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Original Research Article

An Investigation of the Impact of Students' Characteristics and Their Perceptions about Learning Environment on Mathematics and Science Achievement

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Abstract

This research examined the impact of students' characteristics and their perceptions about learning environment on mathematics and science achievement. It specifically aimed to demystify the effect of gender, economic, social and cultural status, immigrant background, teacher feedback, teacher support, exposure to bullying, and disciplinary climate on on mathematics and science achievement .Furthermore, it reanalyzed the results of the 2018 PISA-Saudi Arabia. Economic Social and Cultural Status, Gender, Teacher Support, and Immigrant Background found to have an influence on mathematics and science achievement. The study recommended that educational institutions in Saudi Arabia should pay attention to gender differences and the economic, social and cultural status, and immigrant backgrounds of students.

Keywords: students' characteristics, perceptions, learning environment, mathematics, science, academic performance, education, KSA.

INTRODUCTION

Education is the backbone of any human development and civilization. It forms the basis of personal, social, national and global development (Sari, 2019). In this respect, all countries realize the role of education in the life of their citizens. The importance given to education has been associated with various ideas like quality education, academic performance, scientific achievement, etc. These ideas necessitate the establishment and adoption of local and global assessment programmes. Such programmes seek to provide accurate data about the outcomes of the targeted educational systems. Their results will be helpful for educational institutions and governments. They will assess the performance and academic achievements of students, thus revealing their achievements and demystifying the weaknesses and strengths of the educational systems.

In this respect, the UN introduced PISA, through OECD, as an international assessment programme (Bart, 2022). This programme ventures to help the participating countries understand the real academic and scientific performance of students. Thus, their results help in the development of the educational systems in the participating countries.

PISA targets the achievement of 15-year-olds in reading comprehension, science and mathematics (Rico-Juan, *et al.*, 2024). These subjects are essential since no learning without reading and no education without science and mathematics.

Since 1997, more than eighty countries have joined PISA (Jerrim, 2023). This number reflects not only the importance of the programme but the global awareness of educational assessment as the first step towards developing the educational systems.

Saudi Arabia joined PISA in 2018. The application of PISA is part of the Saudi Vision 2030 that aims at developing all fields in the Kingdom. In this respect, education has got the largest share of the Saudi government's support. This is evident in the unprecedented financial support provided for the educational institutions.

A number of 6,136 students from 235 schools participated in the 2018 PISA-Saudi Arabia. The results

of this assessment cycle revealed that Saudi students' scores on mathematics, science and reading were below the average set by the OECD. That is, the results reflected that the selected sample from Saudi Arabia are weak at mathematics and science subjects. They scored 373, 386 and 399 in mathematics, science and reading, respectively, while the average scores set by the OECD are 489, 489 and 487 in mathematics, science and reading, respectively (PISA, 2018; Alkhudaydi, 2023).

Thus, this study ventured to examine the impact of students' characteristics and their perceptions about learning environment on mathematics and science achievement. It reanalyzed data provided by the 2018 PISA assessment. Therefore, it reanalyzed and interpreted the findings of the 2018 PISA, focusing on the data related to Saudi Arabia. Besides, the focus is made on the extent to which mathematics and science academic performance are influenced by students' characteristics and their perceptions about learning environment.

Research Significance:

PISA is a new assessment programme especially in the Saudi context. It has been only six years since Saudi Arabia joined PISA. Therefore, the results of the 2018 PISA-Saudi Arabia have not been fully investigated, reanalyzed and interpreted. In this respect, this is one of the early studies focusing on the findings of the 2018 PISA-Saudi Arabia. Besides, it is the first study that uses the data of the 2018 PISA-Saudi Arabia to examine the impact of students' characteristics and their perceptions about learning environment on mathematics and science achievement. Its findings will be a basis on which the educational authorities in Saudi Arabia can rely in taking educational decisions. That is, the findings will provide them with the necessary data to develop the educational system. Additionally, this study will provide researchers with the required knowledge to investigate several topics related to teaching and learning science and mathematics.

