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Mediating effects of motivation and socioeconomic status on reading achievement: a secondary analysis of PISA 2018

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Abstract

Background: Research has shown that students from socially disadvantaged backgrounds are more likely to have lower academic performance compared to children from better-off families. However, the way that socioeconomic status (SES) influences student learning outcomes has not yet been fully examined. Thus, this study explores the indirect effects of students' SES on reading achievement through academic motivation. Specifically, the mediating role of the following three motivation elements is investigated: *mastery-approach orientation of achievement goals, enjoyment of reading*, and *expected occupational status*.

Methods: Structural Equation Modelling (SEM) was used to test the hypothesized mediation model in each European country (n = 38) that took part in the PISA 2018 cycle. Specifically, data was obtained from 237,366 15-year-old students. Common measures for SES, academic motivation, and reading achievement were employed to examine whether the selected academic motivation elements have similar effects in each country. Confirmatory Factor Analysis (CFA) was used to validate the factorial structure of mediators and test their measurement invariance across the samples.

Results: Within-country SEM analysis revealed that *expected occupational status* partially mediates the relationship between SES and reading achievement in all countries. *Enjoyment of reading* fitted well as a mediator in almost all countries (n = 37), whereas *mastery-approach orientation of achievement goals* only appeared as a mediator in 11 countries. The direct effect of SES on academic achievement was significantly reduced in all models.

Conclusions: This study provides evidence that *enjoyment of reading* and *expected occupational status* can be treated as mediators in the relationship between SES and reading achievement in European countries. Implications for research and theory for promoting equity in education are drawn. It is argued that schools and teachers should encourage students to participate in activities that foster their intrinsic motivation towards reading and raise their educational and occupational expectations, especially for those coming from socially disadvantaged backgrounds.

Keywords: Equity in education, Socioeconomic status, Academic motivation, International large-scale assessments, Mediation analysis



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Introduction: the focus of the study

The impact of socioeconomic status (SES) on student learning outcomes has been a topic of discussion since the 1960s (Coleman et al., 1966; Hanushek et al., 2019; Sirin, 2005; White, 1982). Evidence shows that children from socially disadvantaged backgrounds are more likely to have lower academic performance and higher rates of school dropout compared to children from better-off families (Kyriakides et al., 2018; Sirin, 2005). The Program for International Student Assessment (PISA) has consistently revealed variations in the academic performance of students from different socioeconomic backgrounds in many countries during the last two decades (OECD, 2019a). For example, the PISA 2012 study revealed that a 15-year-old student from a relatively disadvantaged home is 2.37 times more likely to perform poorly (obtaining a score below level 2 that measures basic skills in mathematics) than a student from an affluent family (see Schleicher, 2014). The fact that students from higher socioeconomic backgrounds are granted a clear advantage over their low SES peers generates significant challenges for educational systems to address these disparities (Charalambous et al., 2018; Kyriakides et al., 2019). Despite the large number of studies that have examined this phenomenon, the pathways of effect that explain this relationship have not been fully elucidated.

The effects of SES on student learning outcomes may operate at different levels. Primarily, one's financial ability may directly impact their access to educational resources, such as schools, teachers, and books. For example, parents with higher SES may provide better schooling opportunities to their children (e.g., Neuenschwander et al., 2007; Wang et al., 2016). Secondly, the educational level and occupational status of parents can serve as sources of intellectual capital within the family (e.g., Barg, 2019; Bradley & Corwyn, 2002). Thirdly, a family's social circle and proximal environment can provide children with additional learning opportunities, serving as a valuable source of cultural capital (e.g., Bourdieu & Passeron, 1977; Brooks-Gunn & Duncan, 1997). Despite the existence of various theoretical and conceptual explanations about the impact of SES on student achievement, only a limited number of studies have attempted to explain this effect using mediation analysis, and even fewer collected data from more than one country. The use of mediation models to identify potential pathways of indirect effects is recommended (Creemers et al., 2010; Hopfenbeck et al., 2017; Jacobs & Harvey, 2005). Mediation analysis is a valuable methodological tool for exploring the effect of a preestablished relationship, fully or partially, through other factors. Thus, this study aims to explore potential dispositional effects of SES on students' reading achievement through their academic motivation.

Academic motivation refers to students' behaviours and internal processes that either support or hinder their academic performance (Schunk et al., 2008). However, as it is considered a multifactorial construct, its meaning varies depending on the theoretical perspective being used (Murphy & Alexander, 2000). Consequently, a common challenge in studying academic motivation is selecting the specific elements to focus on. The present study utilizes large-scale data from the PISA 2018 cycle to examine the mediating role of three motivation elements: *mastery-approach orientation of achievement goals, enjoyment of reading,* and *expected occupational status.* Enjoyment of reading is a subject-specific motivation element, corresponding to the outcome variable of reading achievement, and various studies have revealed its impact on student learning outcomes

in this subject (e.g., Gottfried et al., 2016; Schiefele et al., 2012; Schunk et al., 2008). The other two elements of academic motivation are expected to be associated with student achievement in various subjects (Huang, 2012; Tourón et al., 2018). This study is, however, concerned with achievement in a core subject and these two elements of academic motivation are expected to influence reading achievement since reading is a fundamental skill that is useful for the attainment of all school subjects. The hypothesized mediation model is tested in 38 European countries to explore whether these three elements of academic motivation can be treated as mediators in each country. Thus, the proposed theoretical model is empirically tested in various educational systems and some support to its validity and generalisability may be generated.

Socioeconomic status and academic achievement

What is socioeconomic status?

Socioeconomic status (SES) is a widely known concept, but there is still no consensus on its definition and indicators. In an early definition, Mueller and Parcel (1981, p. 14) argue that "socio-economic status is the relative position of a family or individual in a social system in which individuals are ranked according to their access to or control over wealth, power and status." Later, the idea of capital was introduced, bringing into focus the importance of social relationships in favour of individuals' social status, in combination with material and non-material possessions (Coleman, 1988). According to Bradley and Corwyn (2002), capital is a convenient way to perceive SES because it encompasses three main dimensions: the financial (material resources), the human (intellectual resources, e.g., education), and the social (social connections and relationships that can make other resources available). More recent studies have introduced cultural capital as an explanation for substantial variations in academic achievement in many countries (Marks et al., 2006). Since this study utilizes a PISA dataset, it is noted that the PISA framework adopts a broad definition of SES, which involves students' access to financial, social, human, and cultural resources (OECD, 2019a). This approach favours both the gradient and the materialist view of SES, reflecting the hierarchical ranking and social stratification of individuals in modern societies (Avvisati, 2020).

