College of Education and Arts, University of Tabuk, Saudi Arabia
b. Department of Scientific Research Ethics, Deanship of Scientific Research and Graduate Studies, Yarmouk University, Irbid, Jordan.

Article Info
Received: August 30, 2025
Accepted: December 10, 2025
Published: January 20, 2026

10.46303/jcsr.2026.4

How to cite
Aljoudeh, M. M., & Elyan, R. M. (2026). Exploring Factors Behind Jordanian Students' PISA 2022 Mathematics Decline: A Mixed-Methods Study of Teacher and Supervisor Perspectives. *Journal of Curriculum Studies Research*, 8(1), 61-82. https://doi.org/10.46303/jcsr.2026.4

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ABSTRACT
The poor performance in international examinations such as the Programme for International Student Assessment (PISA) signals that there are serious issues in educational systems in various countries. Jordan's PISA 2022 math assessment results dropped, placing the issue of detecting the causes of this quality problem and applying educational reforms in the forefront. The project aims to reveal factors that contribute to the decline in the math performance of Jordanian students as viewed by their teachers and supervisors. The study employs a mixed-methods design which includes both quantitative survey data with qualitative responses. The researchers applied descriptive statistics along with inferential tests to the quantitative data and thematic analysis to the open-ended responses. The results of the study showed that the COVID-19 pandemic was the most significant factor among all, and it was followed by parental disengagement with students, low student motivation, curricular limitations, teacher workload pressures, and online learning disruptions. The used research instrument was statistically validated. Consequently, the study's outcomes provide a practical roadmap for educational policymakers to improve learning outcomes to the level of world standards. The results can be interpreted as possible ways for the policymakers to take steps to raise the educational quality and keep it at par with international standards. The research indicates that the areas of teacher training, parent involvement, and curriculum development need to be seriously addressed in order to raise student performance in international tests.

KEYWORDS
PISA; mathematics achievement; educational performance decline; teacher and supervisor perspectives; international large-scale assessment.

INTRODUCTION

International evaluations such as the PISA (Programme for International Student Assessment) carried out by the OECD offer significant points of reference in the context of educational comparisons in terms of their quality. The main purpose of PISA is to assess the basic skills of the 15-year-olds in reading, science, and math thus providing a basis for monitoring performance trends and evaluating the effectiveness of policy measures (OECD, 2019; OECD, 2023), among others Since 2006, Jordan has been a participant in the PISA, taking the opportunity given by the results to assess its national educational system. However, Jordanian pupils are no exception to the rule of being below the international average. The sudden decline of 2022 PISA math scores have heightened the need to uncover the root cause of this systemic problem.

Earlier studies have pointed out the variables that influence mathematics performance, such as the quality of teaching, students' motivation, and the involvement of parents. On the contrary, the majority of the studies have mainly employed large-scale quantitative analyses that do not represent local and contextualized perspectives from the teachers. Therefore, considering the specific challenges of Jordan, it is essential to conduct a study that reflects the views of practitioners. Through the application of Bronfenbrenner's Ecological Systems Theory, the research breaks down the complex micro, meso, and macro influences on mathematics learning, illustrating how teachers' practices, family settings, and government regulations together determine the success of students.

Problem Statement and Main Aim

Jordan’s performance in the 2022 PISA mathematics assessment has reached its lowest level, highlighting the need for a deeper examination of the underlying causes from the perspectives of teachers and supervisors. It is very important to know these issues in order to set the right national policies and to train the students properly for the international assessments that will be their future.

Research Questions

1. Which factors contributed to the decline in the mathematics performance of Jordanian students in the 2022 PISA cycle, based on the perceptions of mathematics teachers and supervisors?
2. What improvement strategies do teachers and supervisors propose to enhance students’ performance in future PISA assessments?

Literature Review and Theoretical Framework

Worldwide large-scale educational evaluations, particularly the Program for International Student Assessment (PISA), have a profound impact on the educational policy discourse worldwide because they allow for comparative studies of student success in the main areas of mathematics, science, and reading (OECD, 2023). The voluminous literature of the last 20 years has already pointed out numerous factors affecting students' performance in mathematics across different levels: personal, classroom, and even system-wide (Wang et al., 2023; Rozas et

al., 2022). However, the existing gaps in student performance indicate the need to investigate more deeply vital instructional, systemic, and contextual factors that have been barely considered, especially in the aftermath of the pandemics.

Jordan's PISA Performance Trends (2006–2022)

Figure 1.

Average Scores of Jordanian Students in the PISA Mathematics Assessments (2006–2022)