Problem Statement:

Saudi Arabia is experiencing an overall development in all fields. In this respect, Saudi Vision 2030 puts education at the center of its agenda. The vision works to achieve the Kingdom's goals, including the educational ones. Therefore, Saudi Arabia joined PISA in 2018, with the aim to get a broader vision of the current level of students in mathematics, science and reading.

The 2018 PISA-Saudi Arabia revealed Saudi students' weak achievement in science, mathematics and reading. Therefore, this study reanalyzed and reinterprets the results of the 2018 PISA-Saudi Arabia, with the purpose to identify the extent to which students' characteristics and their perceptions about learning environment affect mathematics and science achievement.

Research Questions:

1. To what extent do students' characteristics affect mathematics achievement among 15 years old students in KSA?
2. To what extent do students' perceptions about learning environment affect mathematics achievement among 15 years old students in KSA?
3. To what extent do students' characteristics affect science achievement among 15 years old students in KSA?
4. To what extent do students' perceptions about learning environment affect science achievement among 15 years old students in KSA?

Research Objectives:

1. To know the effect of students' characteristics on mathematics achievement among 15 years old students in KSA.
2. To know the effect of students' perceptions about learning environment on mathematics achievement among 15 years old students in KSA.
3. To know the effect of students' characteristics on science achievement among 15 years old students in KSA.
4. To know the effect of students' perceptions about learning environment on science achievement among 15 years old students in KSA.

LITERATURE REVIEW

The extent to which different factors affect students' achievement and academic performance in science and mathematics has been one of the most important topics haunting the minds of scholars and educationalists. Its importance stems from the importance of the said subjects in today's world. In this respect, Ali, *et al.*, (2023) used data provided by PISA to study the link between learning environment and students' non-cognitive outcomes. The study proved the existence of a significant link between the learning environment and students' cognitive outcomes.

Baysu, *et al.*, (2022) examined the link between perceived discriminatory school environment and student achievement in math and reading. This cross-national investigation used PISA 2018 to study the impact of discriminatory school environment on students' achievement in the said subjects. It demystified that student perceptions of teachers' discriminatory beliefs and behaviors in school negatively affects math and reading scores. Apart from this, Courtney, *et al.*, (2022) studied the influence of ICT use and related attitudes on students' math and science performance. The study takes the form of multilevel analyses, and it analyzed the last decade's PISA Surveys. It unveiled that ICT use, with regard to all its forms, had no positive relationship with student performance in math or science.

However, higher student attitude toward the use of ICT was associated with higher math and science performance.

Furthermore, Erdogdu (2022) studied how ICT use, learning environment and student characteristics potentially predict academic achievement of students. It evidently demystified that ICT use positively affects student's success. Moreover, students' characteristics were associated with high achievement. However, a negative relationship was noted between academic performance and teacher enthusiasm, and factors like income level and political and economic freedoms negatively affect students' success. Apart from this, Forbes, *et al.,* (2020) used data from PISA 2015 to study patterns of inquiry-based science instruction and student science achievement. The study demystified differences in the nature and frequency of inquiry-based instruction.

Gómez & Suárez (2020) used data from PISA 2015 to examine whether school environment and inquiry-based teaching affect students' critical thinking and science achievement. The study revealed a negative link between IBT and students' scientific performance. But it unveiled a positive link between IBT and students' self-reported critical thinking skills. Furthermore, school environment worked as a positive moderating factor on learning .In a different context, Holzberger, *et al.,* (2020) studied the effect of school characteristics on student outcomes. This meta-analysis used large-scale studies to analyze the phenomenon in relation to students' achievement in science and maths. Moreover, it identified certain school variables like classroom climate, out-of-school activities, etc., as directly affecting students' achievement.

Furthermore, Khine, *et al.,* (2020) reanalyzed data provided by PISA mainly to examine the effects of learning environments on students' non-cognitive outcomes. The study evidently demystified the strong link between students' perceptions of the learning environment and the non-cognitive outcomes of epistemological beliefs, self-efficacy and attitudes.