Student SES is typically measured by family income, parental educational level, and occupational status (Sirin, 2005; White, 1982; Willms & Tramonte, 2019). A favourable combination of these three components is often related to privilege and power towards others in their community through the accessibility and control of resources (Mueller & Parcel, 1981). To better capture financial capital, other researchers have proposed complementary information such as housing expenses or rent of the household (Entwisle & Astone, 1994), or the estimated value of family assets (Ostrove et al., 1999). More explicit information on human capital could also be obtained by considering the number of parents, siblings, or the presence of grandparents at home. Indicators on students' neighbourhood and school resources (Patten, 2019), or the eligibility for free lunch at school, have also been recommended (Harwell & LeBeau, 2010). PISA uses the index of Economic, Social, and Cultural Status (ESCS), which combines three equally weighted components into a single score: parents' education, parents' occupational status, and information about home possessions. The home possessions component is considered as a financial and cultural capital indicator and includes information such as access to the

internet, the number of books and dictionaries at home, and possession of a car (OECD, 2019a). After ongoing revisions and improvements over time, the ESCS index is considered a sophisticated measure with relatively high validity and cross-country comparability (Avvisati, 2020).

The relationship between socioeconomic status and student achievement

The relationship between students' SES and their academic achievement has been addressed many decades ago (e.g., Coleman et al., 1966). Earlier studies reported associations with coefficients over .70, provoking a widely accepted perception that SES is not only important but to a large extent responsible for academic achievement (e.g., Baker et al., 1961; Dunnell, 1971; Klein, 1971; Levine et al., 1973; Thomas, 1962). Subsequent large-scale studies reported weaker correlations. Four decades ago, White (1982) conducted a meta-analysis of 101 studies and found that SES predicts less than 5% of the variance in academic achievement, with a weak correlation between them (r = .22). Sirin (2005) conducted a quantitative synthesis of a large number of studies published between 1990 and 2000 in the US and reported a small to medium correlation with substantial variation among studies (ranging from r = .25 to r = .47). More recently, after reviewing and analysing the results of empirical evidence over the past three decades, Harwell et al., (2016, p. 197) reported that the relationship between SES and academic achievement is "surprisingly modest" (r = .22 on average). The achievement gap has been consistently proven in many countries and in several domains. The magnitude of this relationship was found to vary among studies due to the diverse definitions, indicators, and methods used for measuring SES and/or student learning outcomes (McLoyd, 1998; Sirin, 2005). Additional studies have demonstrated that the achievement gap attributed to SES has slightly grown throughout the years. Chmielewski (2019), combining international datasets spanning over 50 years, found that the achievement gap among lowand high-SES students has increased in most of the 100 countries studied. This result seems to be in line with PISA findings, demonstrating that socially advantaged students perform better than their counterparts in various subjects including reading (OECD, 2019a). International large-scale studies also reveal the inability of educational systems to intervene in social disparities and highlight the need to deliberately address this phenomenon in order to promote equity in education (Kyriakides et al., 2018).

Searching for indirect effects of socioeconomic status on student achievement

The mechanisms that operate behind the student achievement gap based on SES can be classified into four categories: financial, intellectual, social, and dispositional. A predominant cause of the achievement gap relies on families' *financial* capability to provide learning opportunities and educational assets for their children (Sirin, 2005). Educational assets refer to materials and services that support higher cognitive development and academic achievement. These resources may include educational aids, books, computers, schools with ample funds, and effective tutors. As posited by social capital theory, families with limited financial resources may face challenges in addressing their children's educational needs and supporting their academic success through cultural and extracurricular activities such as visits to museums and theatres, trips, music, or sports (Bourdieu & Passeron, 1977; Bradley & Corwyn, 2002). *Intellectual* effects mainly refer to the ways in which parents interact with their children, particularly in relation to their involvement and support with schooling. A lack of intellectual capital may inevitably prevent parents from providing quality learning experiences and support (Barg, 2019). For instance, parents' knowledge of school subjects is expected to serve as a standby resource for their children's learning needs. Generally, parental involvement is considered a reliable factor for student academic, non-cognitive, and social competence, and has been found to be associated with SES (Fan & Chen, 2001; Poon, 2020; Wang et al., 2016; Wigfield et al., 2015). Several studies have reported that the quantity and quality of verbal interactions and the type of language used at home have an impact on children's linguistic competence and development (Bradley & Corwyn, 2002; Lareau, 2011; Weigel et al., 2006).

The relative position of a family in the society may have certain implications for student learning outcomes. *Social capital*, which refers to the human actors, connections, or actions within a community, is embedded into the civil structure and can be utilized by parents to enhance their children's cognitive development, academic achievement, and future life opportunities (Brooks-Gunn & Duncan, 1997; Coleman, 1988). In addition, studies on the social network model have provided evidence of the influence of peers on students' academic performance, educational attainment, and aspirations (e.g., Cohen, 1983; Lorenz et al., 2020; Palacios & Berger, 2022). SES is also expected to influence the social perceptions of school staff, including their expectations regarding students' academic potential and cognitive abilities. This is due to the tendency for underachievers to be usually overrepresented among students from lower SES backgrounds (Westphal et al., 2016).

Socioeconomic groups are also expected to differ in their behavioural tendencies, which are referred to as *dispositional effects*. The poverty theory posits that adverse psychological conditions and family stressors have a negative impact on children's socioemotional development (McLoyd, 1998). For example, hope, which is considered a cognitive process, was found to partially mediate the relationship between SES and academic achievement (see Dixson et al., 2017). Parental academic expectations, which anticipate certain student behavioural responses such as self-concept (Neuenschwander et al., 2007) and school motivation (Hong et al., 2020), were also found to mediate the relationship between student SES and academic achievement (Davis-Kean, 2005; Froiland et al., 2012). Similarly, parents' perceived efficacy and academic aspirations have been identified as key determinants of their children's career trajectories, also linked to their SES (Bandura et al., 2001). Lower-class students were observed to be more vigilant to social threats and stereotypes than their upper-class peers. They are more likely to experience rejection and negative opinions about their competency or intellectual ability (Croizet & Claire, 1998). Maladaptive behavioural responses that differentiate individuals of low and high SES may also impact their motivational patterns. For example, socially disadvantaged individuals are often expected to display lower academic and career aspirations, reduced control over their life outcomes, and fewer self-generated desires (Kraus & Stephens, 2012; Kraus et al., 2012). They are also more likely to prioritize their immediate needs over long-term goals due to the daily struggles they must overcome. These behavioural patterns affect certain aspects of motivation. As mentioned above, fewer learning opportunities and lower parental expectations often lead to reduced self-confidence, lower expectations for success, and diminished ambitions (Dweck & Leggett, 1988; Lam, 2014). However, the mediating role of academic motivation in the relationship between SES and reading achievement has been scarcely validated beyond national datasets (Caro, 2018; Steinmayr et al., 2012).