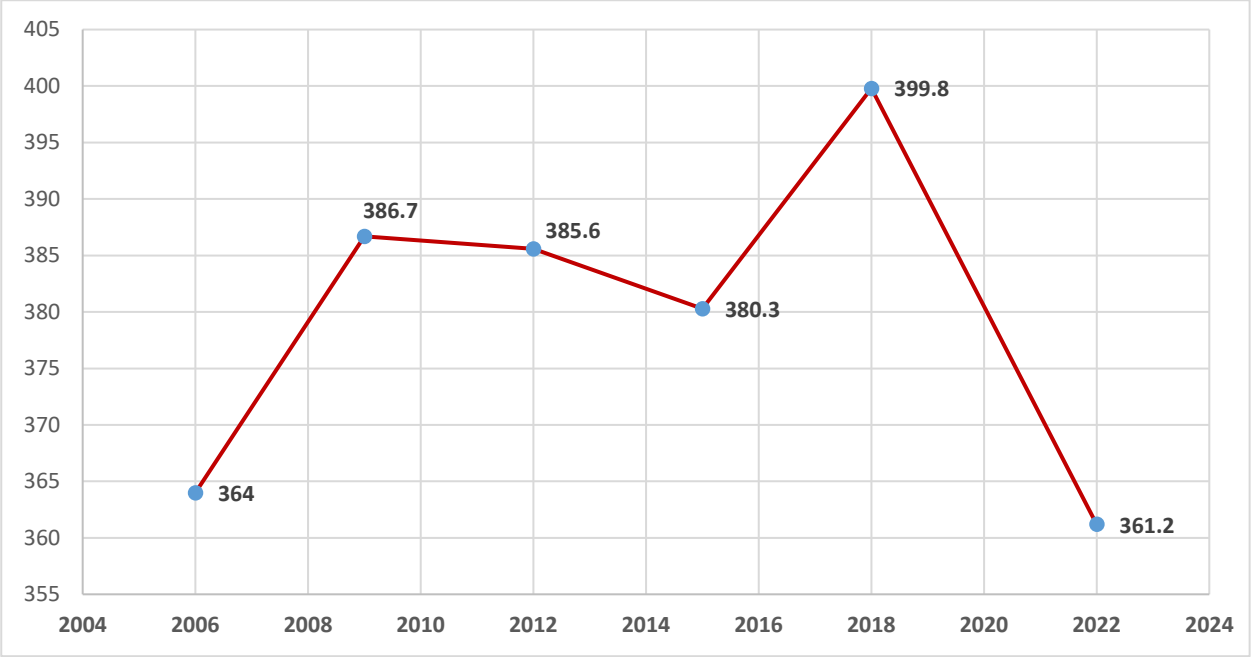
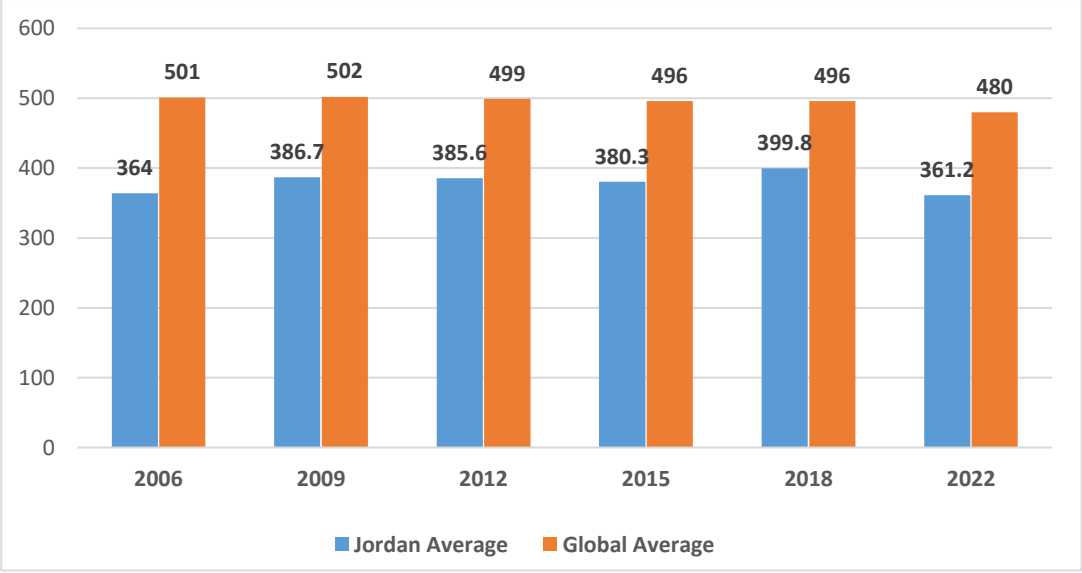


Figure 2.

Jordan's Average PISA Mathematics Scores Compared to the Overall Average of Participating Countries (2006–2022)



By putting these figures into context, they facilitate the comprehension of the variations in Jordan's mathematics performance, such as the remarkable advancements in some periods and the considerable drop recognized in PISA 2022.

Student-Level Factors

In the literature, it has always been that the three major factors which have made a positive impact on the learning of mathematics are socio-economic status (SES), motivation, and past academic performance. The systematic review by Wang et al. published in 2023 places SES as an indicator that is very strong and is common across various contexts, therefore, it confirms the close relationship between family resources, parental education, and home learning conditions with the educational accomplishments of children (Alanati & Abu-Ghalyoun, 2025). Besides, Ma et al. (2021) confirm that factors related to motivation like math self-efficacy and internal enjoyment play a big role in determining performance. Nevertheless, too much emphasis on factors at the student level might hide the more significant systemic factors such as teaching methods and policies that greatly influence and mediate student performance thus pointing out the need for more comprehensive analyses very clearly.

Instructional and Curriculum Dynamics

The quality of instruction, the curricular alignment, and the integration of technology all play an important role in student outcomes in mathematics. In the post-pandemic period, emerging research increasingly focuses on identifying which instructional approaches, such as inquiry-based or teacher-directed methods, are most effective in supporting students' mathematical learning. While Teig et al. (2022) showed inquiry-based learning as effective in developing depth of knowledge and stimulation of critical thinking skills in students, there is ongoing evidence (i.e. Wijaya et al., 2024) demonstrating that teacher-directed instruction is useful during the recovery phases of the pandemic due to structured instruction, balance of instruction remains a topic of discussion (Begimbetova et al., 2025).

