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Impact of socio-economic status and preschool on reading performance in Morocco: Multilevel Structural Equations Model

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Abstract

This study aims to investigate the impact of socioeconomic status (SES) at both the student and school levels, as well as preschool attendance, on reading performance, and to determine whether this relationship vary between rural and urban contexts. The analysis is based on data from 7,017 Moroccan fourth-grade students who took part in the PIRLS 2021 program. Multilevel confirmatory factor analyses (MCFA) were used to confirm the structure of the SES measures. Results of the multilevel structural equation model (MSEM) show that school level SES has stronger direct positive effect on reading achievement than individual-level SES, while preschool attendance plays a partial mediating role. Multigroup analysis indicates that, at the individual level, the effect of SES and preschool on reading performance is consistent in both urban and rural areas, whereas at the school level, the impact of SES is positive and significant only in urban areas.

Keywords: socioeconomic status; preschool; reading performance; multilevel structural equation.

Introduction

Families' position in the social hierarchy is referred to as their socioeconomic status (SES), which is closely linked to the financial and human capital available in the household. According to Tazouti (2014) the main markers of SES are primarily indicated by parental occupation, income, and level of education. In addition, SES includes contextual factors related to the home learning environment, and the access to educational resources such as the number of books in the household and the presence of a study desk (Van Damme et al., 2010).

In Morocco, students from economically advantaged families demonstrate high level of reading compared to their peers from disadvantaged backgrounds (CSEFRS*, 2021). This performance gap is largely explained by unequal access to high-quality schooling and educational resources. Children from more affluent families are more likely to attend better-resourced schools and benefit from supportive learning environments that foster academic success.

Several studies have explored the relationship between socioeconomic status and reading achievement. Some highlight the positive effect of SES on students' reading performance (DeBaz, 1994; Dexter, 2013; Fleming & Malone, 1983; I. V. S. Mullis et al., 2012; Sirin, 2005; Van Vechten, 2013; White, 1982), while others focus on its impact at the school level (Alivernini, 2013; Duru-Bellat, 2003; Thomson, 2018; White, 1982; Yang & Gustafsson, 2004; Yang-Hansen, 2008).

Preschool education also plays an important role in reading achievements (I. Mullis et al., 2007), which itself closely linked to the SES of students' families (Alivernini & Manganelli, 2015; Magnuson & Waldfogel, 2016).

Moreover, numerous studies have identified a significant gap divide in reading performance between urban and rural areas (CSEFRS, 2021; Ibourk, 2017; Tawil et al., 2010). Urban schools are more likely to offer a more supportive learning environment due to better teachers recruitment conditions and a student population from relatively advantaged socioeconomic backgrounds (Ibourk & Raoui, 2021, 2022, 2024, 2025)(Ibourk and Raoui, 2021; 2022; 2024;2025).

Although there is an extensive body of research on the relationship between SES, preschool education, and reading performance, this study has the theoretical advantage of being one of the few to examine the mediating role of preschool education in the relationship between SES and reading performance. From a methodological perspective, the study is distinguished by its application of a multilevel structural equation model, which allows for the hierarchical nature of the PIRLS data and the latent nature of the variable representing socioeconomic status to be considered, thereby enabling a more accurate estimation of the model under study.

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Therefore, this study aims to examine the effect of SES, at both the student school levels, as well as preschool education on reading performance while also assessing whether these effects differ between urban and rural context.

The structure of this paper is as follows: the first section reviews key studies on the relationship between SES, preschool education, and reading performance. The second section outlines the research methodology employed in this study. The third section provides the findings from the different analyses conducted. Finally, the paper concludes with a discussion of the findings concerning the existing literature.

1. Literature Review

1.1. *SES and Academic Performance*

Numerous studies have highlighted the strong influence of socioeconomic status (SES) on reading performance (Bazán et al., 2020; Bazán-Ramírez et al., 2022; DeBaz, 1994; Dexter, 2013; Fleming & Malone, 1983; Mullis et al., 2012; Padilla & Ramírez, 2016; Sirin, 2005; Van Vechten, 2013; White, 1982). Bazán et al. (2020) argue that students' cognitive abilities is a more accurate indicator of their reading performance than family support. However, they also note that parental educational attainment and cultural capital shape these abilities and, consequently, reading outcomes. parental education and family support positively affect students' mathematical achievement (Bazán-Ramírez et al., 2022).

Additionally, research by Padilla and Ramírez (2016), which examined the effects of individual and contextual factors on the reading achievement of 15-year-old Mexican students using PISA 2009 data, shows that socioeconomic status positively affects reading performance. However, this effect is weaker than that of the school's average socioeconomic and cultural composition.

Results from PIRLS 2011, which assesses the reading performance of fourth-grade students, indicate a strong, positive, and consistent relationship between between SES—or its indicators, such as parental education level or occupation—and reading achievement (I. V. S. Mullis et al., 2012). Dexter (2013) found that differences in students' reading skills widen as SES disparities increase. Similarly, Van Vechten (2013) suggests that learners from disadvantaged socioeconomic levels typically demonstrate weaker reading abilities compared to their peers from wealthier backgrounds. Hence,

Hypothesis 1: SES positively influences reading performance at the student level.

At the school level, several studies have established a clear link between the school's economic environment and academic performance (Alivernini, 2013; Duru-Bellat, 2003; Thomson, 2018; White, 1982; Yang & Gustafsson, 2004; Yang-Hansen, 2008). For instance, Thomson (2018) reports that students attending schools with a higher average SES achieve better academic outcomes compared to those in schools with a lower socioeconomic average. Similarly, White (1982), in a meta-analysis, highlighted the importance of distinguishing between effects at the aggregated level (i.e., the average SES of all students in a school) and those at the individual level (i.e., the SES of a single student). This study also found that the impact of SES at the school level is significantly greater than its effect at the individual level.

