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SOCIO-ECONOMIC STATUS AND STUDENTS' MATHEMATICAL LITERACY ABILITIES

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Abstract

Socio-economic status is a comprehensive concept designed to reflect the financial, social, cultural and human resources available to students. Moreover, it is a factor which is strongly associated with students' performance in mathematical literacy. The present study aims to investigate the abilities of students in mathematical literacy upon completing their compulsory education and answer the research question, if there are statistically significant correlations between the students' performance in mathematical literacy and the variables shaping the students' socio-economic status. The variables which shaped the factor of socio-economic status which were investigated in the current study, were the parents' education, the parents' occupation and a number of household possessions that can be taken as proxies for material wealth or cultural capital, like the number of books at home or the number of several digital devices or other objects that belong to the family. The research was carried out in 650 students from all over Greece who were completing 9th grade or were at the beginning of the 10th grade and whose schools were selected based on the degree of urbanization of the area where the respective school was located (large urban center, small urban center, rural area). The findings of the research showed that there are statistically significant correlations in the average performance in mathematical literacy and the parents' education, the parents' occupation, the number of books and the number of laptops owned by the family.

Keywords: *Socio-economic status, mathematical literacy, Greece, compulsory education.*

1. Introduction

Extensive research indicates that a student's family is one of the most reliable predictors of their success in school and future career. PISA results suggest that schools can play a pivotal role in mitigating the impact of students' family socioeconomic status on their future lives. Social factors such as parents' education and the broader standard of living within the family are directly associated with students' performance in mathematics (Caygill & Kirkham, 2008; Wylie & Hogden, 2007). The exploration of the correlation between family socio-economic and cultural levels and students' performance in mathematical literacy has gained significant attention, particularly through the international PISA survey.

The socio-economic and cultural status, as defined by PISA, encompasses a comprehensive concept that mirrors the economic, social, cultural, and human resources available to students (OECD, 2016, 2019). It serves as an indicator of students' access to family resources, including financial capital, social, cultural, and human capital, as well as an assessment of their family's social status. PISA gauges the socio-economic status of students through the Economic, Social, and Cultural Status (ESCS) index, calculated based on data pertaining to their family background, specifically considering parents' education, parents' professional status, and household possessions. A higher ESCS index corresponds to a higher socio-economic and cultural level for both students and their families.

In all countries participating in PISA, there exists a direct correlation between student performance and socio-economic and cultural background, although this relationship is not labeled as causal. Across all nations, including Greece, students classified as socio-economically disadvantaged—those falling within the bottom 25% of the ESCS index—demonstrate lower proficiency in mathematical literacy compared to their socio-economically privileged counterparts, specifically those within the top 25% exhibiting the highest ESCS index values (Zhu, 2018). Aligned with these findings emphasizing the statistical significance of students' family socio-economic and cultural levels in influencing mathematical literacy performance, secondary analyses of PISA data and international samples support this conclusion (Cheema & Galluzzo, 2013; Güre et al., 2020; Kriegbaum & Spinath, 2016; Lara-Porras et al., 2019; McConney & Perry, 2010;

Shala et al., 2021; Takashiro, 2017; Zhu, 2018). Similar investigations have been conducted for Greek representative samples as well (Hiller et al., 2022; Karakolidis et al., 2016a, 2016b; Kalaycioğlu, 2015; Usta, 2015). In summary, in Greece, students hailing from families with a high socio-economic and cultural level exhibit statistically superior performances in mathematical literacy compared to their counterparts from lower socio-economic strata (Hiller et al., 2022; Karakolidis et al., 2016a, 2016b; Kalaycioğlu, 2015; Sofianopoulou et al., 2017; Usta, 2015).

In the latest PISA 2022 results from Greece, students from higher socio-economic backgrounds (the top 25%) outperformed their disadvantaged counterparts (the bottom 25%) in mathematical literacy by 76 score points. While this discrepancy is narrower than the OECD average of 93 points, it still indicates a significant gap. Interestingly, from 2012 to 2022, Greece saw a reduction in mathematical literacy performance gap between socio-economic groups, whereas the OECD average remained unchanged during the same period (OECD, 2023).

2. Research

The study comprised 650 students undergoing compulsory education. Two distinct research tools were devised and employed: a mathematical test and a questionnaire. The mathematical test featured five real-world problems spread across 11 items, with the resulting performance or score serving as the dependent variable for assessing mathematical literacy achievement. The items covered a spectrum of subjects, from routine experiences to broader topics reflecting students' interests and their world, demonstrating mathematical skills pertinent to everyday life. Furthermore, the mathematical principles and information presented in each specific item corresponded to the curriculum of mandatory education in Greece, encompassing mathematics taught in junior high school. The second research tool, the questionnaire was crafted to gather data on participants' family background, encompassing socio-economic and cultural factors such as parents' education, parental occupations, household digital devices or possessions, and the quantity of books at home.