In the same way, implementing technology in mathematics seems to bring both opportunities and challenges. The more recent evidence by Odell et al. (2020) confirms that while using technology, student achievement in mathematics was impacted more positively because they could experience interactive, differentiated learning. On the other hand, Navarro-Martínez and Peña-Acuña (2022) point out the potential for technology to distract students from learning when the use is inappropriate or indiscriminate. This suggests technology is useful to learning when implemented thoughtfully and with pedagogical support - a debate, again, that exists in some of the literature.

System-Level Factors and Equity

Factors at the system level like policy and resource difficulties, as well as crises such as the COVID-19 pandemic, have been designated as significant explanation factors in students' mathematics performance. According to recent research, the COVID-19 pandemic has not only affected but actually has been the main reason for the already existing global inequalities being more pronounced within the educational sector (OECD, 2023). Moreover, the authors Wijaya et

al. (2024) and Rozas et al. (2022) along with others revealed that the disruptions caused by the pandemic left the at-risk students without the necessary support and that the less privileged groups suffered even more thus raising the question of educational inequalities (Ajani et al., 2025).

On top of that, the macro-level studies have not taken into account the qualitative aspects that are essential and involved in the policy's implementation through the workshops that permit very much needed, intentional detours from the textbooks and policies that made a considerable gap between the funding for educational policies and the teachers' final methods of teaching. This indicates a demand for qualitative investigations to gain a clearer picture of how teachers interpret Systematic Expectations and Policies in relation to available resources.

Methodological Limitations and Justification

One of the main limitations, observed multiple times in the literature, is the prevalence of quantitative research designs, especially regression analysis and structural equation modeling. These methods are effective in revealing connections among large data sets but they also frequently miss the complex, actual experiences of the educators and the learners, particularly regarding the ways in which the systemic demands or curriculum changes are reflected in everyday practice (Wijaya et al., 2024; Ngwenya, 2025). On the other hand, the researchers have been supporting the integration of different methodologies that would pair the quantitative methods' wide reach with qualitative methods' in-depth exploration (Darling-Hammond et al., 2021). The mixed-methods designs provide this complementarity: the statistical patterns indicate the general trends, meanwhile the qualitative insights shed light on the contextual meaning and the perspectives of the practitioners. To illustrate, while the quantitative analyses may show the connection between resources and performance, qualitative findings may uncover the impacts of teacher workload, pedagogical creativity, and student engagement on the performance of these relationships. Consequently, the authors of the current research adopt a convergent mixed-methods design to triangulate the survey data with the open-ended responses so that the findings are both generalizable and contextually grounded.

Geographic and Contextual Gap

One of the major gaps in the literature regarding mathematics performance in international assessments is a strong focus on high-performing and Western contexts without paying much attention to underperforming systems, especially in the Arab world (Kaur et al., 2019). The majority of the research done so far has basically ignored the socio-cultural, economic and institutional conditions that influence educational experiences and outcomes thus exacerbating the global discourse on equity. The Jordanian educational system thus presents an excellent opportunity to rectify this situation by revealing how education policies, cultural norms, and resource distribution interact to determine student performance. The experiences of Jordan can add value to the comparative data and also help in making a more inclusive global discussion on educational equity and reform.

Bronfenbrenner's Ecological Systems Theory

Bronfenbrenner's Ecological Systems Theory (1979) gives a detailed map to understanding how students' learning and development are influenced by different systems that are not only layered but also interact. The microsystem (e.g., classroom interactions between teachers and students), the mesosystem (e.g., connections between home and school), the exosystem (e.g., district- or institution-level policies), and the macrosystem (e.g., national educational reforms, socio-cultural norms, and global expectations) together illustrate how multiple environmental layers shape students' learning and development.

Even though the framework has a high explanatory power, it has been little used in research on mathematics performance and also in international assessments such as PISA conducted on a large scale. The majority of the literature categorically neglects the broader ecological model and cites only a few isolated factors, either individual student characteristics or reforms of the educational system. Consequently, the literature fails most of the time to depict the processes through which systemic expectations, curriculum rigidity, or policy pressures get to the teachers and then to the students in terms of their learning outcomes.

The application of Bronfenbrenner's theory in this research provides an opportunity to have a better understanding of the mathematics performance of the Jordanian students. The interaction of factors at three different levels, namely, macro-level disruptions (e.g., COVID-19 school closures and policy responses), meso-level institutional structures (e.g., curriculum and resource allocation), and micro-level classroom practices (e.g., teaching strategies, motivation, and assessment), is thoroughly analyzed in the research which gives a very detailed picture of the factors affecting educational outcomes. The ecological perspective reacts to the interaction between systemic, institutional, and classroom processes and presents a consolidating theoretical framework for the explanation of the 2022 PISA mathematics decline.

To overcome the methodological, contextual, and theoretical gaps, the research simultaneously looks into the perceptions of mathematics teachers and supervisors in Jordan. It employs Bronfenbrenner's Ecological Systems Theory to investigate how macro-level policies, meso-level institutional structures, and micro-level classroom practices interact and impact student achievements. The ecological perspective not only emphasizes the importance of analyzing Jordan's PISA performance decline in relation to the changing systemic dynamics that rule teaching and learning but also makes it a priority.

