

Identifying school climate variables associated with financial literacy outcomes in PISA 2018 data: A multilevel structural equation modelling approach

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Abstract

Repeated financial crises and the current pandemic emergency all exposed the harsh consequences of financial illiteracy shared by large proportions of the general population. Although remedial plans were shown to be most effective if introduced early in life, the exact relationships among student-, family- and school-factors behind youth's financial literacy outcomes were not yet fully understood. Using the latest Programme for International Student Assessment (PISA) 2018 financial literacy data and the theoretical framework of school climate recently proposed by Wang & Degol (2016), this study examined the mechanism for individuals' financial literacy performance in the context of their school environment. A multilevel structural equation model (MSEM) revealed that 33.5% of the variation in students' financial literacy scores could be explained by student-level variables and 47.7% by school-level factors for the full PISA 2018 sample. The MSEM also highlighted key roles financial knowledge and financial confidence played in mediating students' financial literacy performance. Both financial education and financial socialisation were positively associated with financial knowledge and confidence, but their direct effects on financial literacy scores were negative once the mediation effects have been accounted for. Strong contextual effects suggested the important role of school

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environment for facilitating individual-level effects. This study took a person-ecological approach for reconciling two strands of research efforts that focused either on students or on schools. It also confirmed the importance of school education, parental involvement, safety and educational resources for bringing about greater financial knowledge and confidence and identified potential improvement opportunity for pedagogical practices for further advancing students' financial problem-solving capabilities.

Keywords: educational economics, human capital, school climate, financial literacy, PISA, multilevel modelling, structural equation modelling, contextual effect

JEL: A21, C13, C31, I21

1. Introduction

1.1. *An Atlas of Financial Illiteracy*

Repeated economic crises in recent memory have exposed the harsh consequences of financial *illiteracy* shared by high proportions of the general population. Low financial literacy was directly linked with negative credit behaviours such as high amount of credit card debt (Norvilitis & MacLean, 2010), high costs of borrowing (Huston, 2012; Pak, 2018), poor mortgage choices (Cox et al., 2015) and subsequent delinquency and home foreclosure (Agarwal et al., 2015b; Gerardi et al., 2010). Poor financial decisions made early in life can have profound long-term economic and societal impacts (Montoya & Scott, 2013) such as forgoing medical care (Lusardi et al., 2015), mental health crises (Stone et al., 2018) and geronto-poverty resultant from insufficient retirement provision (Lusardi & Mitchell, 2007, 2008). Borrowers' collective misjudgement on mortgage risks kicked start the subprime crises and in combination with Wall Street greed and laissez faire regulatory attitudes that eventually triggered the avalanche of 2008 financial crisis, the first domino of world-changing events whose impact continues reshaping global economics and geopolitics landscape.

Even more concerning is the pervasive global distribution of financial illiteracy. Deficiencies in financial capability had been observed not only in emerging economies (Karakurum-Ozdemir et al., 2019) such as Colombia (Cao-Alvira et al., 2020), Mexico (Arceo-Gómez & Villagómez, 2017; Böhm et al., 2021), India (Agarwal et al., 2015a; Kiliyanni & Sivaraman, 2016; Utkarsh et al., 2020), Indonesia (Cole et al., 2009; Khoirunnisaa & Johan, 2020), Turkey (Akben-Selcuk & Altiok-Yilmaz, 2014), and Eastern European countries (Belás et al., 2016; Opletalová, 2015; Reiter & Beckmann, 2020) but also in advanced economies such as Australia (Ali et al., 2014; Taylor & Wagland, 2013; Thomson & De Bortoli, 2017), Canada (Boisclair et al., 2017), Germany (Bucher-Koenen et al., 2017; Erner et al., 2016), Austria (Silgoner et al., 2015), the UK (Barnard et al., 2021) and the USA (Breitbach & Walstad, 2016; Gale et al., 2012; Lusardi et al., 2010). International comparisons also reported low financial literacy in many Asian countries (Yoshino et al., 2015) and member states of the Organisation for Economic Co-operation and Development (OECD) (Cupak et al., 2018; Lusardi, 2015), particularly amongst the young (De Beckker et al., 2019), females, lower educated (Klapper & Lusardi, 2019) and somewhat surprising, inhabitants of countries with more generous social security systems (Jappelli, 2010).