Furthermore, Lau and Ho (2020) identified students' attitudes towards science, teaching practices, and science performance. The study took the form of a multilevel analysis. Besides, it used data from PISA 2015 to analyze the Chinese and western top performers. It significantly demystified that enjoyment of science learning is the strongest predictor of performance for all regions. Apart from this, Lee (2020) investigated the link between certain non-cognitive characteristics and academic achievement in Southeast Asian countries. The study reanalyzed data from PISA 2009, 2012, and 2015. Moreover, it unveiled that the best non-cognitive predictors of student achievement were metacognitive awareness for reading achievement, self-efficacy, self-concept, and anxiety for mathematics achievement, and environmental awareness and epistemological beliefs for science achievement. Liou (2020) investigated students' attitudes toward science and science achievement. It is an analysis of the differential effects of science instructional practices. Its outcome demystified that inquiry-based instructional practices had greater positive predictive power than teacher-directed instructional practices for students' attitudes toward science.

Radišić, *et al.,* (2021) examined whether students in Italy really disinterested in science. The study takes the form of person-centered approach using the pisa 2015 data. Furthermore, it revealed that the profiles differed on the examined covariates. Besides, it highlighted distinct patterns relative to environmental awareness and achievement. In a similar context, Rohatgi and Scherer (2020) used data from PISA 2015 to identify profiles of students' school climate perceptions. The study evidently demystified three student profiles; those with positive perceptions, those with moderately negative perceptions, and those with extremely negative perceptions.

Apart from this, Rohatgi, *et al.,* (2022) revisited data from the 2015 PISA. The aim was to know the link between supportive climates and science achievement in the nordic countries. Significantly, it demystified that perceived feedback from teachers and students perceiving their teachers as fair explains significant variations in science achievement. In a different context, Teng (2019) used data from PISA 2012 to examine the link between school climate and students' mathematics achievement gaps in Shanghai China. It unveiled that school climate can moderate the effect of family background on mathematics achievement for underachieving students and for low-performing schools, respectively. Apart from this, You, *et al.,* (2021) studied the effect of student and teacher characteristics on student Math achievement. The findings suggest that student characteristics predicted 39.9% of mathematical achievement variance.

RESEARCH METHODS

This secondary analysis of the results provided by the 2018 PISA assessment (OECD, 2018) is quantitative. In this respect, the analysis is based on the descriptive and inferential methods. Therefore, it is a multi-level analysis that mainly analyzes the effect of students' characteristics and their perceptions about learning environment on mathematics and science achievement. Figure 1 reveals the conceptual framework on which this study is based.

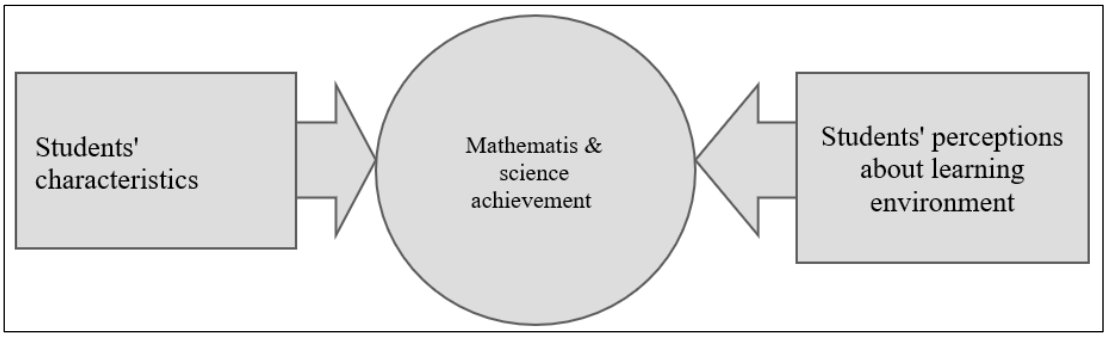

Figure 1: The conceptual framework for this study
***Source:** Designed by the researcher

The population included all 15-year-old students in KSA. Moreover, the sample included 6,136 students who were selected from 235 schools.It is the sample selected by the 2018 PISA. Besides, the selection of the students' characteristics and the students' perceptions about learning environment was based on the literature review, especially on Alkhudaydi (2023).