METHODOLOGY AND PROCEDURES

Research Design

The study, which was aimed at finding out the reasons behind the drop of the Jordanian students' PISA math scores involved the application of a mixed-methods approach comprising both qualitative and quantitative research methods. The quantitative research consisted of a structured questionnaire, and the collected data was analyzed by means of descriptive statistics, one-sample t-tests, and ANOVA to reveal the major factors with statistically significant patterns.

The qualitative research comprised two open-ended questions for the teachers, and the educators' answers were coded thematically as per Braun and Clarke's (2006) framework to draw interpretative insights and provide contextual explanations. The data from both strands were collected at the same time, analyzed separately and then integrated to make sure that they complemented each other and that triangulation was achieved.

Participants

The mathematics teachers and supervisors from 12 educational directorates across Jordan were the target population. These represented public and private, urban and rural schools. The requirement of having at least three years of secondary-level mathematics teaching or supervision experience was imposed on the participants to make sure they were acquainted with the systemic factors.

A random sampling approach was employed in a simple manner, which was based on the records from the Ministry of Education. This method guarantees that every eligible participant has the same chance of being selected, which is in accordance with the quoted sampling procedures we confirmed by Cochran (1991). Although recruitment was enhanced through social media outreach expanding geographic diversity it may have introduced voluntary response bias.

Table 1.

Distribution of Participants by Demographic Variables

Variable	Category	Frequency	Percentage (%)
Gender	Male	101	47.9%
	Female	110	52.1%
	Total	211	100%
Occupation	Teacher	187	88.6%
	Educational Mathematics Supervisor	24	11.4%
	Total	211	100%
Qualification	Bachelor's Degree	81	38.4%
	Higher Diploma	70	33.2%
	Master's Degree	44	20.9%
	Doctorate	16	7.6%
	Total	211	100%
Experience	Less than 5 years	46	21.8%
	5 to less than 10 years	49	23.2%
	10 years or more	116	55.0%
	Total	211	100%

Data Tools

The instrument included five Likert-scale domains derived from literature, which reflected the effects caused by COVID-19 in the following aspects: curriculum, students, teachers, and parents. Besides, there were two open-ended questions that investigated further causes and

solutions. The pilot study involving 18 teachers resulted in slight changes in the items and elimination of one item with low consistency.

The survey was conducted through Google Forms, starting from May 3rd and ending on May 24th, 2024. Ethical clearance was granted by the Research Ethics Committee of Yarmouk University. The researchers provided informed consent, the subjects were free to participate or not, and the information was made untraceable and encrypted.

Instrument Reliability and Validity

Internal consistency was verified among the different areas by means of the Cronbach's Alpha method which showed results in the range of 0.71 to 0.87, as indicated in Table 2.

Table 2.

Cronbach's Alpha Coefficients for the Main Dimensions of the Questionnaire

Dimension	Cronbach's Alpha
COVID-19 Pandemic and Shift to Online Learning	0.71
Curriculum and Educational System	0.85
Student-Related Factors	0.75
Teacher-Related Factors	0.87
Parent-Related Factors	0.76

Construct validity was assessed via item-total correlations (Table 3, see appendix). While most items showed strong correlations, one COVID-19 pressure item (.320) was retained for contextual value.

Data Analysis

Descriptive statistics, one-sample t-tests, and ANOVA were the methods used for the quantitative data analysis. The qualitative responses were thematically coded in accordance with Braun and Clarke's (2006) framework. Manual coding was confirmed through intercoder reliability checks yielding a coefficient of 0.87. The comparison of results was done through a side-by-side approach and the interpretation was done collectively so as to produce systemic-level inferences.

Theoretical and Ethical Alignment

Theoretical framework of Bronfenbrenner's Ecological Systems Theory aided interpretation in terms of microsystem (teacher/student), mesosystem (home-school), exosystem (school governance), and macrosystem (policy context). Ethical practices not only followed international standards but also guaranteed the safety of the participants during the whole process.

RESULTS AND DISCUSSION

In order to uncover the reasons behind the drop in Jordanian students' performance in the 2022 PISA mathematics assessment, the teachers and supervisors who were part of the study sample gave their answers which were analyzed by determining the means and standard deviations for each questionnaire item, and then the overall mean for the corresponding dimension. Table 4

gives the means and standard deviations for the key dimensions of the questionnaire that are ordered from the highest to the lowest based on the participants' answers, and it also includes the results of the one-sample t-test that evaluated the significance of these means with respect to the midpoint of the five-point Likert scale.

Table 4.

Means, Standard Deviations, and One-Sample t-Test Results for the Main Dimensions of the Questionnaire

Dimension	Mean	Std. Deviation	t	Sig.
COVID-19 Pandemic and Shift to Online Learning	4.04	0.63	14.66	< .001
Parent-Related Factors	3.98	0.61	13.80	< .001
Student-Related Factors	3.90	0.54	13.36	< .001
Curriculum and Educational System	3.80	0.63	9.22	< .001
Teacher-Related Factors	3.50	0.67	2.19	.030

According to Table 4, the interpretation of the drop in Jordanian students' performance in the 2022 PISA math test is based on factors supported by previous research and theoretical literature which are all statistically significant. The most prominent cause of the drop in performance was the COVID-19 pandemic together with the transition to online learning, while teacher-related factors were considered as the least important. The standard deviation numbers are relatively small and close to each other, which denotes that the study sample had a very high degree of agreement with their responses, and the variations of coefficients were below 20% for all dimensions.