The mediating role of academic motivation

Based on a theory-driven mediation hypothesis, academic motivation must demonstrate association with both the independent variable (i.e., SES) and the dependent variable (i.e., academic achievement). Academic motivation is widely recognized as a crucial psychological asset for students and a predictor of their academic success (Kriegbaum et al., 2015; Maehr & Meyer, 1997; Steinmayr & Spinath, 2009). Additionally, its reciprocal relationship with academic achievement (Creemers & Kyriakides, 2008) indicates that motivation is a dynamic and malleable trait (Lazowski & Hulleman, 2016). In this respect, it can also be seen as a non-cognitive outcome of schooling that schools and teachers should strive to enhance. Previous studies have associated academic motivation with provisional factors, including parental influence and teacher behaviour (Baumert & Demmrich, 2001; Teodorović et al., 2022). Other studies have linked academic motivation to stable background characteristics, such as personality (Judge & Ilies, 2002) and gender (Steinmayr & Spinath, 2008). Recent theoretical elaborations suggest that the impact of SES on academic motivation should be taken into consideration (Eccles & Wigfield, 2020; Fisher et al., 2017). However, only a few empirical studies have utilized mediation analysis to investigate the role of academic motivation in the relationship between SES and academic performance. The few studies that have examined the mediating role of academic motivation have referred to elements such as self-concept, self-efficacy, interest, and educational aspirations (Kriegbaum & Spinath, 2016; Li et al., 2020; Ma et al., 2023; Østbø & Zachrisson, 2021; Ozturk & Singh, 2006; Steinmayr et al., 2012; Weiser & Riggio, 2010). Nevertheless, important questions remain regarding other elements of academic motivation and the extent to which their mediating role can be observed in diverse settings and contexts. For this reason, we utilize the PISA database, which provides the opportunity to examine various dimensions of motivation across different countries. Among the factors related to motivation that appear on the student questionnaire, three elements are examined in this study. The selection was based on assumptions and empirical evidence that these motivation elements potentially support the mediation hypotheses, presenting associations between both SES and student achievement in reading.

Mastery-approach orientation of achievement goals

The main idea behind the achievement goal theory of motivation is the orientation of goals (Ames, 1992; Dweck & Leggett, 1988). The concept refers to the objectives that students share to achieve learning tasks and is categorized into two types: mastery goals and performance goals. Mastery goals are characterized by an inherent appreciation for learning, where students possess the belief that achieving high-quality learning outcomes can help them reach long-term objectives. Therefore, students strive to deepen

their understanding of their work and develop their competence. Driven by the idea that learning opportunities should be seized, mastery approach orientation of goals has been linked to effort-based strategies, including persistence, commitment, and deeper engagement in learning (Elliot, 1999; Hulleman et al., 2010; Kaplan & Maehr, 2007), as well as higher academic achievement (Huang, 2012). On the other hand, performance goals are oriented towards demonstrating competence by achieving specific objectives. Due to the belief in the connection between ability and outcome, individuals may strive for high performance even with minimal effort and superficial learning, often leading to low-quality outcomes. Unsuccessful results can lead to feelings of inadequacy and deterioration of self-worth. Therefore, in order to combat self-doubt and establish their superiority, students may adopt a failure-avoiding motivational pattern that is often linked to maladaptive strategies like cheating or procrastination (Ames, 1992; Patrick et al., 2011). It should, however, be acknowledged that the orientation of goals is a more complex construct and does not utterly separate students into the mastery and performance groups (Dekker & Fischer, 2008; Elliot & McGregor, 2001; Elliot et al., 2011).

The influence of family characteristics (including SES) on students' goal orientation has been discussed in several studies (e.g., Gutman, 2006; Midgley et al., 2001). Recent studies claim that students of higher SES tend to have a stronger mastery approach orientation compared to those of lower SES (Berger & Archer, 2016, 2018; Jury et al., 2015). However, these studies utilized school SES measures rather than individual SES indicators. Furthermore, the crucial role of goal orientation in mediating the relationship between SES and academic achievement has not been explored using SEM techniques.

Enjoyment of reading

Intrinsic motivation refers to the authentic desire of a self-directed individual to engage in an activity for the purpose of enjoyment and personal satisfaction. When studying intrinsic motivation in relation to student outcomes, such as reading literacy, the concept of *enjoyment of reading* may represent this idea and referred to as subject motivation as well (e.g., Creemers & Kyriakides, 2008). As described in Self-Determination Theory (Ryan & Deci, 2000), intrinsic motivation leads to healthier regulatory processes and greater engagement in learning, as individuals are driven to act by their own intentions for personal fulfilment. The expected outcomes of such a motivational process include independent learning, increased commitment and effort, a sense of integrity, and high-quality performance. In regard to extrinsic motivation, individuals are compelled to act by external forces, incentives, and motives. Several studies reported positive association between intrinsic motivation and student performance (e.g., Gottfried et al., 2016; Schiefele et al., 2012; Schunk et al., 2008).

As explained in the self-determination theory, motivation is considered a dynamic factor where external conditions are determinants. To enhance intrinsic motivation, a student's social environment should support the fulfilment of three psychological needs: autonomy, competence, and relatedness (Niemiec & Ryan, 2009). This can often be achieved through domain-related stimulating activities, as well as parental expectations regarding specific school subjects (Grolnick et al., 2009; Raftery-Helmer & Grolnick, 2016). Moreover, parents' interest in certain academic subjects was found to be

positively associated with their children's participation in those classes (Simpkins et al., 2005). These promotive parental behaviours may start during a child's early childhood through play and continue throughout their school years (Jacobs & Bleeker, 2004). Low SES parents often come up against time, economic, cognitive, and emotional constraints that can impact the quality and quantity of their children's home learning experiences. For example, parents with lower levels of education may provide fewer cognitively stimulating activities at home (Wigfield et al., 2015). Parental cognitive involvement was found to influence students' subject-specific interests, partially explaining the effects of SES (Caro, 2018). On the contrary, students from high SES families have greater access to learning opportunities, not only through cultural and educational resources, but also through parent-child interactions (Gottfried et al., 1998, 2015). These types of stimuli are valuable resources for developing competence, autonomy, and socialization which facilitate the initiation of intrinsic motivation. Previous studies provided evidence that interest plays a partial mediating role in the relationship between SES and academic competence (Kriegbaum & Spinath, 2016). However, these results were limited to German students. In this study, we examine whether similar relations can be identified in European countries.