Regarding reading achievement, these findings have been confirmed by several studies (Alivernini, 2013; Yang-Hansen, 2008; Yang & Gustafsson, 2004). Alivernini (2013), for example, using PIRLS 2006 data, suggests that schools where students' family economic status is uniformly low also tend to have the widest reading proficiency gaps. He explains that in economically advantaged school environments, family cultural capital—particularly the availability of educational resources such as books at home—plays the most significant role in shaping reading outcomes. Similarly, Yang-Hansen (2008), examining data from 1991 to 2001, displays a positive impact of school-average SES on reading performance, the magnitude of this effect varies across countries,though.

According to van Ewijk & Sleegers (2009), the disciplinary or atmosphere in a classroom can be influenced by the average socioeconomic level, and teachers may adapt their instructional methods based on the composition of the class. They also note that while peer pressure and competitiveness can motivate students to exert greater effort, schools with high socioeconomic status may benefit from greater parental support.

(Murillo et al., 2018) emphasizes that the majority of students in some schools may come from underprivileged homes, lack motivation, or engage in disruptive behavior, which can make maintaining social order challenging. Conversely, other schools predominantly enroll students from affluent families and communities, many of whom are highly motivated to succeed, potentially leading to an overestimation of the school's effect. Similarly, they explain that the effect of school may depend on the nature of the dependent variable. For example, language learning can take place in several contexts outside school, which reduces the effect of school, whereas mathematics learning tends to be more closely tied to school instruction. Some studies suggest that the school's effect is not purely direct; it interacts with factors such as student characteristics, teaching methods, school organization, disciplinary practices, school climate, parental involvement, and teacher commitment.

Thus,

Hypothesis 2: SES has a positive impact on students' academic outcomes at the school level.

1.2. *SES and Preschool Education*

The effect of SES can vary depending on the number of years spent in preschool, particularly when preschool education is not formally mandatory, as is the case in Morocco. Households with better material and cultural resources are more inclined to send their children to preschool and cover the related expenses. In this regard, the National Survey on Preschool Education in Morocco (HCP†, 2014) reports that enrollment rates are higher among children from wealthier families compared to those from less affluent backgrounds. Children from the top 20% of households in terms of living standards are 3.7 times more likely to attend preschool than those from the bottom 20%. Similarly, children from non-poor households—defined in multidimensional poverty terms—are three times more likely to be enrolled in preschool compared to those from multidimensionally poor households. These disparities reflect the low per capita income in large households and its insufficiency to cover preschool education costs.

However, at the same income level and area, parents with medium or high educational level and/or middle or high social origins are more committed to preschool enrollment for their children. The probability of preschool enrollment for a child whose father has a higher education degree is 2.5 times greater than that of a child whose father never attended school, and 1.5 times greater than that of a child whose father completed only primary education. Similarly, senior managers, professionals, technicians, employees, and artisans tend to recognize the value of preschool education, with over 60% of their children aged 3 to 5 enrolled. In contrast, more than 75% of children from agricultural laborers and farm operators have never attended preschool. (Ibourk and Raoui, 2022).

Furthermore, in a study of preschool enrollment trends among 3- and 4-year-olds between 1968 and 2013, Magnuson & Waldfogel (2016) highlight enrollment inequalities across family income groups, low-income, middle-income, and high-income families. They observe that preschool enrollment gap between 3- and 4-year-old children from poor (1st quantile) and wealthy (5th quantile) families widened between 1970 and 1980, then stabilized (for 3-year-olds) and declined (for 4-year-olds) until 2010. Additionally, when comparing this trend to disparities in reading and math achievement scores between students from low-income (10th percentile) and high-income (90th percentile) families between 1970 and 1980, they find that the regression patterns are nearly identical. These academic achievement gaps then either stabilized or slightly decreased between 1980 and 2010.

† Haut-Commissariat au Plan

Hypothesis 3: Family SES may have a positive impact on the number of years children spend in preschool education.

1.3. *Preschool Education and Academic Performance*

Investing in preschool education has a measurable impact on academic performance. Studies have shown a positive relationship between the number of years spent in preschool and reading achievement (I. Mullis et al., 2007). According to PIRLS 2011 findings, I. V. S. Mullis et al. (2012) report that fourth-grade students who attended at least three years or more than one year of preschool education achieve higher reading scores than their peers who attended only one year or less of preschool education (519 points and 513 points vs. 493 points, respectively). Meanwhile, students who never attended preschool exhibit significantly lower average reading scores (475 points).

Moreover, a study on the large-scale expansion of preschool education in Argentina by Berlinski, Galiani, and Gertler (2009) shows that attending preschool has a positive impact on students' academic performance in both Spanish and mathematics. The findings shows that one year of preschool education increases average academic performance by 8% or raises the standard deviation of test score distribution by 23%.

Similarly, Puhan et al. (2019), show that preschool education has a positive effect on primary school students' performance in the Odia language, Their study finds that students who attended preschool performed significantly better in both oral and written assessments compared to those who never attended preschool.

Thus,

Hypothesis 4: Preschool education could positively influence reading performance at the individual level.

1.4. *SES, Preschool Education, and Reading Performance in Urban and Rural Settings*

Several studies have identified a significant gap in reading performance between urban and rural areas (CSEFRS, 2021; Ibourk, 2017; Tawil et al., 2010). Urban schools are more likely to offer a supportive learning environment, as they benefit from better conditions for hiring teachers and from a population of students that are from relatively advantaged backgrounds. Additionally, in urban areas, students have greater access to attend private schools (CSEFRS, 2021; Ibourk, 2017), which place good emphasis on foreign languages from the early years of education.

Furthermore, the National Survey on Preschool Education in Morocco (HCP, 2014) reports that the preschool enrollment rate among children from the wealthiest 20% of households (in terms of living conditions) is 3.7 times higher than that of children from the poorest 20%. This ratio is 1.4 times in urban areas and 3 times in rural areas, highlighting a greater disparity in preschool access in rural settings.