1.2. Financial Literacy as a Necessity

One major reason behind the escalating interests in citizens' financial literacy can be attributed to the policy adjustment taking place in the past two decades. The neo-liberal ideology of reducing government involvement in the economy had crowded out societal care such as pension, health and education from the collective via the state to the individuals (Gilbert, 2002). In a post-financialisation world (Krippner, 2005), the primary goal of political economy has shifted from the redistribution of wealth to the incorporation of individuals within the mainstream financial architecture (Regan & Paxton, 2003). The succession of the asset-based welfare system to the income-based model (Finlayson, 2009), however, was by no means unique to the Anglosphere. The Hartz

reforms of 2003/04, according to [Seeleib-Kaiser \(2016\)](#), had significantly altered Germany’s post-war social welfare arrangement, leading [Ferragina et al. \(2015\)](#) to re-classify Germany from a conservative welfare into a liberal welfare state comparable to the United Kingdom. Although a detailed account of the history, politics and moral philosophy of social welfare reforms is beyond the scope of this project, this background information does confirm financial literacy as a social necessity independent of one’s beliefs or preference.

Strengthening citizen’s financial literacy also generates substantial social returns. The latest U.S. Department of Justice statistics showed a total loss of near 3.25 billion dollars to financial fraud in 2017 ([Morgan, 2021](#)) while similar figure was estimated to be 190 billion pounds for the UK, more than the public spending on health and defence *combined* ([Gee, 2018](#)). A financially informed and alert individual is less likely to fall victim to fraud and scams ([Gamble et al., 2015](#); [Lusardi, 2012](#)) although this effect was thought to be moderated by one’s ability to recognise and resist manipulative tactics ([Drew & Cross, 2016](#)). In addition to the monetary benefit, some scholars see financial education as a service to civics and democracy since a financially literate population is more resilient to political opportunists. Teaching citizens—as well as the young who will be future voters—about taxation, tariff, outsourcing, labour market transition and career choices protects not only individuals’ financial security and dignity but also informs and empowers voting behaviours through which governments are scrutinised and democracy is upheld ([Davies, 2015](#)) and even modified ([Arthur, 2016](#)). After all, financial literacy can be seen as an investment in human capital ([Lusardi & Mitchell, 2014](#)). Today’s young people are growing up in a society in which the financial landscape is complex and the financial responsibilities of citizens are substantial.

1.3. Profiles of Successful Learners

As the cellular constituent of the broad economy, personal finance success has long attracted interests from policy makers and educators. Numerous research efforts have been devoted into identifying the common traits shared by

individuals displaying knowledge, confidence and behaviour conducive to high financial literacy performance. Potrich et al. (2015b) found well-educated individuals from wealthy families and earning good income themselves had the highest propensity to demonstrate substantial financial literacy. The positive correlations between socioeconomic status and financial literacy performance was observed not only in adult samples but also in late year school students. Using school enrolment data from the State of Victoria, Australia, Ali et al. (2016) found socio-economic variables such as urban-rural locations, non-English speaking at home as well as parental education and occupations accounted for very high proportion of the variations in students' financial literacy test scores. Negative correlations, on the other hand, had been observed between cross-border relocation experience and financial literacy performance. Using 2012 PISA data, Gramaŧki (2017) applied a propensity score matching technique to 15-year-old migrant students and concluded that, everything else being equal, second generation migrants underperformed their native peers by 0.15 standard deviations (SD) and this penalty increased to 0.30 SD for first generation migrants.

In addition to social factors, there appeared to be a persistent and sizeable sex difference in financial literacy performance with greater awareness of monetary matters amongst males (Atkinson & Messy, 2011; Lusardi et al., 2010) regardless of test question sophistication (Agnew & Cameron-Agnew, 2015; Agnew & Harrison, 2015) and across countries (Bucher-Koenen et al., 2017). Correlational studies largely discounted macroeconomic variables behind male advantages in financial literacy performance (Chambers & Asarta, 2018) in favour of factors at the family level (Chambers et al., 2019), corroborating the observation that females appeared to start falling behind too early in life (Driva et al., 2016) to allow market force to take effect (Preston & Wright, 2019). Culture did seem to play a partial role in explaining sex difference (Grohmann, 2016) with gender gaps appearing significantly smaller in countries with more egalitarian financial arrangement for custody and marriage (Hospido et al., 2021). Additional proposals were also put forward ranging from historic forces (Bottazzi & Lusardi,

2020), risk aversion (Chen & Garand, 2018), lacks of confidence (Bucher-Koenen
 110 et al., 2021; Danes & Haberman, 2007) or problem-solving attitudes (Longobardi et al., 2018), to imbalanced household decision-making (Fonseca et al., 2012). Consensus remains strong amongst existing literature advocating more inclusion of women in promoting population’s financial literacy and well-being.