Table 5.

Means, Standard Deviations, and One-Sample t-Test Results for Items Related to the COVID-19 and Online Learning Dimension

Item	Mean	Std. Deviation	t	Sig.
Infrastructure issues (lack of devices and internet access)	4.34	0.88	15.44	< .001
Rapid transition to remote learning	4.11	1.06	9.80	< .001
Loss of instructional time and educational activities	4.08	0.93	10.63	< .001
School closures during the pandemic	4.06	1.10	8.65	< .001
Loss of social interaction between students and teachers	4.06	0.99	9.70	< .001
Health challenges and psychological stress	3.58	0.97	2.74	.007

To make clearer the influence of each factor, the means and statistical significance of the individual items belonging to each dimension were examined. The results of the highest-rated

dimension, which consists of the COVID-19 pandemic and shift to online learning, are depicted in Table 5.

As illustrated in Table 5, infrastructure challenges, particularly the lack of devices and limited internet connectivity, were identified as the most significant pandemic-related causes for the decline in students' mathematics performance in PISA 2022. Conversely, health-related challenges and psychological stress were perceived as the least impactful among the items in this dimension.

Table 6 provides the means and standard deviations for items under the second most important dimension, which pertains to parent-related factors, along with the corresponding t-test results.

Table 6.

Arithmetic Means, Standard Deviations, and One-Sample t-Test Results for Items in the Second Most Influential Dimension: Parent-Related Factors

Item	Mean	Std. Deviation	t	Sig.
Weak parental monitoring of their children's academic progress	4.50	0.70	22.79	< .001
Limited parental knowledge of the international PISA assessment	4.15	0.84	12.96	< .001
Challenges related to the suitability of the home learning environment	3.97	0.81	10.25	< .001
Insufficient academic and emotional support from the family	3.88	0.91	7.68	< .001
Difficulty in communication between parents and the school	3.80	0.99	5.81	< .001
Disparity in parents' educational levels and its impact on supporting students academically	3.58	1.10	2.35	.020

Table 7.

Arithmetic Means, Standard Deviations, and One-Sample t-Test Results for Student-Related Factors

Item	Mean	Std. Deviation	t	Sig.
Lack of student awareness of the significance of PISA results for their country	4.44	0.76	19.92	< .001
Inadequate academic preparedness and prior achievement	4.29	0.73	17.74	< .001
Negative attitudes and low motivation toward learning mathematics	4.27	0.70	18.00	< .001
Weak academic skills (such as planning and organization)	4.20	0.77	15.13	< .001
Negative self-perception (low self-esteem)	3.77	0.80	6.70	< .001

Student's economic circumstances	3.45	1.06	0.75	.452
Student's social circumstances	3.43	1.05	0.43	.666
Limited exposure to technology	3.33	1.22	-0.81	.419

The results in Table 6 show that, from the perspective of teachers and supervisors, the most prominent parental factor contributing to the decline in Jordanian students' performance in the 2022 PISA mathematics assessment is the weak follow-up by parents. On the other hand, variation in parental educational levels was perceived as the least influential factor within this domain.

Table 7 reveals that the most influential student-related factor was students' lack of understanding of the national relevance of their PISA results, while economic conditions, social background, and limited exposure to technology were rated with comparatively less agreement by the respondents.

Table 8.

Arithmetic Means, Standard Deviations, and One-Sample t-Test Results for Curriculum and Educational System-Related Factors

Item	**Mean**	**Std. Deviation**	**t**	**Sig.**
Challenges in remote and underdeveloped areas	4.31	0.84	15.72	< .001
Disparities in the educational infrastructure between schools	4.26	0.82	15.11	< .001
Challenges in creating a supportive teaching and learning environment	4.14	0.75	14.40	< .001
Inadequate access to technology-based learning resources	3.91	0.90	8.20	< .001
Evaluation strategies do not align with the cognitive levels required by the PISA assessment	3.66	0.89	4.32	< .001
Enrichment and instructional activities in the curriculum fall short of PISA standards	3.56	1.03	2.24	.030
Shortage of qualified teachers and professional staff	3.54	1.08	1.82	.070
Teaching strategies do not promote the higher-order thinking demanded by PISA	3.47	0.93	1.15	.250
Weakness in teacher training and professional development programs	3.36	1.12	-0.52	.610

From Table 8, it is evident that geographic and infrastructural inequalities, particularly in remote areas and school resources, were perceived as the most critical systemic challenges. Conversely, items related to teacher training and pedagogy were seen as less impactful suggesting that teachers may feel adequately supported in these aspects.

Table 9 demonstrates that the teachers' workload burden of balancing instruction with administrative duties was the main obstacle to sufficient student preparation for the PISA exam. In contrast to this, the teachers' proficiency, in both mathematics content and pedagogical techniques, was assessed at a level lower than the average, indicating that these factors were

considered by the responders to be less problematic or even already managed through continuous training efforts that might still be taking place.

Table 9.