Expected occupational status

Students' expected occupational status represents their career aspirations and future goals, which are important motivational forces for individuals. The concept of future identity, as explained in the identity-based motivation theory, provides a good understanding of the expected occupational status (Fisher et al., 2017; Oyserman, 2009). Desired identities can influence an individual's actions and choices in a given situation, depending on how they perceive it to be meaningful, relevant, and achievable. This theory places special emphasis on social class during the process of constructing one's identity. For individuals with low SES, financial scarcity can produce feelings of insecurity and uncertainty, making it difficult to adopt higher aspirations due to present obstacles. As a result, pursuing these goals may often seem impossible and thus meaningless. The theory also argues that stigmatization based on social class and negative perceptions regarding social mobility often prevent individuals with low SES from directing their actions and persisting enough to achieve their long-term goals.

Social status and educational level in upper classes can be considered a cultural asset within families, where children are expected to uphold the 'family tradition' (De Graaf et al., 2000). Hossler et al. (1999) described these educational pathways within the family as "simple, linear, and predictable" (p. 2). Similarly, parents with higher levels of education are more likely to have higher expectations for their children and may support learning (Davis-Kean, 2005; Kyriakides et al., 2018). They also tend to stimulate their children's academic interest (Hoover-Dempsey & Sandler, 1997). Students are expected to internalize parental expectations and values by forming educational or life aspirations that align with them (Plenty & Jonsson, 2021). Berger and Archer (2016) found that students from high SES schools are expected to pursue higher-status professions compared to those from low SES schools. A secondary analysis of PISA data revealed a significant effect of students' expected occupational status on school performance (Tourón et al., 2018). This effect was found to be stronger in low GDP countries

(Gamazo & Martínez-Abad, 2020). In other countries, differences in occupational aspirations between social groups were found to be lower than expected suggesting shifting the focus of policies and practices from the conventional 'aspiration-raising' approach to a more transformational approach that promotes academic attainment and high expectations from the early years of students' lives (Gore et al., 2015; Harrison & Waller, 2018). One could argue that students' SES may influence their occupational expectations, which can subsequently impact their academic achievement. The study reported here attempts to test this assumption especially since the mediating role of expected occupational status has not been systematically examined in various countries.

Research aims

A review of the literature indicates that SES has an impact on student learning outcomes. The current study aims to explore potential pathways of indirect effect between SES and reading achievement through academic motivation. Specifically, three elements of academic motivation are treated as mediators: one subject-specific (i.e., *enjoyment of reading*) and two generic motivation elements (i.e., *mastery-approach orientation of achievement goals* and *expected occupational status*).

Mediation analysis provides the opportunity to explore indirect effects within a preestablished relationship. A mediation model typically sets up a chain pathway of effects from an independent variable (X) to a dependent variable (Y) through a third mediating variable (Hayes, 2017). Investigating mediation is crucial not only for advancing theory but also for designing targeted interventions aiming to promote quality and equity in education (Baron & Kenny, 1986; Creemers et al., 2010; Hall & Sammons, 2013).

The theoretical framework of this study is presented in Fig. 1. The model assumes that part of the effect of SES on reading achievement can be explained through three academic motivation elements. This is based on the hypothesis that SES can influence students' enjoyment in reading activities, tendency to master new knowledge, and occupational aspirations, which in turn can impact their reading performance at school. The model accounts for both direct and indirect effects of SES on student achievement. The figure also shows that the three elements of academic motivation are interrelated. This mediation model was tested in 38 European countries using data from PISA 2018 cycle.



Fig. 1 The hypothesized model

Within-country analyses were conducted in order to identify whether these three elements of academic motivation can be treated as mediators in each European country. Thus, this study aims to answer the following questions:

- (1) Which of the selected academic motivation elements, namely *mastery-approach orientation of achievement goals, enjoyment of reading,* and *expected occupational status* mediate the relationship between students' SES and reading achievement, and to what extent?
- (2) To what extent each of the three academic motivation elements can be treated as mediator in each European country?

Methods

Participants

The participants were 15-year-old students that took part in the PISA 2018 cycle. PISA is an international large-scale assessment study run by the Organisation for Economic Co-operation and Development (OECD) with the aim of evaluating educational systems and informing education policy. The evaluation data includes various measures from teachers, school principals, and, in some cases, parents. These measures include student performance in mathematics, science, and reading. The study was launched in 1997 and first administered in 2000 and since then it is conducted every three years. The domain focus of the PISA 2018 cycle was reading, and data was collected from 79 countries/educational systems. In the present study, the theoretical model presented in Fig. 1 is tested in European countries that participated in PISA 2018. For the purposes of this study, European continent, according to the United Nations classification, as well as the member states of the European Union. From those countries participating in the PISA 2018 cycle (n=41), 38 provided sufficient data for this study. As a result, data from 237,366 students was used in the present study.

Variables

Dependent variable: reading literacy

The dependent variable in all analyses is the reading literacy achievement score, which was the domain of focus in the PISA 2018 cycle. Reading literacy is considered a collection of skills and strategies that empower individuals to achieve diverse objectives in various situations through their interaction with texts (OECD, 2019b). PISA 2018 reading assessment provides scores on a combined scientific literacy scale, which include ten plausible value estimates in reading achievement for each student. These scales consist of three subscales: Locate Information, Understand, and Evaluate and Reflect (see OECD, 2019b). Based on OECD recommendations, the analyses used in the present study considered the ten plausible values reported in PISA 2018. Specifically, the analysis was run 10 times and the reported parameters were averaged. In each case, the variance of the result to consider the measurement error was taken into account in our attempt to check for statistical significance. To account for the different sampling probabilities, only

the student weights in the analysis were considered. This can, however, be attributed to the fact that a uni-level SEM analysis was carried out.

Independent variable: SES

The PISA index for economic, social, and cultural status (ESCS) is presented with values transformed into z-scores to enhance the comparability and homogeneity of the index across countries. The ESCS score is a composite of three equally weighted components, totalling 20 items. These components include the educational level of the parent with the highest educational attainment, the occupational status of the parent with the highest professional position, and information about the family's home possessions. The ESCS was found to have high reliability and cross-country comparability (Avvisati, 2020).