1.4. *Measuring Financial Literacy*

115 All intervention programs aiming for financial literacy advancement must be constructed based on sound evidence. Amongst competing inventories, OECD’s Programme for International Student Assessment (PISA) stands out as a comprehensive and reliable source of data for measuring 15-year-olds’ financial literacy outcomes thanks to OECD’s careful sampling procedure and attention to
 120 construct validity of measurement. Four technical features of PISA are crucial for the architecture of this study. First, following statistical theory, PISA designers acknowledged the hierarchical nature of education research data such that students are nested in schools, and schools are further nested in countries. Second, one student weight is assigned to each observation in order to account
 125 for the fact that not all schools in a country are equally likely to be sampled by the PISA organiser; and given a particular school that has been chosen, not every student in this school is equally likely to be asked to participate in the test (Rust, 2014). A third complication arises from the “planned missingness” in students’ responses because each participant is only given a small number of
 130 questions relative to the entire test bank in order to ensure their responses are not undermined by tiredness (von Davier, 2014), leading to the outcome variables being represented by multiple plausible values. Fourthly, PISA consulted and synthesised multiple schools of thoughts (OECD, 2019a) in constructing their financial literacy framework. As a result, 2018 PISA data set (OECD,
 135 2020a) provides not only variables measuring behavioural competency outcomes but also cognitive and affective factors such as familiarity with concepts of finance and confidence about financial matters, enabling a nuanced study design involving decomposing the total effect of financial literacy performance into its

knowledge, affect, and application components.

140 1.5. Program Effectiveness for Advancing Financial Literacy

Since youths partition their time between schools and families, research efforts aimed at promoting young people’s financial literacy over the years evolved into two strands: on the design and evaluation of school financial education programs, and on the influence of home environment through the process of
145 financial socialisation—the intentional or involuntary transmission of financial concepts which are required to functioning successfully in society (Bowen, 2002). A recent meta-analysis conducted by Kaiser & Menkhoff (2020) found that while school financial education programs had sizeable impacts on *financial knowledge* (+0.33 *SD*) similar to education interventions in other domains, their effect on
150 students’ *financial behaviour* is quite small (+0.07 *SD*). This conclusion added to a list of weak or non-findings regarding the long-term behavioural effect brought about by school financial education programs. Brown et al. (2016), for instance, reported mixed outcome in students’ long-term financial well-being depending on the programs received; whereas Cole et al. (2016) observed that
155 traditional personal finance courses lacked any explanatory power in accounting for graduates’ financial outcome once the additional mathematics training in which finance topics were packaged has been controlled for. Despite careful controls and thoughtful study designs, correlating classroom interventions and young people’s financial literacy outcomes has repeatedly yielded paradoxical
160 results of non-significant or even negative relationship; some positive findings remained small in magnitudes and/or were sensitive to robust analyses.

Literature along the financial socialisation line of enquiry delivered more consistent findings. Building on the acknowledgement that families serve as information filters from the outside world (Danes & Haberman, 2007) as well as
165 the foundation for youth’s continued financial concept formation, Gudmunson & Danes (2011) put forward a family financial socialisation theory to accommodate both the process and the outcome for variations in young people’s financial capabilities. Using structural equation modelling, Jorgensen & Savla (2010) was able

to show that perceived parental influence had a direct and moderately significant
 170 influence on financial attitude, did *not* have an effect on *financial knowledge*, and
 had an indirect and moderately significant influence on financial behaviour, me-
 diated through financial attitude. This attitude(A)–behaviour(B)–cognition(C)
 conceptualisation of financial literacy (Potrich et al., 2015a) continues to influ-
 ence subsequent research effort. More recently, Moreno-Herrero et al. (2018)
 175 continued this line of enquiry by applying multilevel regression analyses to the
 2015 PISA data and reported that students’ financial literacy was associated
 mainly with understanding the value of saving and discussing money matters
 with parents. In addition, exposure and use of financial products, in particular
 holding a bank account, improved students’ financial knowledge as well.