Arithmetic Means, Standard Deviations, and One-Sample t-Test Results for Teacher-Related Factors

Item	Mean	Std. Deviation	t	Sig.
Heavy instructional and administrative workload impeding PISA preparation	4.34	0.88	15.53	< .001
Lack of awareness-raising programs for parents on the importance of the PISA assessment	3.83	0.85	7.34	< .001
Teachers' insufficient familiarity with international assessments such as PISA	3.64	0.98	3.64	< .001
Lack of training sessions for students to prepare them for the PISA mathematics test	3.64	0.89	3.75	< .001
Teachers focusing on lower cognitive levels in student assessment practices	3.64	0.98	1.72	.086
Teachers' resistance to modifying instructional and assessment strategies	3.64	0.98	0.95	.341
Absence of remedial programs for students based on PISA performance outcomes	3.64	1.00	0.73	.467
Teachers' limited engagement with technology and digital transformation	3.64	1.05	-0.75	.456
Weak instructional competencies in pedagogical methods	3.00	1.08	-5.32	< .001
Weak content mastery in mathematics among teachers	2.78	1.06	-8.47	< .001

Summary of Key Findings from Participant Responses

The main findings of the present study with primary school teachers and supervisors presented to the study can be summarized.

1. COVID-19 Pandemic and Online Learning Transition: This was pointed out as the main factor leading to the decline of Jordanian students' performance in the 2022 PISA mathematics assessment. Particularly, in this area, infrastructure-related problems, like the absence of devices and internet connections, were identified as the major issues.
2. Factors Related to Parents: The lack of parental supervision and involvement became the most important reason for students' poor academic performance in the PISA 2022 mathematics test.
3. Factors Related to Students: The students' lack of knowledge regarding the significance of the PISA results for their country was pointed out as the main problem by the sample.

4. Curriculum and Educational System: Teachers and supervisors particularly pointed out the difficulties they encountered in remote and underserved areas as being the most critical problems within this aspect.

5. Factors Related to Teachers: The heavy teaching and administrative responsibilities were mentioned as the most important factor that restricts teachers' capability of properly preparing students for assessments such as PISA.

These results mainly agree with previous research dealing with the drop in student performance in international assessments, especially the studies that emphasize the COVID-19 pandemic and its educational challenges as the main reasons (Wang et al., 2023; Wijaya et al., 2024; Casinillo, 2019; Mbugua et al., 2012; Mabena et al., 2021).

Additional Causes Identified by Participants

The analysis of the open-ended responses of teachers and supervisors in each dimension where they were asked to suggest additional causes resulted in the emergence of the following classifications, which are displayed in Table 10 (see appendix):

The most frequently cited additional causes were parental disengagement, student distraction and discipline issues, and curriculum overload, closely aligning with quantitative findings and reinforcing the multi-layered pressures identified through Bronfenbrenner's ecological systems framework.

Suggested Improvement Plans by Teachers and Supervisors

The participants also proposed a series of recommendations and improvement plans to address the factors underlying students' low performance in the PISA mathematics test. These suggestions were analyzed and categorized by domain, as shown in Table 11 (see appendix).

The results indicate a strong agreement between the participants' perceptions and the international research. The conclusion that the pandemic COVID-19 and online learning interruptions had the most significant impact is in line with worldwide proof that learning difficulties and inequities with regard to digital access were severe during this period (OECD, 2023; Wijaya et al., 2024). Likewise, the recognition of parents' disengagement corresponds with the research of Rozas et al. (2022) and Mbugua et al. (2012) thus underscoring the importance of home learning environments in mathematics achievement deduction.

The issue of student demotivation and unawareness of PISA was found to be at the same level as the self-efficacy and value perception mentioned by Ma et al. (2021) as the main factors influencing performance. Moreover, the problems of overloaded curriculum and weak PISA cognitive demand matching were also pointed out by Teig et al. (2022), who suggested that high-level math performance requires inquiry- and literacy-oriented instruction.

The theory put forward by Bronfenbrenner (1979) concerning ecological systems can help us definitely and completely comprehend these findings, as it indicates that learning results are influenced by the interactions of different systems on micro, meso, exo, and macro levels.

The Covid-19 crisis was a disruption of the macro system that affected the exo system through government policies of school closures and limitations in digital infrastructure, then it

moved on to the meso system with the collusion of home and school being weakened, and eventually to the micro system with the teacher-student interaction being disrupted. This systemic view of the situation accounts for the fact that the teachers in the research project talked about parental disengagement, decreased student motivation, and weakened routine discipline being the main factors of the downward trend of math achievement with such consistency.

The findings of the research are in agreement with the new proof about the mathematical literacy issues in post-COVID-19 settings. Harisman et al. (2023) indicated that pupils sometimes had difficulties with the PISA-like mathematical literacy tasks which demanded understanding, visualizing, and logical thinking, this corresponds with the opinions of the Jordanian teachers who complained about the lack of students' problem-solving skills. Likewise, Dewantara et al. (2023) proved that numeracy materials based on real-life situations considerably draw students' interest in mathematics which is in line with this study's outcome that the examples in the curriculum often do not correspond to the life of the students.

Additionally, worldwide teaching models throw light on the possible improvement paths. In countries like Singapore, the lesson study has been shown to increase the teachers' collaboration, the reflection on the teaching methods and the students' conceptual understanding (Fang et al., 2009). The lack of such systematic collaboration in Jordan together with the teachers' heavy administrative loads, which were pointed out in the present study, account for the limited time that is left for PISA-level problem-solving, innovation and differentiation to take place. On the other hand, research by Supianti et al. (2022) indicates that learning resources based on mathematics literacy when well-structured can ease the difficulty of understanding, which implies the necessity of digital resources beyond the emergency period of the pandemic.