Mediating variables

Three elements of academic motivation were considered as mediators in this study. First, *mastery-approach orientation of achievement goals* comprises three items answered by students on a five-point Likert scale, ranging from "Not at all true of me" to "Extremely true of me" (e.g., My goal is to completely master the material presented in my classes). Second, *enjoyment of reading* is measured by five items rated on a four-point Likert scale, ranging from "Strongly disagree" to "Strongly agree". Three of them were negatively worded and thus reversed (e.g., I read only to get information that I need). Finally, *expected occupational status* is an open-ended question (i.e., What kind of job do you expect to have when you are about 30 years old?). Students' answers were coded and ranked according to the International Standard Classification of Occupations (ISCO) of International Labour Organization (ILO). The codes were then mapped to the PISA International Socio-Economic Index (ISEI) for interpretation, where higher scores express higher expected occupational status.

Data analysis

Before testing the theoretical mediation model (i.e., Fig. 1), Confirmatory Factor Analysis (CFA) was conducted to verify the factorial structure of the two latent/mediating variables (i.e., mastery-approach orientation of achievement goals and enjoyment of reading) in each country. Specifically, a CFA model was used for each country. Then a Multiple Group Confirmatory Factor Analysis (MGCFA) was conducted to determine if the two latent/mediating variables elicit similar response patterns across the 38 countries. Subsequently, Structural Equation Modelling (SEM) was used to test the mediation model, with the same process being replicated in each country. First, the direct effect of SES on academic achievement was calculated. Second, the selected elements of academic motivation were regressed with both the independent and dependent variables to identify their predictive power. Last, mediation path models that included all three mediating variables were constructed for each country (Baron & Kenny, 1986). The hierarchical structure of the PISA 2018 dataset (i.e., students nested within schools) is acknowledged. Since all variables of this study are situated at the student level, uni-level analyses were conducted by using EQS 6.4 software (Bentler, 2006). Each model was estimated by using normal theory maximum likelihood methods (ML). The ML estimation procedure was chosen because it does not require an excessively large sample size. To evaluate

the fitting of each model, the Root Mean Square Error of Approximation (RMSEA), the Standardised Root Mean Square Residual (SRMR), and the Comparative Fit Index (CFI) were considered. The robust X^2 test statistic and parameter estimates were also taken into account. CFI values greater than .90 or .95 are typically interpreted to reflect an acceptable or excellent fit to the data, correspondingly. RMSEA and SRMR values smaller than .05 or .08 are typically interpreted to reflect a reasonable fit to the data (see Hu & Bentler, 1999). Although a non-statistically significant value for chi-square may suggest a good model fit, leading us to accept the null hypothesis as predictions should match the actual data, a statistically significant chi-square was not interpreted as a problematic indication for the model's fit, considering the indicator's sensitivity to large sample sizes (Ullman, 2007). Finally, the factor parameter estimates for the models with acceptable fit were examined to help interpret the model. Non-statistically significant effects informed our decision-making to exclude specific mediators and refine the emerged models (Hu & Bentler, 1999).

Results

Testing the validity of PISA scales measuring Mastery-approach orientation of achievement goals and Enjoyment of reading

To test the factorial structure of the latent/mediating variables, a two-factor CFA model was formed for each country. Specifically, the model included three items loading on *mastery-approach orientation of achievement goals* and five items loading on *enjoyment of reading*. The correlation between the two latent variables was also considered. The third mediator, which refers to *expected occupational status*, is a single-item observed variable and was not included in the CFA model. Therefore, 38 separate within-country analyses were conducted.

The CFA models had a good fit in all countries, meeting the evaluation criteria (i.e., CFI > .95, SRMR \leq .05, and RMSEA < .05). In three countries, the value of RMSEA was found to be .07 which is slightly over the required value (i.e., Belarus, Czech Republic, and Greece). However, an RMSEA value below .08 can also be considered acceptable, indicating a fair model fit (Hu & Bentler, 1999). All factor loadings were found to be statistically significant at .05 level in all countries. The great majority had estimates over .70. In addition, the correlation between the two factors was statistically significant (p < .05) in all countries, with coefficients ranging from .14 to .45. The CFA model emerged from analysing the data of Denmark is presented in Fig. 2 as a typical example of the analyses conducted in each country.

MGCFA was then conducted to evaluate whether the PISA questionnaire elicits similar response patterns across the 38 countries for *mastery-approach orientation of achievement goals* and *enjoyment of reading*. Measurement invariance can be examined at three sequential levels: configural, metric, and scalar (Kline, 2015). First, configural invariance investigates the extent to which the pattern of fixed and free factor loadings among and between factors and items is the same. Configural invariance was supported since the value of RMSEA was found to be equal to .05 and the value of CFI was higher than .98. Therefore, the configural model fitted the data adequately [i.e., $X^2(668) = 12,270$, CFI=.986, SRMR=.038, RMSEA=.053]. The second step in testing



Fig. 2 First-order factor model emerged from analysing the data of Denmark with factor parameter estimates

for invariance involves examining metric invariance by comparing the baseline model, which allows factor loadings to be freely estimated across multiple groups, with the metric model, which assumes that factor loadings are equal across all 38 country groups. Differences between the two nested models can be examined using the X^2 difference test (Muthén & Muthén, 2012) and the Δ CFI (Cheung & Rensvold, 2002). Accordingly, all factor loadings for the two latent mediators were constrained to be equal across the 38 country groups, but both the corrected X^2 difference test and Δ CFI indicated that the factor loading invariant model was significantly worse than the baseline model. This implies that the metric invariance of the questionnaire was not supported for any of the two scales measuring *mastery-approach orientation of achievement goals* and *enjoyment of reading*. The lack of metric invariance makes factor score comparisons invalid since differing response mechanisms seem to underlie country-group answers to the items of each factor (Brown et al., 2015). It is, therefore, not possible to run an across-country analysis to test the proposed theoretical model especially since the results of MGCFA raises doubts about the cross-country comparability of the items measuring these two

elements of academic motivation. Consequently, separate within-country analyses (n=38) were conducted, and their main results are presented below. Variation in the results which may emerge from these 38 country-analyses should be interpreted by considering the lack of metric invariance.