Thus,

Hypothesis 5: The effect of SES and preschool education on reading performance is expected to be stronger in urban areas than in rural areas.

Overall, the evidence reviewed above shows that parental SES has a direct impact on reading performance at both the individual and school levels. Additionally, an indirect effect is observed through the mediating role of preschool education.

2. Method

2.1. *Participants and Procedure*

The data for this study are drawn from a nationally representative sample of 7,017 fourth-grade students and their parents who participated in the PIRLS 2021 international assessment, with boys accounting for 51.6% of the sample. Among the surveyed schools, 72% are located in urban areas, while only 28% are in rural areas.

At each selected school, one or two classes were randomly chosen, and all students in these classes participated in the assessment. During a typical school day, students completed both the reading test and the Student Questionnaire, while their parents completed the Home Questionnaire at home.

2.2. *Measures*

The PIRLS assessment administered to students served as a tool to evaluate reading performance. The Student Questionnaire and the Home Questionnaire were utilized to evaluate SES and preschool education.

Measurement of Reading Performance

Reading achievement among students was evaluated through an assessment that included a mix of open-ended and multiple-choice questions. Item Response Theory (IRT) models were used to derive the reading proficiency scale from the constructed responses, and the plausible value methodology was applied to generate five literacy score estimates for each student (I. V. S. Mullis et al., 2012). In the present study, the five plausible values were utilized across all analytical models to account for reading performance.

Measurement of Preschool Education

Preschool education was measured by using a single item in which parents reported the number of years their child attended preschool with the following response categories:

- 1 = Not enrolled
- 2 = One year or less
- 3 = Two years
- 4 = Three years or more

Measurement of Socioeconomic Status

The following SES indicators were used (Van Damme et al., 2010):

- Number of books at home: A single item in the Home Questionnaire with the following categories:
    - 1 = 0–10 books
    - 2 = 11–25 books
    - 3 = 26–100 books
    - 4 = 101–200 books
    - 5 = More than 200 books
- Educational resources at home: Three items derived from the Student Questionnaire (two items) and the Home Questionnaire (one item). This variable was constructed by summing three indicators:
    - Having a shared computer or tablet at home
    - Having a study desk at home
    - Number of children's books at home

- Parental employment (6 items): This variable was constructed from responses provided by both parent's questionnaire, and was categorized as follows:
    - 1 = Never had a paid job
    - 2 = General worker
    - 3 = Skilled worker
    - 4 = Office employee
    - 5 = Professional
- Parental education (7 items): This variable was derived from both parents' responses in the Home Questionnaire, categorized as follows:
    - 1 = Primary education, lower secondary, or never attended school
    - 2 = Lower secondary education
    - 3 = Upper secondary education
    - 4 = Post-secondary, non-university education
    - 5 = University degree or higher

Measurement of School Location

School location was represented by two categories:

- 1 = Urban
- 2 = Rural

This classification was derived from the "Immediate Area Surrounding the School" variable, which originally had five categories:

- 1 = Densely populated urban area
- 2 = Suburban—on the outskirts or periphery of an urban area
- 3 = Medium-sized or large city
- 4 = Small town or village
- 5 = Remote rural area

The transformation was applied as follows:

- Urban schools = Categories 1 + 2 + 3
- Rural schools = Categories 4 + 5.

2.3. *Data Analysis*

The analysis was conducted in multiple stages. First, the evolution of the average reading score was examined in relation to the study variables. Subsequently, to establish the validity of the SES measurement scale, a multilevel confirmatory factor analyses were conducted.

Next, a multilevel structural equation model was specified, considering SES as a predictor of reading performance at both the individual and school levels, and preschool education as a mediator between SES and reading performance at the student level.

Finally, to evaluate the equivalence of the model across urban and rural contexts, a multigroup analysis of the specified model was conducted.

2.3.1 Multilevel Confirmatory Factor Analysis

Traditionally, multilevel data analysis has been implemented using confirmatory factor analysis (CFA) conducted either at the individual level, based on observed scores, or at the higher, group level, based on aggregated mean scores, followed by a single-level analysis (Heck, 2001).

However, using a single-level analysis for multilevel data may not be optimal and it is associated with several analytical and interpretative challenges (Byrne, 2011).

In contrast to single-level CFA, multilevel confirmatory factor analysis (MCFA) facilitates the simultaneous consideration of both data levels. More specifically, MCFA partitions the total covariance matrix into an intragroup covariance matrix and an intergroup covariance matrix, enabling the estimation of both within-group and between-group effects.

To achieve this, Muthén (1994) proposes a five-step MCFA procedure:

1. Step 1: Perform a conventional confirmatory factor analysis (CFA) on the total covariance matrix.
2. Step 2: Estimate group-level variance.
3. Step 3: Conduct a factor analysis on the intragroup covariance matrix.
4. Step 4: Perform a factor analysis using the covariance matrix between groups
5. Step 5: Perform the multilevel confirmatory factor analysis (MCFA).

The initial four phases offer preliminary understanding of how the measurement scale is structured across various layers of analysis and supply essential justification for employing multilevel approaches. The final phase, involves conducting the MCFA itself, delivering the clearest validation or refutation of the proposed multilevel factor structure.

This step, along with the subsequent analyses, was conducted using Mplus software (version 7).

2.3.2 Multilevel Structural Equation Modeling

The examination of the relationships between the variables under investigation is conducted using Multilevel Structural Equation Modeling (MSEM) as an analytical tool (Bonneville-Roussy et al., 2022). This approach allows for the formulation of measurement models, in which a set of observed indicators are used as measures of one or more latent variables. Which it can, in turn, be related to each other in what is known as structural models.

Structural equation modeling (SEM) has been extended to allow for multilevel specification, where latent variables at both individual and group levels can be examined simultaneously. These models can be used to analyze the measurement properties of indicators at both the individual and school levels. They work on ensuring unbiased estimates of the relationships between latent variables at these two levels of observation.