Interestingly, the competencies of teachers were not considered to be of great importance in the decline of performance. This is contrary to the findings of Casinillo (2019) and Mabena et al. (2021), who pointed out that teacher quality was a main factor. Nevertheless, the qualitative evidence indicates that the problems of teachers are more connected with their heavy workload, lack of time for preparation and the limitations of the education system than with their poor mastery of the subject matter or teaching methods. In this way, the influence at the exosystem level as described by Bronfenbrenner is reflected, where attitudes of the structure determine the effectiveness of practice in the classroom rather than the skill of the teacher.

In addition to the school settings, international comparisons prove to be useful to place Jordan's results in a proper perspective. For instance, the subpar performance of Malaysia in PISA has been explained with reasons such as social and economic inequality, mismatch of curriculum, and variation in teaching (Perera & Asadullah, 2019)—all these factors were also related to the comments made by teachers in Jordan. Moreover, it was shown by Sälzer and Heine (2016) that the behavior of students during the test, for instance, not answering some

questions or being inactive during the timed assessment, made the PISA scores go down considerably. Such behaviors were also pointed out in the qualitative results of this study, where the teachers remarked that the kids' lack of attention, behavioral issues, and low tolerance had increased since the pandemic.

On the international policy front, the OECD (2020) and IEA (Rocher & Hastedt, 2020) have pointed out that with uneven resource distribution and lack of assessment literacy, systems will not be able to cope with international assessments. The very large differences between urban and remote areas in Jordan, both statistically and descriptively, indicate those structural limitations. Moreover, psychometric considerations support these doubts; Elyan (2021) showed that differential item functioning arises when groups of students are unequal in terms of learning opportunities and assessment conditions, which means that Jordan's systemic inequities could also be reflected in the PISA performance patterns statistically.

The investigation results have a number of practical implications for educational planning. Digital infrastructure and crisis preparedness mechanisms have to be strengthened in the first place, as they are vital for the future resilience of the system against disruptions. In addition, awareness campaigns directed at parents that would increase their involvement, could lead to better home-school collaboration and thus they would be supportive of the children's learning in mathematics. The main aspects in the curriculum redesign should be clarity, alignment with PISA cognitive levels, and reduced overload so that there will be time for deeper engagement with mathematical reasoning. Lastly, on one hand, reducing teachers' administrative tasks and on the other hand, giving them training according to PISA standards specifically, may create a condition that is very conducive to international assessments at the classroom level.

CONCLUSION

Through the integration of the views of mathematics teachers and supervisors from the different levels of the educational system, the study was able to identify the main reasons for the decline in the performance of the Jordanian students in the 2022 PISA mathematics assessment. The results point to a mixture of interrelated factors, which include, among others, the systemic impact of the COVID-19 pandemic, lack of parental involvement, and student discouragement. All these factors together formed a barrier to students' achievement. On the other hand, teacher-related competencies were viewed as less important, indicating that the development of educators might not be the main bottleneck in the PISA performance outcomes.

Firmly based on Bronfenbrenner's Ecological Systems Theory, the research highlights the manner in which education results are influenced by the continuous interactions occurring over various systemic layers. At the macro-level, disruptions such as school closures and inequality in the availability of educational facilities, at the meso-level family-school partnerships being weak and micro-level problems such as students reduced intrinsic motivation were together responsible for the learning environment during and after the pandemic. The findings add to

the already existing global evidence that during educational crises the structural inequalities are not only revealed but also intensified, particularly in the case of developing countries like Jordan.

Though employing various methods with their inherent strengths, such as a representative national sample and mixed-methods triangulation, this research is limited by its exclusive use of teacher perceptions and no direct student-level data. It might be that the generalizability of results will be undermined by the self-reporting bias and the absence of any performance-based measures. Such a scenario will necessitate future studies to be multi-perspective in their data acquisition, which should include not only the student and parental perspectives but also the institutional metrics to authenticate and broaden the implications of these conclusions.

Stakeholders in the education sector in Jordan, based on these findings, should mainly consider the planning of resilience in the system, particularly in digital learning infrastructure and the state of crisis preparedness. Moreover, the parents' participation should be pursued through awareness programs and students' knowledge of the reasons and significance of the international assessments should be strengthened. Long-term studies and regression-based modeling are suggested to explore further the causal relationships between system variables and learning outcomes, informing eventually the policy reforms that will make educational equity and PISA readiness.

Recommendations

To enhance Jordanian students' performance in the subsequent PISA assessments, the current research proposes a group of interrelated actions, which are based on Bronfenbrenner's Ecological Systems Theory. The first intervention is providing teachers the skill to implement higher-order thinking with ease through economical, professional training that focuses on inquiry-based learning and real-world problem-solving. The content of the curriculum should be changed to better demonstrate real-life situations and to be PISA compatible so that it will be relevant in all grades. Parental involvement is to be strengthened through campaigns that create awareness and partnerships with the community, particularly in areas that are poor, to ensure that home learning environments are improved. The technology's role elicited mixed reactions; however, the testing of adaptive learning tools along with sufficient training and appraisal could assist in reducing educational inequalities in the digital sphere. The interventions should, however, be accompanied by transparent monitoring systems to measure the progress made and the impact created. These recommendations in combination are aimed at building a support system of resilience, quality instruction, and student engagement in an education landscape that is globally competitive.