Searching for the mediating effects of academic motivation

This subsection focuses on examining whether any of the selected academic motivation elements mediate the relationship between SES and reading achievement. A model that includes all mediators was constructed for each country, forming the theoretical hypothesis (see Fig. 1). The results indicate that in 10 countries, all mediators were statistically significant, and the model fit was satisfactory, confirming the study hypothesis. In the other 28 countries, only two of the factors fitted well as mediators. In these cases, we excluded the mediators that did not have a statistically significant effect with either the independent variable (i.e., SES) or the outcome variable (i.e., reading achievement). After excluding elements that could not be treated as mediators, the models showed significant improvement, reaching to a satisfactory fit in all cases. The final mediation models fit parameters for all countries are provided in Appendix. As a result of mediation, the direct effect of SES on reading achievement was substantially reduced in all countries. This suggests that part of the effect was accounted for by the specific academic motivation elements.

Overall, the results indicate that *expected occupational status* consistently mediates the relationship between SES and student achievement in all 38 European countries participating in PISA 2018. In addition, this factor had the largest mediating effect in most countries (n = 31), compared to the other two mediators. *Enjoyment of reading* fitted well the models as a mediator in almost all countries (i.e., 37 out of 38). Mastery-approach orientation of achievement goals served as a mediator in only 11 countries. The effect sizes of each mediator, as well as the direct and indirect effects of all models, are presented in Table 1. The explanatory power of academic motivation elements as mediators is more evident in certain countries, such as Croatia, Finland, Latvia, Estonia, and Malta. However, it remains significant in all educational systems irrespective of the total impact of SES on student performance. The final model for Belarus is presented in Fig. 3 as an example, representing the most common model with two mediators: expected occupational status and enjoyment of reading. The model indicates that the latent variable of enjoyment of reading and the observed variable of expected occupational status serve as mediators, explaining part of the effect of SES on reading achievement. SES continues to have a direct effect on reading achievement (with a coefficient of .295) but is lower than the initial (.445). Furthermore, a positive correlation between the mediators was observed (.238), as in all participating countries.

| Country | Initial direct effect of SES → Read. Ach | Final models | | | | | | | |
|---------------------------|---|--|------------------------------|-----------------------------|---------------------------------------|--------------|--------------|--|--|
| | | Direct effect of SES → Read. Ach after mediation | Total indirect effects | % of indirect effects | Indirect effect through the mediators | | | | |
| | | | | | Mast. App. Goals | Enj. of Read | Exp. Occ. St | | |
| Austria | .348 | .233 | .115 | 32.98 | NSS | .055 | .060 | | |
| Belarus | .445 | .295 | .150 | 33.68 | NSS | .059 | .090 | | |
| Belgium | .407 | .326 | .081 | 19.99 | NSS | .028 | .053 | | |
| Bosnia and Herzegovina | .271 | .153 | .118 | 43.55 | NSS | .018 | .100 | | |
| Bulgaria | .390 | .277 | .113 | 28.88 | NSS | .029 | .084 | | |
| Croatia | .266 | .111 | .155 | 58.34 | NSS | .023 | .132 | | |
| Cyprus | .259 | .184 | .075 | 29.01 | .005 | .021 | .049 | | |
| Czech Republic | .437 | .240 | .197 | 45.09 | NSS | .059 | .138 | | |
| Denmark | .336 | .272 | .064 | 19.01 | .003 | .031 | .030 | | |
| Estonia | .251 | .139 | .112 | 44.57 | .014 | .053 | .045 | | |
| Finland | .304 | .145 | .159 | 52.31 | NSS | .091 | .068 | | |
| France | .456 | .320 | .136 | 29.77 | NSS | .034 | .102 | | |
| Germany | .419 | .298 | .121 | 28.89 | NSS | .049 | .072 | | |
| Greece | .312 | .213 | .099 | 31.62 | NSS | .040 | .058 | | |
| Hungary | .433 | .250 | .183 | 42.22 | NSS | .056 | .127 | | |
| Iceland | .245 | .145 | .100 | 40.71 | .027 | .046 | .027 | | |
| Ireland | .319 | .179 | .140 | 43.89 | NSS | .090 | .050 | | |
| Italy | .279 | .177 | .102 | 36.52 | NSS | .023 | .079 | | |
| Kosovo | .222 | .182 | .040 | 18.04 | .007 | NSS | .033 | | |
| Latvia | .235 | .122 | .113 | 48.01 | NSS | .044 | .068 | | |
| Lithuania | .346 | .229 | .117 | 33.75 | .006 | .013 | .098 | | |
| Luxembourg | .419 | .304 | .115 | 27.49 | NSS | .045 | .071 | | |
| Malta | .271 | .151 | .120 | 44.21 | .003 | .034 | .082 | | |
| Moldova | .414 | .294 | .120 | 28.99 | .004 | .020 | .096 | | |
| Montenegro | .232 | .154 | .078 | 33.54 | NSS | .025 | .052 | | |
| Netherlands | .329 | .229 | .100 | 30.39 | NSS | .041 | .059 | | |
| Norway | .266 | .166 | .100 | 37.62 | .035 | .028 | .038 | | |
| Poland | .331 | .184 | .147 | 44.42 | NSS | .060 | .087 | | |
| Portugal | .353 | .221 | .132 | 37.43 | NSS | .051 | .082 | | |
| Romania | .401 | .279 | .122 | 30.43 | NSS | .023 | .099 | | |
| Russia | .267 | .196 | .071 | 26.49 | NSS | .045 | .026 | | |
| Serbia | .294 | .187 | .107 | 36.39 | NSS | .019 | .088 | | |
| Slovak Republic | .415 | .276 | .139 | 33.47 | .004 | .030 | .104 | | |
| Slovenia | .322 | .185 | .137 | 42.53 | NSS | .046 | .091 | | |
| Sweden | .317 | .247 | .070 | 22.05 | NSS | .044 | .026 | | |
| Switzerland | .385 | .245 | .140 | 36.41 | .001 | .065 | .074 | | |
| Ukraine | .377 | .276 | .101 | 26.72 | NSS | .046 | .054 | | |
| United King- dom | .271 | .174 | .097 | 35.88 | NSS | .048 | .049 | | |

Table 1 Direct and Indirect Effects of SES on Students' Achievement after Mediation

SES Socioeconomic Status, Read. Achiev. Reading Achievement, Mast. App. Goals Mastery-approach orientation of achievement goals, Enj. of Read. Enjoyment of reading, Exp. Occ. St. Expected occupational status, NSS Not statistically significant

Table 1 (continued)

All values are statistically significant at p < .05



Fig. 3 The model emerged from analysing the data of Belarus

Discussion

The present study investigates the mediating role of three academic motivation elements within the relationship between SES and reading achievement, utilizing data from the PISA 2018 cycle. The hypothesized model was tested in 38 European countries. The results suggested that *expected occupational status* appear to be a mediator in all countries. *Enjoyment of reading* was also found to be a mediator in almost all countries (i.e., 37 out of 38). This finding reveals that the mediating role of these two academic motivation elements is consistent across Europe. *Mastery-approach orientation of achievement goals* was found to be a mediator in only 11 countries. Implications of findings for understanding educational inequalities with regard to the dispositional effects of SES on students' outcomes can be drawn.