Given the hierarchical structure of the educational data (students are nested within classrooms, which are in turn nested within schools), the multilevel approach is commonly applied in the field of education. The conventional method for handling multilevel data consists of either aggregating or disaggregating variables from different levels into a single level. It's followed by the application of standard multivariate models, considering the the assumption that observations are independent and identically distributed (i.i.d.). However, in educational contexts, this assumption does not hold, which means that these traditional statistical techniques can produce incorrect results.

2.3.3 Multigroup Analysis

Prior to examining group differences in the structural model between groups, it is essential to ensure that these differences do not stem from measurement model parameters. Therefore, it is crucial to verify whether measurement

parameters (particularly factor loadings) function similarly across groups before evaluating any evidence of structural coefficient equivalence (structural invariance).

The multigroup analysis feature in Mplus is used to assess measurement invariance between groups by examining differences in the Comparative Fit Index (CFI) across nested models. In line with the guidelines proposed by Byrne & van de Vijver (2010), multigroup measurement invariance analysis begins with the specification of a baseline (configural) model, in which model parameters are freely estimated for each group without imposing cross-group equality constraints. The fit of this model provides the baseline CFI value, against which a series of increasingly restrictive invariance models are compared to identify the source of non-invariance. A CFI difference below 0.01 serves as evidence of measurement equivalence across groups (Alivernini & Manganelli, 2015).

This series consists of three models:

- The first model tests for the equality of factor loadings across groups.
- The second model includes item intercepts.
- The third model examines whether the residual variances of the items are consistent across different groups.

It is widely acknowledged that the last measurement equivalence assessment (which concerns the equality of error variances across groups) is not only of limited interest and importance (Bentler, 2005; Widaman & Reise, 1997) but also somewhat unreasonable (Little et al., 2007) and even discouraged (Selig et al., 2008) in such cases. Therefore, in this study, we limit our analysis to the first two assessments.

- Factor loading equivalence assessments are referred to as the "weak invariance model".
- Intercept equivalence assessments are referred to as the "strong invariance model".

After evaluating measurement model invariance, we proceed to structural model invariance, using a series of CFI-based difference tests. To do so, we first establish a best-fitting baseline model for each group separately, in which all factor loadings are specified as invariant across groups. Then, we compare this baseline model to a constrained model, in which all hypothesized structural paths are equally constrained across groups (Alivernini & Manganelli, 2015). A significant difference in CFI ($\Delta CFI > 0.01$) between these two models would provide evidence of group differences in the structural path coefficients (Dimitrov, 2010).

Subsequently, to identify the specific structural relationships causing the non-invariance, a series of comparisons is conducted between the baseline model and less restrictive models in which a coefficient is constrained (Byrne & van De Vijver, 2010).

Model Fit Assessment

The statistical relevance of the MCFA and MSEM models is based on widely used indicators to evaluate model fit, including:

- Comparative Fit Index (CFI)
- Root Mean Square Error of Approximation (RMSEA)
- Standardized Root Mean Square Residual (SRMR)
- Chi-square (χ^2) test (Dyer et al., 2005)

For all types of analyses:

- A CFI score of 0.90 or above suggests that the model adequately fits the data (Bentler, 1990).

- A RMSEA and SRMR value of 0.05 or lower represents good model fit (Bentler & Bonett, 1980).
- The χ^2 test should be non-significant, but given its high sensitivity to sample size, it was not considered in assessing model fit in this study.

3. Results

3.1. *Descriptive Statistics*

The following descriptive statistics examine the relationship between reading performance, SES indicators, and the number of years spent in preschool education.

Figure 1 illustrates the average reading score according to the number of years spent in preschool. The results show that reading performance improves as the number of years in preschool increases. Students who attended preschool for three years or more achieved the highest average score (384.07 points), whereas students who never attended preschool obtained the lowest average score (341.88 points).

Fig. 1: Average Reading Score Based on the Number of Years Spent in Preschool

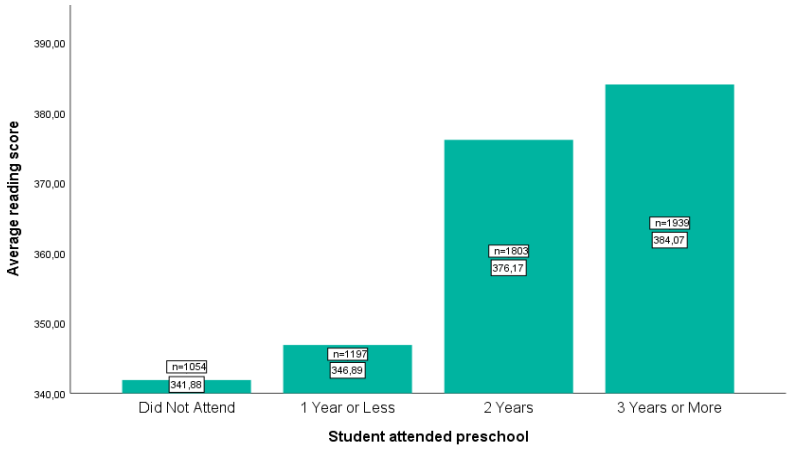


Figure 2 shows that the average reading score increases with the level of parental education. The groups with the lowest and highest average scores are, respectively, "Primary education, lower secondary education, or no schooling" and "University degree or higher."

Figure 3 shows that students whose parents hold prestigious occupations generally achieve higher reading scores, with the exception of those whose parents are small business owners. Although being a small business owner is considered a prestigious profession, students whose parents belong to this category tend to have lower average scores in reading.

This counterintuitive result could be linked to specific characteristics of the group representing this category, such as educational attainment. For instance, a small grocery store owner with no formal education or a low level of schooling may have less influence on their child's academic performance compared to an office employee or skilled worker who has spent more years in formal education.