RESULTS AND DISCUSSION

By revisiting the results provided by the 2018 PISA-Saudi Arabia, it becomes obvious that Saudi students are weak in mathematics and science. Therefore, a close look at the dataset provided by the 2018 PISA-Saudi Arabia will provide deeper understanding of the causes beyond Saudi students' low scores in science and mathematics. Before discussing these points, it is urging to provide a presentation of the independent variables investigated in this study, along with their PISA codes, data type and number of items related to each variable. See data in Table 1.

Table 1: Independent Variables Investigated in this Study

Level	Variables	PISA code	Data type	No. of items
Student	Gender	GENDER	Categorical	1
	Economic, Social and Cultural Status	ESCS	Numerical	4*
	Immigrant Background	IMMIG	Categorical	3*
	Teacher feedback	PERFEED	Numerical	3
	Teacher support	TEACHSUP	Numerical	4
	Exposure to bullying	BEINGBULLIED	Numerical	6
	Disciplinary climate	DISCLIMA	Numerical	5

* Number of indices
Source: the researcher

The independent variables investigated in this study are student-level variables. These variables include gender, economic, social and cultural status, immigrant background, teacher feedback, teacher support, exposure to bullying, disciplinary climate.

The above mentioned variables are investigated through the 2018 PISA's application of Student Questionnaire. (OECD, 2019a). Moreover, they are given the short forms *GENDER, ESCS, IMMIG, PERFEED, TEACHSUP, BEINGBULLIED, DISCLIMA,* respectively.

The results of the 2018 PISA-Saudi Arabia revealed that the responses made by Saudi students to the questionnaire recorded a slightly higher mean than the international average of 0, except for the ESCS and PERFEED variables. This indicates that Saudi students had better TEACHSUP than other students who participated in this PISA cycle, as the TEACHSUP variable recorded the values M = .5413, SD = 1. Furthermore, the variables of DISCLIMA and BEINGBULLIED recorded the values M = .26, SD = 1 and M = .03, SD = 1, respectively. These values are higher than OECD average for PISA. Contrastingly, The variables of ESCS and PERFEED recorded the values M = -.663, SD = 1 and M = - 0.054, SD = 1, respectively. These values are lower than the standard deviation of the OCED international average. See data in Table 2.

Table 2: Descriptive Statistics of Student-level Variables

Student Factors	No. of Items	Response Scale	Range of Possible Responses	Range of Actual Scores	Scale Mean (median)	SD	Mean in comparison to OECD Average*
Gender	1	Nominal	F=1, M=2	1-2	1.51 (2)	.500	NA
Economic, social and cultural status	3	Interval	Three variables	NA	NA	NA	-.663
Immigrant background	3	Nominal	Native First-generation immigrant Second-generation immigrant	1-3	1.18 (1)	.506	NA
Teacher feedback	3	Nominal	Never or almost never (1) Some lessons (2) Many Lessons (3) Every lesson or almost every lesson (4)	1-4	2.27	1.052	-0.054
Teacher support	4	Nominal	Every lesson (1) Most lessons (2) Some lessons (3) Never or hardly ever (4)	1-4	1.514	.9063	.5413
Exposure to bullying	6	Nominal	Never or almost never (1) A few times a year (2) A few times a month (3) Once a week or more (4)	1-4	1.41	1.011	.03
Disciplinary climate	5	Nominal	Every lesson (1) Most lessons (2) Some lessons (3) Never or hardly ever (4)	1-4	3.089	1.079	.26

Source: The researcher

Therefore, the values recorded by these variables can be used as predictors of mathematics and science achievement.

The following equations will be used to answer the research questions regarding scientific Literacy.