First, the mediating role of *expected occupational status* in all countries seems to provide further empirical support to the identity-based theory of motivation (Fisher et al., 2017). This theory argues that students' family social class is a dynamic force in their future identity construction and self-concept, including their occupational expectations. Such self-expectations have been linked to students' academic achievement in previous studies (Gamazo & Martínez-Abad, 2020; Tourón et al., 2018). The current study moves a step forward and demonstrates the indirect effect of personal occupational expectations,

which partly explains the influence of SES on reading achievement in European countries. This finding has practical implications, particularly in terms of equity. It highlights the importance of adjusting educational factors to moderate the impact of SES on student learning outcomes.

Enjoyment of reading has to do with the concept of intrinsic motivation (Ryan & Deci, 2000) since it is closely related with subject motivation (Creemers & Kyriakides, 2008). The mediating role of *enjoyment of reading* between SES and student achievement aligns with previous research findings that examined the role of a related construct, such as interest in reading (Kriegbaum & Spinath, 2016). This study seems to provide further evidence that students from higher socioeconomic backgrounds in European countries tend to derive more enjoyment from reading activities, which subsequently leads to better performance in reading. Higher SES families may also be more likely to promote an interest for reading in their children through various literacy-related activities and access to reading materials/books (Caro, 2018; Jacobs & Bleeker, 2004; Weigel et al., 2006; Wigfield et al., 2015), and through parental support (Gottfried et al., 1998, 2015). As a result, SES has an effect on enjoyment of reading, and through that, on reading achievement.

Mastery-approach orientation of achievement goals is based on the belief that mastering subjects and their topics will facilitate the attainment of relevant goals. Previous studies have demonstrated associations between SES and mastery goals (Berger & Archer, 2016, 2018; Jury et al., 2015). Families from higher socioeconomic backgrounds may cultivate a disposition that values academic performance through effort and commitment towards learning opportunities (Elliot, 1999; Hulleman et al., 2010; Kaplan & Maehr, 2007). The present study reveals that mastery-approach orientation of achievement goals mediates the relationship between SES and reading performance in 11 European countries. No apparent geographical, cultural, or language similarity among these 11 countries seems to exist. The equity gap was also searched in these countries. As explained by PISA, the equity gap refers to the magnitude of SES in explaining the variance in reading performance (OECD, 2019a). By considering the impact of SES on achievement, it was possible to classify these 11 countries into three categories: low, average, and high equity gap. Out of these countries, three were in the high equity gap group, one in the average, and seven in the low equity gap group. It was therefore not possible to attribute the fact that mastery-approach orientation of achievement goals was found to be a mediator in these countries and not in the other European countries. The results of the MGCFA were, finally, taken into account especially since metric invariance could not be established implying that the factor loadings of the items measuring this construct were not equally high across the European countries. It was found that the factor loadings in these 11 countries were all high (i.e., all of them were above .70, and 27 out of 33 were above .80). These results indicate that the PISA items used to measure mastery goals were good indicators of this construct in the 11 countries where this element of academic motivation was found to be a mediator. One could therefore claim that establishing a better scale measuring *mastery-approach orientation of achievement goals* may help us detect the mediating role of all three elements of academic motivation in all European countries. Future studies could also consider systematically collecting both quantitative and qualitative data to investigate why and which achievement goals mediate the relationship between SES and reading achievement in certain contexts. Such investigations may inform educational systems on how to address the orientation of achievement goals.

Finally, the main limitations of this study are acknowledged and suggestions for further research are provided. First, the study is cross-sectional, which means that it does not allow for the establishment of definitive causal relationships, since the observed effects refer to the achievement at a specific time point and not to achievement gains. Longitudinal studies should be conducted to uncover predictive effects and investigate potential mechanisms underlying the observed relationships. Second, we examined the mediating role of only three elements of academic motivation. Our selection was limited to the variables available in the PISA dataset, which attempts to capture each concept with a relatively small number of items. For example, mastery-approach orientation of achievement goals was measured with only three items, which may limit the complete affordance of the respective theory referring to multiple orientations of achievement goals (Dekker & Fischer, 2008; Elliot & McGregor, 2001; Elliot et al., 2011). Future studies should investigate the extent to which other elements of academic motivation could also be treated as mediators. In this way, a comprehensive theoretical model explaining how SES affects achievement through various elements of academic motivation may emerge. Third, from the mediators used in this study, enjoyment of reading is subject-specific, while the other two mediators were generic motivation elements that are not related only with reading achievement. Further studies are, therefore, needed to investigate the extent to which the two generic motivation elements (i.e., expected occupational status and masteryapproach orientation of achievement goals) can be treated as mediators of the effect of SES on student achievement in various subjects. Finally, this secondary analysis made use of data in European countries only and participants were 15-year-old students. Further studies could search for comparable mediation paths in regions outside of Europe and with different age groups of students.