Fig. 2: Average Reading Score Based on Parental Education Level

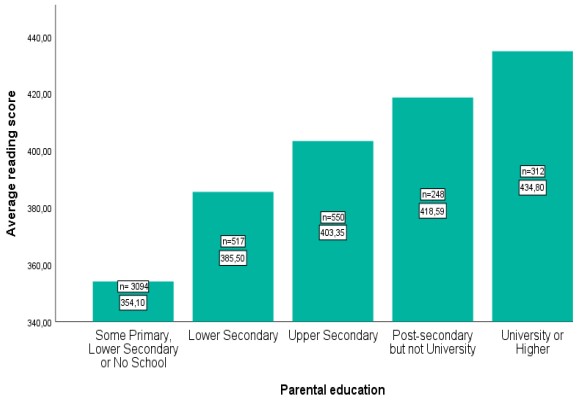
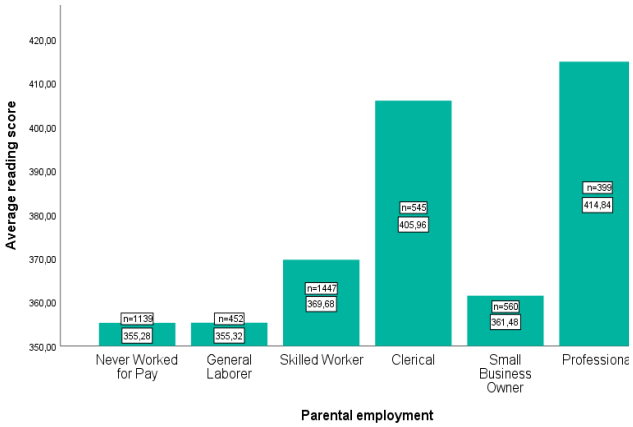


Fig. 3: Average Reading Score Based on Parental Occupation



The availability of certain material resources at home is a key determinant of students' academic performance.

Figure 4 shows that the average reading score increases when the number of books at home increases but then declines with the last category. It is important to note that the groups representing this category is very small (85 individuals, accounting for only 1% of the sample size).

Figure 5 shows that for the first four categories, the average reading score increases with the number of children's books are at home. Having a large number of children's books might be expected to have positive influence on reading performance, students who own more than 200 children's books actually recorded the lowest average reading score, though. Similarly, the group representing this category is very small (85 individuals, or 1% of the sample).

Fig. 4: Average Reading Score Based on the Number of Books at Home

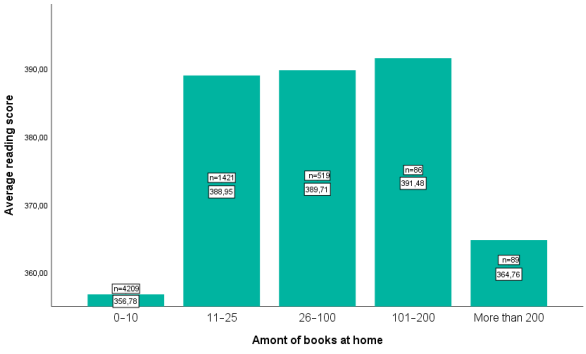
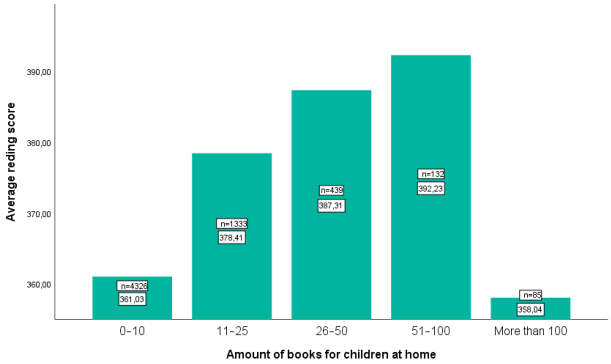


Fig. 5: Average Reading Score Based on the Number of Children's Books at Home



In addition to the importance of having children's books at home, the availability of other educational resources, such as a study desk or a shared computer or tablet, is associated with higher average reading scores (Figures 6 and 7).

Fig. 6: Average Reading Score Based on Ownership of a Shared Computer or Tablet

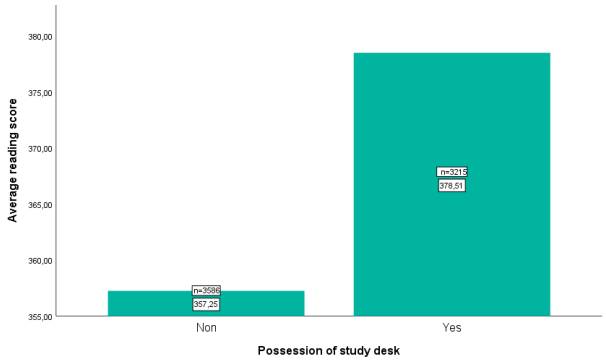
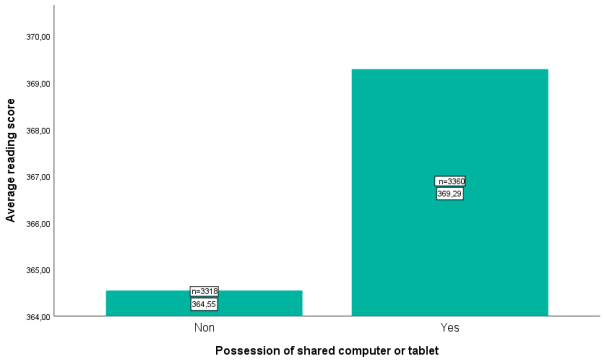


Fig. 7: Average Reading Score Based on Ownership of a Study Desk



In summary, the descriptive statistics indicate that, overall, higher values of the variables representing SES and preschool education are associated with higher average reading scores. The following sections will clearly explain the effect of SES and preschool education on reading performance.