180 1.6. Research Questions

The current study wishes to incorporate both the school intervention and
 family socialisation arms of existing literature under a uniform framework re-
 cently proposed by Wang & Degol (2016) named “school climate”. Besides
 the classroom activities (ACADEMIC) and parental involvement (COMMUNITY)
 185 aspects reviewed earlier, the school climate framework also acknowledges the
 importance of school safety (SAFETY) and adequate resources (INSTITUTIONAL
 ENVIRONMENT) for cultivating a healthy and thriving young generation. By
 taking advantage of the latest wave of 2018 PISA financial literacy results, this
 project aims to answer these two research questions:

190 RQ1. To what extent can the variation in students’ financial literacy outcomes
 be accounted for by each of the school climate variables?

RQ2. How does the school-level climate impact on individual learners’ financial
 literacy acquisition process?

1.7. Article Overview

195 This thesis is structured as following: Key concepts such as school climate
 and financial literacy are explained in detail in Section 2 along with the hypoth-
 esised relationship between each construct. Section 3 will explain the 2018 PISA

financial literacy data including sample characteristics and variable formation. A multilevel structural equation model will be proposed in this chapter as well as related technical considerations such as weights, estimators and the model evaluation procedure. Subsequently, analysis results will be presented in [Section 4](#) including both descriptive and inferential statistics. Coefficients from student- and school-levels will be presented separately first, then linked together by the contextual effects. Finally, [Section 5](#) will discuss the pedagogical and policy implications of these findings, pointing out the limitation on causal inference as well as directions for future research effort.

2. Theoretical Framework

2.1. School Climate

A positive school climate is easier to recognise but difficult to define ([OECD, 2019b](#)). When organising school attributes into frameworks, early studies loosely clustered themselves into two camps along the concrete–abstract spectrum. When researching on students’ behavioural problems and emotional distress, for example, [Kuperminc et al. \(1997\)](#) recognised the insufficiency of using observable characteristics of a school as the metric for its managerial success but adopted a utilisation and perception approach based on social-ecological and developmental theories. Such emphasis on school users’ *perception* continued into [Esposito \(1999\)](#)’s study of students’ social disadvantages on their academic outcomes, with exploratory factor analysis results suggesting a five-factor model including student academic orientation, parent-school relationships, security, administration and teacher-student relationships. [Freiberg & Stein \(1999\)](#), on the other hand, took a more idealised view of school climate as “the heart and soul of a school”—the very “essence of a school that leads a child, a teacher, an administrator, a staff member to love the school and to look forward to being there each school day” (p. 11). However broad or narrow the definition, both ends of the spectrum signalled that the ultimate utility of any school climate framework should facilitate our understanding of student development.

With this goal in mind, Wang & Degol (2016) surveyed six theories for the purpose of building a multidimensional school climate framework. Since schooling is an interaction between individuals and every environment immersing them (the bio-ecological theory), students inevitably develop protective and/or maladaptive behaviours (risk and resilience perspective) in addition to all existing bonds they formed with parents (attachment theory). Thanks to students' ever-growing capabilities, schools may then encourage learners to connect, invest, participate and believe in their learning environment (social control theory), by bridging their motivation towards success criteria (social cognitive theory) and by removing barriers (stage- environmental fit theory) to growth. These theories jointly guided a literature review and coding exercise that led to a four-domain, 13-dimension structure of school climate framework (see Figure 1, Wang & Degol, 2016, p. 318). This current project approached Wang & Degol's (2016) ontology from the domain-level and referred the ACADEMIC climate as the overall quantity and quality of the teaching-learning activities; COMMUNITY as the engagement and interpersonal ties schools maintain with stakeholders such as and in particular parents; SAFETY as the degree of physical and emotional security afforded by schools; and INSTITUTIONAL ENVIRONMENT as the organisational and structural features of schools in particular their educational resource availability. All four branches of the school climate framework serve as platforms upon which students' financial literacy can be constructed.