Level-1:

$$Yij = \beta 0j + \beta 1j\ (ESCS) + \beta 2j\ (DISCLIMA) + \beta 3j\ (TEACHSUP) + \beta 4j\ (PERFEED) + \beta 5j\ (PEINGBUL) + \beta 6j\ (GENDER\_F) + \beta 7j\ (IMMIG\_SE) + \beta 8j\ (IMMIG\_F1) + r_{ij}$$

Level-2:

$\beta 0j = \gamma 00 + u0j$
$\beta 1j = \gamma 10$
$\beta 2j = \gamma 20$
$\beta 3j = \gamma 30$
$\beta 4j = \gamma 40$
$\beta 5j = \gamma 50$
$\beta 6j = \gamma 60$
$\beta 7j = \gamma 70$
$\beta 8j = \gamma 80$

Where,

$\beta 0j$ is the mean scientific literacy score in school j
$\beta 1j$ is the differentiating effect of economic social and cultural status in school j
$\beta 2j$ is the differentiating effect of disciplinary climate in school j
$\beta 3j$ is the differentiating effect of the teacher to support in school j
$\beta 4j$ is the differentiating effect of teacher feedback in school j
β_{5j} is the differentiating effect of being bullying in school *j*
β_{6j} is the mean difference between the scientific literacy scores of male and female students
$\beta 7j$ is the differentiating effect of second-generation immigrant students in comparison to native students in school j
$\beta 8j$ is the differentiating effect of first-generation immigrant students in comparison to native students in school j

Regression analysis of scores related to Scientific Literacy was done on level 1 variables. The aim was to determine the student-level predictors which are important to explicat the student scores' variation. In this respect, the model includes the independent variables of the ESCS for the students; students'

responses about DISCLIMA, students' responses regarding TEACHSUP, students' responses about PERFEED, students' responses about BEINGBULLIED during the last year prior to the test, the total gender difference in the scientific literacy scores, the difference in scores related to the immigrant state of students, and the total effect related to immigrant differences.

The mean and standard error values related scientific literacy achievement were 385 and 4.34, respectively. Furthermore, the variables included in level-1 were eight. Only five variables had significant effects on the scientific literacy, as per the random coefficients models. In this respect, the students gender's slope (γ_{60}) recorded the value 25.73 (t = 4.52). Thus, the average of the male students records 25.7 points higher than the points related to the female students. Besides, slope related to the students' economic, social and cultural status was ultimately significant in predicting the score of scientific literacy: its slope (γ_{10}) was 13.68 (t = 10.87). Evidently, a chang with one standard deviation in this variable denoted 13.6 change in the outcome. The slope related to teacher support (γ_{30}) recorded the value 4.60 (t = 3.01). This ultimately explicats that an increase of one unit in the teacher support's level will bring about an increase of 4.6 unit in the students' scientific literacy.

The students' slope; immigrants and second-generation immigrants (γ_{70}) recorded the value 26.45 (t = 4.70). Thus, the second-generation immigrants' average records 26.4 points higher than the immigrant students' average. Besides, the students' slope; both immigrants and first-generation immigrants (γ_{80}) recorded the value 35.91 (t = 5.61). This demystifies that a change of one standard deviation in this variable denotes a change if 35.9 in the outcome. The remaining variables recorded no obvious effect on Saudi students' scores in scientific literacy.

Table 3: Estimation of Fixed Effects on the Random Coefficient Model in scientific literacy

Fixed Effect	Coefficient	Standard Error	*t*-ratio	*p*.
SL_SC average, $\gamma 00$	385.39	4.34	88.67	0.001
ESCS, $\gamma 10$	13.68	1.25	10.87	.000***
DISCLIMA, $\gamma 20$	2.14	1.32	1.62	0.105
TEACHSUP, $\gamma 30$	4.60	1.52	3.01	0.003**
PERFEED, $\gamma 40$	-2.50	1.34	-1.86	0.062
BEINGBUL, $\gamma 50$	-2.10	1.44	-1.46	0.143
GENDER_F, $\gamma 60$	25.73	5.69	4.52	.000***
IMMIG-SE, $\gamma 70$	26.45	5.62	4.70	.000***
IMMIG-F1, $\gamma 80$	35.91	6.39	5.61	.000***

Note. In this model, dummy coded variables Gender (reference group: Female =0), Immigrant Background (reference group: Native =0), *p< .05. **p < .01. ***p < .001

Source: the researcher

Mathematics Literacy student factors

The following equations will be used to answer the research questions regarding Mathematics scores.