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APPENDIXES

Table 3.

Correlation Coefficients Between Questionnaire Items and Their Respective Dimensions

Dimension	Item	Correlation Coefficient
COVID-19 and Shift to Online Learning	School closures during the pandemic	.693**
	Rapid transition to online learning	.705**
	Infrastructure issues (lack of devices, internet access)	.698**
	Loss of instructional time and learning activities	.688**
	Loss of social interaction between students and teachers	.730**
	Health and psychological pressure challenges	.320**
Curriculum and Educational System	Instructional and enrichment activities fall short of PISA standards	.619**
	Teaching strategies do not foster PISA-level thinking	.671**
	Inadequate availability of technology-based learning resources	.676**
	Assessment strategies fall short of PISA requirements	.753**

	Insufficient teacher training and qualification	.653**
	Disparities in school resources	.702**
	Challenges in remote areas	.746**
	Lack of a supportive learning environment	.677**
	Shortage of qualified teachers and staff	.650**
Student-Related Factors	Lack of academic readiness and prior achievement	.431**
	Negative attitudes and low motivation toward mathematics	.454**
	Student's economic conditions	.654**
	Student's social conditions	.724**
	Low self-perception/self-esteem	.688**
	Limited exposure to technology	.701**
	Weak study skills (planning and organization)	.593**
	Lack of awareness of PISA's national importance	.503**
Teacher-Related Factors	Weak content knowledge in mathematics	.689**
	Ineffective teaching methods	.748**
	Heavy teaching load and administrative duties limit preparation time for PISA	.369**
	Insufficient familiarity with international assessments like PISA	.794**
	Emphasis on lower cognitive levels in student assessment	.740**
	Resistance to change in instructional and assessment strategies	.687**
	Lack of remedial programs based on PISA outcomes	.719**
	No training programs to prepare students for the PISA exam	.738**
	Lack of awareness programs for parents about the importance of PISA	.565**
	Limited teacher adaptation to technology and digital transformation	.740**
Parent-Related Factors	Weak parental follow-up on student progress	.571**
	Communication difficulties between parents and schools	.650**
	Inadequate academic and emotional family support	.763**
	Poor parental awareness of the PISA assessment	.670**
	Home learning environment challenges	.784**
	Variation in parental education levels and ability to assist in learning	.655**

Note: Correlation is significant at the 0.01 level (2-tailed).

Table 10.

Categorization of Additional Causes Suggested by Teachers and Supervisors

Domain	Additional Causes Identified	Frequency (n)	Illustrative Quotes from Participants
Pandemic & Online Learning	Lack of teacher experience with online instruction	34	"Most teachers were not trained to teach online, so lessons became passive and ineffective."
	Reliance on online resources for exams	21	"Students copied from the internet instead of solving problems."
	Weak attendance enforcement	18	"Attendance rules were not enforced, so many students did not attend regularly."
	Parental neglect of online learning	16	"Parents treated online learning as optional."
	Student overuse of devices	11	"Phones were used more for games than learning."
Curriculum & System	Curriculum overload	29	"The math content is too dense for the time available."
	Curriculum difficulty exceeds proficiency	24	"Students struggle because the content level is higher than their abilities."
	Memorization culture	22	"Students memorize steps instead of understanding concepts."
	Misalignment with student realities	17	"Examples do not reflect students' daily lives."
Student Factors	Distraction and reduced discipline	31	"Students lost focus and discipline after COVID-19."
	Inequity in opportunities	23	"Students in remote areas have fewer resources to learn."
	Lack of intrinsic motivation	19	"They see no value in mathematics."
	Weak communication skills	10	"Students cannot express their reasoning clearly."
Teacher Factors	Lack of experience dealing with post-pandemic learners	14	"Students returned with emotional and academic gaps."
	Lack of psychological support for teachers	9	"Teachers are under pressure without support."
Parent Factors	Parental disengagement	38	"Parents do not follow up at all."
	Low parental awareness of importance of education	27	"Some parents do not prioritize academic achievement."

Table 11.

Improvement Plans Proposed by Teachers and Supervisors to Address the Decline in Jordanian Students' PISA Mathematics Performance

Domain	Suggested Improvement	Frequency (n)	Illustrative Quotes
Teachers	More professional development in PISA-style pedagogy	42	"Teachers need training on higher-order thinking questions."
	Reduced workload	36	"Administrative tasks leave no time for quality preparation."
	Strengthening digital competencies	28	"Teachers must be digitally fluent to teach effectively."
	Assigning a PISA-preparation teacher	17	"One teacher should specialize in PISA readiness."
Curriculum/System	Update curriculum and reduce overload	39	"The curriculum needs streamlining to match instructional time."
	Integrate PISA-type questions	33	"Students must practice PISA-style problem solving."
	Improve school infrastructure	22	"Digital resources are insufficient in many schools."
Students	Motivation programs	30	"Students should understand why PISA matters."
	Mock PISA assessments	26	"Practice tests will help familiarize students with the format."
Parents	Awareness sessions	34	"Parents must understand their responsibility."
	Strengthen school–parent communication	25	"There must be regular meetings with parents."