Implications for policy and practice can also be drawn from this study. First, schools and teachers should consider that students from lower socioeconomic backgrounds may require additional support to stimulate their intrinsic impetus towards literacy activities and to develop positive attitudes towards reading. This could be achieved by employing on-task activities and instructional techniques to enhance students' learning disposition, such as orientation, exploration, and self-regulated learning tasks (Kyriakides et al., 2020; Paris & Paris, 2001). For example, research has shown that effective teachers provide orientation tasks to their students which promote students' motivational dispositions (Kyriakides et al., 2018). Orientation refers to the provision of learning objectives for a

specific task, lesson, or series of lessons by the teacher, as well as exploring with students why an activity takes place in the lesson. This exploration may encourage students to recognize the utility and practicality of new learning content or activities, leading to increased participation in the classroom. Different learning needs should be addressed through distinct types of orientation tasks, with the goal of making learning meaningful for all students, including those from low-SES background (Kyriakides et al., 2018). In this respect, teachers should encourage low-SES students to understand the importance of reading both inside and outside the classroom. Accordingly, such teaching methods may enhance students' self-regulation and help them gradually become independent readers. Second, schools and teachers may serve as agents of support and guidance for students, helping them to raise their personal expectations and overcome any barriers that may impede their educational and occupational success (e.g., Oyserman et al., 2021). Particular attention should be given to students from low socioeconomic backgrounds to help them improve their academic standards and consider career paths outside of their family and social circles. A systematic effort is required to connect these aspirations with the educational process by providing ongoing support and promoting successive learning achievements (Gore et al., 2015; Harrison & Waller, 2018). During this process, differentiated teaching is likely to provide activities that are meaningful and goals that are equally attainable by all students, regardless of their socioeconomic background (Kyriakides et al., 2020). Differentiation of teaching aims to address the needs of distinct groups of students, and it can be seen as a characteristic of effective teaching, especially towards providing equal opportunities in the classroom (Kyriakides et al., 2013; Seidel & Shavelson, 2007). Similarly, parental involvement should be encouraged through the establishment of comprehensive school partnership policies. School initiatives could focus on guiding parents to promote the value and utility of reading at home through extracurricular activities, as well as raising their educational and occupational expectations for their children (Kyriakides et al., 2018).

Disparities in student learning based on SES persist as a major concern for educational systems worldwide. The current study provides some evidence of the indirect pathways through which SES affects reading achievement stressing the role of academic motivation. Taking into consideration that academic motivation is a malleable characteristic (Lazowski & Hulleman, 2016), strategies and action plans to promote equity at school level by making use of the findings of this study could be developed.

Appendix

See Table 2.

| Country | X ² | df | CFI | RMSEA | SRMR | RMSEA 90% CI |
|------------------------|----------------|----|------|-------|------|--------------|
| Austria | 214.865* | 15 | .990 | .044 | .020 | (.039, .050) |
| Belarus | 331.393* | 15 | .975 | .060 | .032 | (.055, .066) |
| Belgium | 347.668* | 15 | .986 | .051 | .022 | (.047, .056) |
| Bosnia and Herzegovina | 330.516* | 13 | .977 | .061 | .038 | (.056, .067) |
| Bulgaria | 504.786* | 13 | .956 | .085 | .064 | (.078, .091) |
| Croatia | 412.008* | 13 | .976 | .068 | .038 | (.063, .074) |
| Cyprus | 645.157* | 34 | .961 | .057 | .044 | (.053, .061) |
| Czech Republic | 574.968* | 15 | .976 | .073 | .025 | (.068, .078) |
| Denmark | 795.041* | 34 | .976 | .054 | .029 | (.051, .057) |
| Estonia | 775.39* | 32 | .963 | .066 | .037 | (.062, .070) |
| Finland | 251.473* | 15 | .987 | .053 | .020 | (.047, .059) |
| France | 435.832* | 13 | .975 | .072 | .038 | (.066, .078) |
| Germany | 197.086* | 15 | .990 | .047 | .021 | (.041, .053) |
| Greece | 347.117* | 15 | .970 | .059 | .030 | (.053, .064) |
| Hungary | 270.66* | 13 | .985 | .062 | .032 | (.056, .069) |
| Iceland | 361.093* | 34 | .979 | .054 | .033 | (.049, .059) |
| Ireland | 279.836* | 15 | .985 | .056 | .021 | (.051, .062) |
| Italy | 643.216* | 13 | .980 | .064 | .031 | (.060, .068) |
| Kosovo | 119.835* | 5 | .987 | .067 | .019 | (.057, .078) |
| Latvia | 335.263* | 13 | .969 | .068 | .034 | (.062, .075) |
| Lithuania | 959.643* | 32 | .966 | .065 | .047 | (.061, .068) |
| Luxembourg | 216.088* | 15 | .985 | .051 | .024 | (.045, .057) |
| Malta | 279.451* | 34 | .983 | .046 | .029 | (.041, .051) |
| Moldova | 446.939* | 32 | .979 | .049 | .034 | (.045, .053) |
| Montenegro | 351.918* | 15 | .974 | .058 | .029 | (.053, .063) |
| Netherlands | 329.381* | 15 | .977 | .066 | .027 | (.060, .073) |
| Norway | 387.157* | 34 | .988 | .042 | .025 | (.039, .046) |
| Poland | 399.946* | 13 | .975 | .073 | .038 | (.067, .079) |
| Portugal | 265.821* | 15 | .985 | .053 | .021 | (.048, .059) |
| Romania | 192.561* | 13 | .985 | .052 | .030 | (.046, .059) |
| Russia | 295.228* | 13 | .979 | .053 | .030 | (.048, .059) |
| Serbia | 463.016* | 13 | .969 | .072 | .047 | (.067, .078) |
| Slovak Republic | 534.764* | 32 | .980 | .051 | .033 | (.048, .055) |
| Slovenia | 286.86* | 15 | .982 | .053 | .023 | (.048, .059) |
| Sweden | 370.465* | 15 | .974 | .066 | .027 | (.060, .071) |
| Switzerland | 741.748* | 34 | .970 | .060 | .039 | (.056, .064) |
| Ukraine | 322.308* | 13 | .964 | .063 | .031 | (.057, .069) |
| United Kingdom | 538.199* | 15 | .987 | .050 | .020 | (.047, .054) |

Table 2 Final mediation models' fit parameters

* p<.001

Abbreviations

| CFA | Confirmatory Factor Analysis |
|-------|--|
| CFI | Comparative Fit Index |
| CI | Confidence Interval |
| ESCS | Economic, Social, and Cultural Status |
| ILO | International Labour Organization |
| ISCO | International Standard Classification of Occupations |
| ISEI | International Socio-Economic Index |
| MGCFA | Multigroup Confirmatory Factor Analysis |
| OECD | Organisation for Economic Co-operation and Development |
| PISA | Programme for International Student Assessment |
| RMSEA | Root Mean Square Error of Approximation |
| | |

| SEM | Structural Equation Modelling |
|------|---|
| SES | Socioeconomic status |
| SRMR | Standardized Root Mean Squared Residual |
| ΔCFI | Change in CFI |

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Declarations

Ethics approval and consent to participate

This is a secondary analysis of existing data. Data in this study are publicly available. Data are fully anonymized without any possibility to identify individual student and school given the information in the study. Therefore, no requirement for ethical approval or consent to participate was needed.

Consent for publication

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Competing interests

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