3.2. *Confirmatory Factor Analyses*

- **Step 1:** Conduct a standard confirmatory factor analysis (CFA) using the full covariance matrix

A prior model was examined, considering SES as a latent variable explaining the four observed indicators, using the total sample covariance matrix. Although the CFI and SRMR values fell within a range suggesting adequate model fit (Table 1), the model did not exhibit a good fit to the data, as indicated by a high χ^2 statistic relative to the degrees of freedom (χ^2 (2) = 112.602, $p < 0.001$) and an elevated RMSEA value (0.089).

Table 1: Fit Indices of the Multilevel SES Measurement Model

	Khi deux	df	RMSEA	CFI	SRMR
Step 1	112.602***	2	0.089	0.920	0.044
Step 3	309.380***	2	0.151	0.876	0.059
Step 4	15.117***	2	0.157	0.986	0.025
Step 5	58.800***	4	0.044	0.894	0.059 /0.026
Step 5 (Factor Loading adjustment)	3.742	2	0.011	0.995	0.001 /0.043

Table 2: Standardized Factor Loadings and Intraclass Correlation Coefficients (ICC).

	Standardized Factor Loadings							ICC
	Step 1 : total	**Step 3**	**Step 4**	**Step 5a: within**	**Step 5a: between**	**Step 5b: within**	**Step 5b: between**	
Educational resources at home	0.71	0.58	0.98	0.59	0.97	0.55	0.98	0.198
Parental education	0.62	0.39	0.86	0.40	0.88	0.36	0.87	0.352

Parental employment	0.42	0.22	0.72	0.22	0.75		0.49	0.237
Number of books at home	0.72	0.72	0.90	0.73	0.90	0.78	0.89	0.290

Table 2 shows the standardized factor loadings and intraclass correlation coefficients (ICC). All factor loadings are statistically significant. However, the parental employment item appears to be weaker indicator of the latent construct. Even after removing this item, the model fit quality significantly deteriorated.

As noted previously, the analysis based on the total covariance matrix do not account for the hierarchical structure of the data and may therefore make it potentially misleading. Given that this matrix includes both within-group and between-group data, the outcome could be affected by the factor structure at the group level, particularly when significant systematic variance exists between groups, even when disaggregated observations are included in the analysis.

The following step is to evaluate the extent of between-group information present in the overall covariance matrix.

- **Step 2: Estimating Between-Group Variance**

At this stage, intraclass correlation values (ICCs) were calculated for each indicator to assess the extent of variation across groups. As it's shown in the far-right column of Table 2, the ICCs for the four indicators vary from 0.198 to 0.352, with an average ICC of 0.269. Tagliabue et al. (2020) set the standard ICC threshold at 0.05. Given these comparatively high ICC values, we determined that there is adequate between-group variance to statistically support the use of a multilevel analysis.

- **Step 3: Conducting a Factor Analysis on the Within-Group Covariance Matrix**

In the third step, a single-level CFA model was applied, using the within-group covariance matrix, where individual scores were adjusted based on their corresponding group means.

At this step, the model fit indices indicate a weaker fit compared to the Step 1 model. More specifically, in comparison to Step 1, the CFI decreased significantly to 0.876, while the RMSEA, SRMR, and χ^2 relative to degrees of freedom increased (Table 1).

This indicates that the systematic between-group relationships—which were removed from the within-group covariance matrix used in Step 3—may have contributed to better model fit in Step 1, which was based on the total covariance matrix. In other words, latent constructs likely operate at the between-group level.

In this model, the factor loading estimates vary between 0.22 and 0.72. The loadings observed in Steps 3 and 4 closely resemble those found in the final multilevel model.

- **Step 4: Conducting a Factor Analysis on the Between-Group Covariance Matrix**

At this step, we examined the fit of a CFA model at the between-group level, using the estimated between-group covariance matrix of the population.

The fit statistics listed in Table 1 indicate that the Step 4 model does not correspond closely with the data. While SRMR and CFI values showed improvement, the RMSEA value of 0.157 indicates a poor fit.

The χ^2 statistic is lower than in Steps 1 and 3, but this is largely explained by the smaller sample size in this step (schools rather than individual students).

- **Step 5: Conducting a Multilevel Confirmatory Factor Analysis (MCFA)**

As presented in Table 1, the Step 5 a priori model demonstrates an adequate fit at both the within-group and between-group levels, with RMSEA = 0.044, SRMR_within = 0.059, and SRMR between = 0.026. However, the fit is slightly weaker, as indicated by the CFI = 0.894. The χ^2 value in relation to the degrees of freedom shows improved results compared to Steps 1 and 3.

This model's parameter estimates include factor loadings at both the within-group and between-group levels (see Table 2). The between-group factor loadings are notably high, ranging from 0.75 for 'Parental employment' to 0.97 for ' Educational resources at home.

At the within-group level, the factor loadings are lower: ranging from 0.22 for "Parental employment " to 0.73 for "Number of Books at Home".

Given the large sample size and theoretical importance of the items, factor loadings greater than 0.32 are seen as acceptable (Tabachnick & Fidell, 2019). Therefore, we eliminated the item that measures "Parental employment" at the individual level and retained the 3 remaining items. consequently, the Step 5 model was revised, and the removed item is aggregated at the school level.

The goodness-of-fit measures for the revised model indicate a robust alignment with the data (Tables 1 and 2).

3.3. *Structural Equation Model*

The multilevel structural equation model (MSEM) specifies the effects of SES and preschool education on reading performance. As illustrated in Figure 1, the model demonstrates a good fit to the data, with CFI = 0.941, RMSEA = 0.021, SRMR within = 0.025, and SRMR_between = 0.084.