This study aimed to address the research question, if there is a statistically significant correlation between students' performance in mathematical literacy and the socio-economic and cultural variables that influence their status?

3. Results

After conducting ANOVA for independent samples, it was determined that there is a statistically significant correlation between students' performance in mathematical literacy and the educational level of their mother ($F(8,641)=6.494$, $p<.001$), as well as the educational level of their father ($F(8,641)=7.69$, $p<.001$). Additionally, significant correlations were found with the mother's occupation ($F(9,616)=7.37$, $p<.001$) and the father's occupation ($F(9,610)=8.33$, $p<.001$), as well as the number of books at home ($F(6,636)=11.03$, $p<.001$) and the number of laptops owned by the students' family ($F(3,638)=12.36$, $p<.001$).

Table 1. Analysis of Variance (ANOVA).

	df	F	Mean square	p-value
Performance in ML – mother's education	8	6.49	610.65	.000
Performance in ML-father's education	8	7.69	713.40	.000
Performance in ML-mother's occupation	9	7.37	689.96	.000
Performance in ML-father's occupation	9	8.33	760.81	.000
Performance in ML-number of books at home	6	11.03	1010.26	.000
Performance in ML-number of laptops at home	3	12.36	1181.99	.000

ML=Mathematical Literacy

After conducting Post Hoc testing, it was observed that students whose mothers or fathers have completed higher education tend to achieve statistically higher average scores in mathematical literacy compared to students whose mothers or fathers respectively have completed secondary education, as well

as those whose mothers or fathers respectively have attained knowledge from compulsory education levels. Similarly, students whose fathers have completed secondary education exhibit better average performance in mathematical literacy than those whose fathers have knowledge only from compulsory education levels. Furthermore, Post Hoc testing revealed that students whose mothers or fathers work in specialized professions tend to achieve statistically significantly higher average scores in mathematical literacy than students whose mothers or fathers respectively work in semi-specialized occupations or in elementary (or labor) occupations. Likewise, students whose mothers or fathers work in semi-skilled occupations demonstrate better average performance in mathematical literacy than those whose respective mothers or fathers work in elementary or manual occupations. Additionally, following Post Hoc testing, it was noted that there is a statistically significant positive correlation between the number of books and laptops in students' homes and their average performance in mathematical literacy. More specifically, a higher number of books or laptops in the household is associated with better performance in mathematical literacy.

Table 2. Post Hoc Test Bonferroni (1).

variables	categories	Mother			Father		
		N (%)	Mean	SD	N (%)	Mean	SD
Parent's education	ISCED levels 6-8	363(55.8)	18.05	10.07	303(46.5)	18.70	10.34
	ISCED levels 2-5	244(37.5)	14.84	9.83	277(42.6)	15.12	9.30
	ISCED level 1	35(5.4)	10.66	7.50	59(9.1)	11.47	8.96
Parent's occupation	High skilled white collar	294(45.2)	19.28	10.05	277(42.6)	19.68	10.49
	Low skilled white collar	211(32.4)	15.69	10.01	119(18.3)	16.14	9.39
	High and low skilled blue collar	121(18.6)	11.31	7.98	224(34.5)	12.70	8.40

Table 3. Post Hoc Test Bonferroni (2).

		N (%)	Mean	SD
Number of books at home	No books	10(1.5)	9.00	5.03
	1-10	47(7.2)	11.02	6.44
	11-25	62(9.5)	11.76	7.86
	26-100	178(27.4)	15.19	9.88
	101-200	143(22)	17.90	9.72
	201-500	132(20.3)	19.13	10.68
	More than 500	71(10.9)	20.61	9.79
number of laptops owned by the family	No laptops	69(10.6)	13.68	9.93
	1 or 2	439(67.5)	15.54	9.41
	3-5	124(19.1)	20.79	10.67
	More than 5	10(1.5)	22.10	13.10

4. Conclusion

The socio-economic and cultural status of students or their families which is determined by various factors directly associated with the students' family backgrounds significantly influences students' performance in mathematical literacy, as consistently highlighted in the literature (Hiller et al., 2022; Karakolidis et al., 2016a; Kalaycioğlu, 2015; OECD, 2004, 2013; Usta, 2016). In the current study, we examined these components individually, including parental education levels, both for mothers and fathers, their respective occupations, and household possessions, which encompass items and digital devices owned by the family, along with the quantity of books in the student's home. The study comprised a sample of 650 students from Greece who were either in the process of finishing or had recently completed compulsory education. Their schools were chosen based on the level of urbanization in the respective areas where the schools were situated. The current research findings, consistent with existing literature, demonstrate that certain factors within the socio-economic and cultural context significantly correlate with students' mathematical literacy performance. Notably, the educational levels of both parents, their respective professional roles, and the availability of books and laptops in the household exhibit statistically significant associations.

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