Level-1:

$$Yij = \beta 0j + \beta 1j\ (ESCS) + \beta 2j\ (DISCLIMA) + \beta 3j\ (TEACHSUP) + \beta 4j\ (PERFEED) + \beta 5j\ (PEINGBUL) + \beta 6j\ (GENDER\_F) + \beta 7j\ (IMMIG\_SE) + \beta 8j\ (IMMIG\_F1) + r_{ij}$$

Level-2:

$\beta 0j = \gamma 00 + u0j$
$\beta 1j = \gamma 10$
$\beta 2j = \gamma 20$
$\beta 3j = \gamma 30$
$\beta 4j = \gamma 40$
$\beta 5j = \gamma 50$
$\beta 6j = \gamma 60$
$\beta 7j = \gamma 70$
$\beta 8j = \gamma 80$

where,

$\beta 0j$ is the mean mathematics score in school j
$\beta 1j$ is the differentiating effect of economic social and cultural status in school j
$\beta 2j$ is the differentiating effect of disciplinary climate in school j
$\beta 3j$ is the differentiating effect of the teacher to support in school j
$\beta 4j$ is the differentiating effect of teacher feedback in school j
β_{5j} is the differentiating effect of being bullying in school *j*
β_{6j} is the mean difference between the mathematics scores of male and female students
$\beta 7j$ is the differentiating effect of second-generation immigrant students in comparison to native students in school j
$\beta 8j$ is the differentiating effect of first-generation immigrant students in comparison to native students in school j

Regression analysis of scores related to Mathematics was done on level 1 variables. The aim was

to determine the student-level predictors which are important to construe the variation in student scores. In this respect, the model includes the independent variables of the ESCS for the students; students' responses about DISCLIMA, students' responses regarding TEACHSUP, students' responses about PERFEED, students' responses about BEINGBULLIED during the last year prior to the test, the total gender difference in the scientific literacy scores, the difference in scores related to the immigrant state of students, and the total effect related to immigrant differences.

The mean and standard error values related scientific literacy achievement were 381 and 5.09, respectively. Furthermore, the variables included in level-1 were eight. Only five variables recorded significant effects on mathematics, as per the random coefficients models .In this respect, the slope related to being bullying (γ_{50}) recorded -4.88 (t = -1.15). Therefore, an increase of one unit in the level of this variable denotes a decrease of 4.88 unit in the mathematics score.

Furthermore, the slope related to the statues of a student, at the economic, social and cultural, was significant. Therefore, it is a significant predictor that can potentially predict the mathematics score. The slope (γ_{10}) recorded the value 12.07 (t = 09.61). Significantly, a change of one standard deviation in this variable denoted a change of 12.07 in the outcome. Besides, the slope related to teacher support (γ_{30}) recorded the value 5.79 (t = 4.03). This explicats that and increase of one unit in the teacher support's level will bring about an increase of 5.79 unit in their mathematics score.

Moreover, the slope related to immigrants and second-generation immigrants (γ 70) recorded the value 27.11 (t = 4.23). This signifies that the second-generation immigrants recorded 27.11 points higher than the points belonging to the immigrants. The slope related to immigrants and first-generation immigrants (γ 80) recorded the value 42.08 (t = 6.22). This denotes that a change of one standard deviation in this variable means 42.08 change in the outcome. The other measures at level-1 recorded no significant effect on students' Mathematics scores.

Table 4: Estimation of Fixed Effects on the Random Coefficient Model in Mathematics l

Fixed Effect	Coefficient	Standard Error	*t*-ratio	*p*.
MA_SC average, γ00	381.358823	4.75413	80.216	0.001
ESCS, γ10	12.074146	1.22305	9.872	.000***
DISCLIMA, γ20	3.121853	1.28437	2.431	0.015
TEACHSUP, γ30	5.791929	1.47962	3.91	0.001**
PERFEED, γ40	-1.88341	1.30057	-1.410	0.152
BEINGBUL, γ50	-4.881935	1.39360	-3.503	0.000
GENDER_F, γ60	7.451093	6.30224	1.182	0.236
IMMIG-SE, γ70	27.114073	5.45673	4.969	.000***
IMMIG-F1, γ80	42.082512	6.20178	6.780	.000***