Individual-Level Results

At the individual level, the model explains 2.5% of the total variance in average reading scores. This means that most of the difference in reading levels between students at the same school is not captured by the predictors introduced. Significant interpersonal disparities remain, likely driven by unobserved factors outside the scope of our model, such as intrinsic motivation, extracurricular reading habits, or innate cognitive abilities.

The relationship between SES and reading performance is positive and significant ($\beta = 0.117$, $p < 0.000$). In other words, SES has a direct, positive, and significant impact on reading performance, confirming Hypothesis 1.

The indirect effect is $\beta = 0{,}020$ ($p < 0.05$), resulting in a total effect of $\beta = 0.137$ ($p < 0.001$). More specifically:

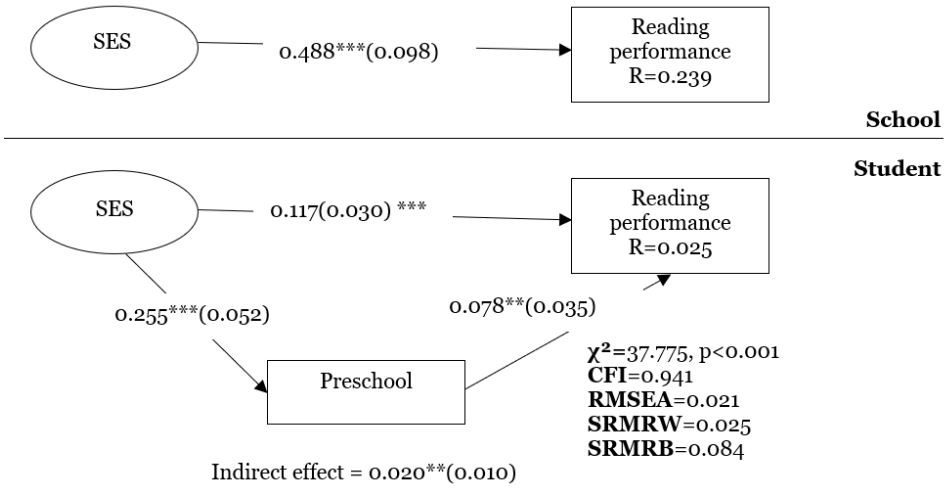
- The regression coefficient of preschool education on SES is positive and significant ($\beta = 0.255$, $p < 0.000$), confirming Hypothesis 3 regarding the effect of SES on preschool attendance.
- A positive and significant relationship is also observed between preschool education and reading performance ($\beta = 0.078$, $p < 0.05$), confirming Hypothesis 4, which predicted the positive impact of the preschool education on reading performance.

School-Level Results

At the school level, the results show that the model explains 23.9% of the total variance in reading performance. This indicates a strong contextual effect, and that the selected variables are good predictors for differentiating reading performance from one school to another.

The regression coefficient is $\beta = 0.488$ ($p < 0.001$), suggesting that the effect of SES on reading performance is stronger at the school level compared to the individual level. Consequently, Hypothesis 2 is confirmed.

Figure 8: Standardized results from the multilevel structural equation model



3.4. *Multigroup Analysis*

3.4.1 Multigroup Analysis of Measurement Invariance

Before testing the hypothesis regarding differences between urban and rural settings, it is first necessary to make sure of the invariance of the measurement model parameters.

Table 3 provides a summary of the results from the measurement invariance analysis, where 4 predefined models were specified and tested.

Model 1 test configural invariance, assessing whether the number of factors remains constant across groups. The model demonstrated an adequate fit (RMSEA = 0.024; CFI = 0.988; SRMRwithin = 0.002; SRMRbetween = 0.078), indicating that the factorial structure is optimally represented as a one-factor model at both the student and school levels and in both groups.

Model 2a (weak invariance), the factor loadings were constrained to be equal among the different groups. The CFI difference exceeded 0.01, indicating that factor loadings are not invariant. Examination of the modification indices revealed that this non-invariance was primarily attributable to the "Parental Education" item at school level.

In Model 2b, we freed this item, and the CFI difference (ΔCFI) became equal to 0.01, suggesting partial weak invariance.

Model 3 (partial strong invariance), in which an additional constraint of equality was imposed on the intercepts, produced a non-significant CFI difference (ΔCFI < 0.01). This implies that all intercepts, except for that of the "parental education" item, are invariant across groups.

Table 3: Measurement Parameter Invariance

Measurement Model	CFI	ΔCFI
Model 1: Baseline Model	0.98*8*	
Model 2a: Weak Invariance	0,96*6*	0,2*2*
Model 2b: Partial Weak Invariance	0.97*8*	0.01
Model 3: Partial Strong Invariance	0.98*2*	0.006

3.4.2 Multigroup Analysis of Structural Invariance

Table 4 presents the results of the multigroup analysis related to the structural model coefficients.

The comparison between the baseline model (Model 1), the model in which all factor loadings were constrained to be equal across groups except for the "Parental Education" item, and the model where both factor loadings and structural relationships were constrained simultaneously revealed a significant difference (ΔCFI > 0.01).

In other words, there is a structural non-invariance between urban and rural settings regarding the effect of SESwithin and preschool education on reading performance, either at the student level, school level, or both levels simultaneously.

To identify the source of this invariance, a series of comparisons is made between the baseline model and less restrictive models in which a coefficient is constrained. The results indicate that the difference in CFI is less than 0.01 when the coefficient of the structural link between SSE and reading performance is constrained (model 3). In this case, the interpretation is based on the more parsimonious constrained model. This means that in each case the coefficient in question is considered invariant and can be interpreted as identical between groups (Byrne, 2012; Cheung & Rensvold, 2002; Kline, 2011). The regression coefficient indicates a positive but nonsignificant effect (β = 20.596, P = 0.052). In other words, at the individual level, no effect was detected in either rural or urban areas.

The constraint of the coefficient linking preschool attendance to reading performance shows an insignificant difference in CFI (model 4). This coefficient proved to be positive and significant (β =7.137, P<0.01), indicating a positive effect of preschool attendance on reading performance in both urban and rural areas.