2.1.1. School Financial Education Programs (FEdu)

Amongst the many redress schemes aimed at promoting citizens' financial capability, the return on investment was the highest when direct classroom interventions were applied to the young. Lusardi & Mitchell (2014) have shown that providing financial knowledge to high schoolers before they enter the labour market increased their well-being by approximately 82% of their initial wealth, while the rate of return was around 56% for college graduates. In order to test the causal effects between classroom interventions and students' financial understanding Amagir et al. (2018) reviewed 24 studies evaluating the effectiveness

of secondary school financial education programs using either random control trails or quasi-experimental research designs, and found all but two reported positive effects between school interventions and students' financial knowledge. The effect sizes, however, appeared to be dependent on the length of the delivery periods, with one long and intensive program yielding $d = 0.981$ for basic economic knowledge and 1.020 for personal finance but only $d = 0.221$ to 0.267 from a short series. The review paper also found general positive correlations between school programs and students' attitudes towards finance-related matters (FA) such as confidence. Kaiser & Menkhoff (2020) recently updated the literature using publications employing (quasi-)experiment designs and reported an average treatment effect of 0.331 for the 31 pooled samples and 0.369 for the 12 high school sub-samples on financial knowledge (FC) gains. Based on existing literature, the current project therefore hypothesises that

H1: There exists a positive association between FEdu and FC.

H2: There exists a positive association between FEdu and FA.

The relationships between school financial education programs and students' subsequent financial *behaviours* (FB), on the other hand, were more mixed. Early studies by Bernheim et al. (2001) examined the impact of the progressive introduction of financial curriculum mandates in many US states between 1957 and 1985 on recipients' saving behaviour and net worth at the end of 1995. Analyses showed that (a) systematic differences in saving rates across states did not appear until after mandates were imposed, (b) saving rates only started to raise many years after the mandate, and (c) net worth was higher by roughly one-year's worth of earnings for an average individual having been exposed to the mandate. This 20-year time horizon study led the authors to the conclusion that school financial education efforts *did* have meaningful impact on recipients' life-long financial well-being albeit with significant implementation lags. Most recently, a German study showed causal evidence that teaching financial literacy to 16-year-olds had significant short- and longer-term effects on risk and time preferences (Sutter et al., 2020). This result lent weight to an earlier randomised

controlled trial with 3,000 Grade 9 students in Spain (Bover et al., 2018) where students showed more patience in hypothetical saving choices both immediately after the treatment and three months later. Frugality, delayed gratification, faster debt clearance and decreased reliance on credit financing were all documented by Carlin & Robinson (2012) in the US after a finance-related theme park training. Other publications, however, showed weak or even non-findings for financial behaviour improvement. A short financial education program on German high schoolers, for example, showed reduction in impulse purchases but no significant increase in savings (Lührmann et al., 2015). A review article by Fernandes et al. (2014) found school programs explained only 0.1% of the variance in financial behaviours and decaying to negligible levels 20 months later. Since the current literature is yet to reach consensus about the strength of the relationship between school interventions and students' financial behaviour, it is prudent to hypothesise:

H3: The relationship between FEdu and FB is non-negative.

2.1.2. Parental Influence and Financial Socialisation (FSoc)

Although financial capability is an important integral of adulthood, the process of acquiring the financial knowledge and skills begins in early childhood. Parents provide a context in which children learn what money is, for instance, and how it is used and saved (Birbili & Kontopoulou, 2015). Whether intentionally or informally, financial intuition is passed around the household through frequent interactions, conversations, and lessons. Consequently, the financial knowledge and skills acquired while growing up at home form the foundation for the financial attitudes and behaviours carried into adulthood (Serido & Deenanath, 2016). Using a panel data set from the Dutch DNB Household Survey between 2000 and 2012, Bucciol & Veronesi (2014) reported that parental teaching about savings increased the likelihood of adult saving by 16% and the saving amount by approximately 30%. Similar intergenerational effect was observed from longitudinal studies in the US, linking adolescents' observation of parents' responsible financial behaviour to their own good deci-

sions and actions later in life (Tang, 2017). Moreno-Herrero et al. (2018) further examined the relationship between students' financial socialisation experience and their financial literacy outcome using PISA 2012 data. By operationalising
320 financial socialisation as the frequency of money-related discussions with parents, saving habits and bank account ownership, the authors reported positive associations between financial socialisation and PISA financial literacy scores. These studies suggested that

H4: The relationship between FSoc and FC is non-negative.