Note: In this model, dummy coded variables Gender (reference group: Female =0), Immigrant Background (reference group: Native =0), *p< .05. **p < .01. ***p < .001

Source: the researcher

The variables represented in the above table as ESCS, γ10, DISCLIMA, γ20, TEACHSUP, γ30, PERFEED, γ40, BEINGBUL, γ50, GENDER_F, γ60, IMMIG-SE, γ70, and IMMIG-F1, γ80, recorded the coefficient values 12.074146, 3.121853, 5.791929, -1.88341, -4.881935, 7.451093, 27.114073, and 42.082512, respectively. The effect of DISCLIMA on students' achievement in science and mathematics is consistent with (Baysu, *et al.*, 2023; Gómez, *et al.*, 2020; Rohatgi & Scherer, 2020; Rohatgi, *et al.*, 2022; Teng, 2019). Moreover, the results related to the effect of teacher support on students' achievement in science and mathematics aligns w (Holzberger, *et al.*, 2020; Jerrim, 2023). Besides, the results related to being bullied agree with (Ali, *et al.*, 2023; Baysu, *et al.*, 2022; Forbes, *et al.*, 2020) These values reveal significant correlation between the variables and the students' achievement in science and mathematics. This indicates that the student-level variables affect Saudi students' achievement in science and mathematics. This result is consistent with (Ali, *et al.*, 2023; Baysu, *et al.*, 2022; Forbes, *et al.*, 2020).

CONCLUSION

This research reanalyzed and interpreted the results provided by the 2018 PISA-Saudi Arabia. It specifically focused on using the data provided by the 2018 PISA-Saudi Arabia in analyzing the impact of students' characteristics and their perceptions about learning environment on mathematics and science achievement. These variables included gender, economic, social and cultural status, immigrant background, teacher feedback, teacher support, exposure to bullying, and disciplinary climate .They were given the short forms GENDER, ESCS, IMMIG, PERFEED, TEACHSUP, BEINGBULLIED, DISCLIMA, respectively. Thus, the gender ESCS, γ10, DISCLIMA, γ20, TEACHSUP, γ30, PERFEED, γ40, BEINGBUL, γ50, GENDER_F, γ60, IMMIG-SE, γ70, and IMMIG-F1, γ80, recorded the coefficient values 12.074146,

3.121853, 5.791929, -1.88341, -4.881935, 7.451093, 27.114073, and 42.082512, respectively. In this respect, the weak performance of Saudi students in science and mathematics, as per the data provided by the 2018 PISA-Saudi Arabia and Alkhudaydi (2023), is to a great extent attributed to some student-level variables being discussed in this study.

RECOMMENDATIONS

1. The educational institutions in Saudi Arabia should pay attention to gender differences, thus giving females the chance to interact in science and mathematics classes.
2. Training courses should be provided to the teachers of mathematics and science subjects. These courses should focus on positive psychology so that teachers will be able to deal positively with all students.
3. Conferences and workshops on recent trends teaching mathematics and science subjects should be held.
4. Teachers of mathematics and science subjects should consider the economic, social and cultural status, and immigrant backgrounds of students.
5. Schools and universities should organise conferences and workshops on how to increase the level of teacher support to students.
6. Exposing students to bullying should be prohibited. This, schools and universities should protect all students from being exposed to bullying.
7. The departments of science and mathematics in the Saudi universities should carry out larger-scale studies that will provide the educational authorities with a broader understanding of the said problem.
8. Schools and teachers of mathematics and science subjects in Saudi Arabia should regularly provide the educational authorities with reports on the students' performance in these subjects.
9. The educational authorities in Saudi Arabia should conduct annual tests of mathematics and science subjects. The tests should target random samples of students from different schools in the Kingdom.
10. The results of the tests recommend in the previous point should be used as the basis for continuous development of teaching mathematics and science subjects.

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