Similarly, we find that the difference in the CFI relating to the constraint of the coefficient of the link between SES_{within} and preschool is not significant (model 5). This coefficient is positive and statistically significant. In other words, SES positively influences preschool education at the individual level in similarly in both urban and rural areas.

However, when the link between $SSE_{between}$ and reading performance (model 6) at school level is constrained alone, the difference becomes significant. This implies that at school level, the structural model is non-invariant. The unstandardized coefficients for urban areas indicate a positive and statistically significant effect (β = 89.341, P<0.001), while in rural areas (β =-33.925, P=0.138), it is negative but not significant. In other words, in urban areas, the SES of schools has a positive influence on reading performance, while in rural areas no effect has been identified.

As the difference between urban and rural areas is only significant at school level, we conclude that Hypothesis 5 is not supported.

Table 4: Structural Model Invariance

Modèle structurel	CFI	ΔCFI
Model 1: Baseline Model (Invariant Factor Loadings)	0,94*9*	-
Model 3: constrained Coefficient for the Link: SES_{within} → Reading Performance	0,943	0,006

Model 4: constrained Coefficient for the Link: SES_{within} → Preschool Education.	0.94*9*	0.00*0*
Model 5: constrained Coefficient for the Link: Preschool Education → Reading Performance	0,94*8*	0,00*1*
Model 6: constrained Coefficient for the Link: $SES_{between}$ *→ Reading Performance*	0.84*8*	0,101

4. Discussion

The objective of this study was to assess the impact of SES, on both the student and school levels, as well as the effect of preschool education on reading performance in the urban and rural context.

The findings show a direct positive impact of SES on reading performance at the individual level. Similar findings have been reported by Alivernini & Manganelli (2015), Battle (2002), Bradley & Corwyn (2002), Dexter (2013), Duncan et al. (1998), McLoyd (1998), and Van Vechten (2013). This can be explained by the fact that children from affluent backgrounds often attend better schools (Mohammed Bijou & Narjis Bennouna, 2018) and benefit from greater access to educational resources necessary for their academic success.

The findings also indicate an indirect effect of SES on reading performance, suggesting that preschool education partially mediates the link between SES and reading achievement. The analyses demonstrate a positive association between family SES and participation in preschool education, aligning with the findings of HCP (2014) and Magnuson & Waldfogel (2016), who observed that the number of years spent in preschool increases with higher family SES. In a country where preschool education is not mandatory, economically disadvantaged families lack the financial means to enroll their children in preschool institutions.

Conversely, consistent with several previous studies (Berlinski et al., 2009; I. Mullis et al., 2007; I. V. S. Mullis et al., 2012; Puhan et al., 2019), our results confirm a positive impact of preschool education on reading performance in fourth grade. This can be attributed to the long-term benefits of investing in preschool education, which positively affect academic outcomes and facilitate the transition to primary school by developing a set of social, intellectual, emotional, and physical skills that prepare young children for formal schooling.

At the school level, SES exerts a stronger positive effect on reading performance than at the individual level. These results align with previous research by Alivernini (2013), Duru-Bellat (2003), Thomson (2018), White (1982), Yang & Gustafsson (2004), and Yang-Hansen (2008). White (1982) found that the effect of SES at the school level is significantly greater than at the individual level. Similarly, Alivernini (2013) reported that schools with uniformly low family economic levels also have the largest reading proficiency gaps, and that in more affluent school environments, the cultural capital of families, particularly access to educational resources such as books at home, plays a crucial role.

On the other hand, van Ewijk & Sleegers (2009) explain this effect by reporting that the average socio-economic level can influence the disciplinary climate or atmosphere in a classroom. Teachers can adapt their teaching style to the type of students in the class. They also point out that schools with high socio-economic status may benefit from increased support from parents, while peer pressure and competition may encourage pupils to work harder.

Concerning the multigroup analysis, contrary to the initial hypothesis, the findings showed that at the individual level, regardless of the school's location, the direct effect of SES on reading performance and the mediating role of preschool are consistent. A similar result was obtained by (Alivernini & Manganelli, 2015), who found no difference between socio-economically disadvantaged regions and other Italian regions. The consistency of the mediating role of preschool can probably be explained by public policies aimed at developing preschool since 2018 and by community initiatives that have reduced inequalities linked to socioeconomic status by making preschool more affordable and accessible (INDH, 2019; UNICEF, 2019)

However, at school level, the effect of SES on reading performance varies depending on the school location. In urban context, the average SES of the school has a positive and statistically significant impact on pupils' reading performance. This result suggests that socially advantaged urban schools collectively have conditions that are more conducive to learning reading skills, particularly in terms of educational resources, infrastructure quality and shared cultural capital within the school community. These school composition effects are well documented in the literature and indicate that the school's aggregate SES can influence teaching practices, teacher expectations, and the overall academic climate (Coleman et al., 1966; Van Ewijk & Sleegers, 2009).

By contrast, in rural areas, the effect of SES at the school level appears to be negative but not significant. That's to say that socio-economic differences between rural schools do not systematically translate into differences in reading performance. This lack of significant effect can be explained by low SSE variability between rural schools, limiting the model's ability to detect a contextual effect. Furthermore, rural schools often have specific organizational characteristics, such as smaller class sizes and closer relationships between students, teachers, and families. These relationships may play a major role in attenuating the influence of aggregate SES on learning outcomes (Howley & Howley, 2010).

Although the structural equation method is relevant for calculating SES, the confirmatory factor analysis step required the removal of the "parental employment" element, which is theoretically considered essential for constructing SES. In future studies, calculating a composite SES index could prove crucial for comparing results with those of the present study. Future research could also explore these effects on other academic disciplines as well as on children's social and psychological development, including aspects such as social skills acquisition, perceptions of learning, and overall well-being.

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