325 H5: FSoc is positively related to FA.

H6: FSoc is positively related to FB.

2.1.3. School Safety (Safety)

School safety is the prerequisite for any learning and growth. As a social construction, the definition of school safety can be subjective and coloured by
330 one's social location, cultural experiences and school context (Cornell & Mayer, 2010). Since its initial definition as an absence of weapons and/or homicides in school settings (Skiba et al., 2006), the understanding of school safety has evolved substantially to emphasise the prevention of overt and covert violence such as bullying behaviours (physical safety, Jimerson et al., 2012), caring and
335 supportive staff as well as the availability of mental health services (emotional safety, Kuperminc et al., 1997), and delinquent acts committed by students against their peers and teachers (school order and discipline, Gottfredson et al., 2005). Although studies specifically examining the relationship between adverse school experiences such as being bullied and financial literacy performance were
340 yet to emerge, Kutsyuruba et al.'s (2015) review article on the associations between school safety and students' general academic attainment may serve as a general guide suggesting

H7: There is a positive association between Safety and FC.

H8: There is a positive association between Safety and FA.

345 H9: There is a positive association between Safety and FB.

2.1.4. Institutional environment (Resource shortage)

Both the physical and social infrastructure of schools greatly influence users' experience and functioning. An optimal learning environment requires appropriate heating and cooling, ample supply of lighting, necessary acoustic control
350 and regular maintenance (environmental adequacy, [Uline & Tschannen-Moran, 2008](#)). Secondly, structural organisation such as class size was also linked to students' education outcomes ([Finn & Achilles, 1999](#)). Lastly, although the core of classroom instruction involves the interaction between teachers and students, the quality of such interaction is frequently facilitated by the equipment,
355 materials, and supplies. Optimising resource utilisation has been attributed to improved student attainment particularly for schools in impoverished communities ([Miles & Darling-Hammond, 1998](#)). Based on the observed impact school resource had on learner outcomes, this study hypothesises that

H10: Resource shortage is negatively associated with students' average FB.

360 H11: Class size is negatively associated with students' average FB.

2.2. Financial Literacy

In its official publication *PISA 2018 Assessment and Analytical Framework* ([OECD, 2019a](#)), the OECD provided an explicit definition of "financial literacy" as

365 the knowledge and understanding of financial concepts and risks, and the skills, motivation and confidence to apply such knowledge and understanding in order to make effective decisions across a range of financial contexts, to improve the financial well-being of individuals and society, and to enable participation in economic life (p.
370 128)

with emphases on both the thinking and behaviour that characterise such construct and the purposes for developing this particular literacy. Of particular

relevance to the current project are the knowledge, confidence and application aspects of financial literacy.

375 *2.2.1. Knowledge Aspect of Financial Literacy (FC)*

Since poor financial behaviours have been associated with a lack of financial knowledge (Hastings et al., 2013; Lusardi & Mitchell, 2014), one major goal of financial literacy interventions is to ensure students receive the information and support they need to make responsible and appropriate financial decisions
380 confidently, both in their school years and in adult lives (OECD, 2020b).

2.2.2. Confidence Aspect of Financial Literacy (FA)

The positive association between students' confidence and their academic attainment has also been well documented. By synthesising one decade of large-scale international assessment data, Lee & Stankov (2018) found self-
385 beliefs (labelled "self-efficacy" in PISA and "confidence" in TIMSS) to be the strongest non-cognitive predictor for students' mathematics achievement. Similar relationships had also been observed in the realm of financial literacy such as Arellano et al.'s (2014) study using the Spanish portion of the PISA 2012 financial literacy data, and Borges Ramalho & Forte's (2019) results based on the
390 Brazilian sub-sample of the 2016 OECD/INFE International Survey of Adult Financial Literacy Competencies.

2.2.3. Application Aspect of Financial Literacy (FB)

Although financial knowledge and confidence forms the very foundation upon which financial capability can be developed, it is individuals' willingness and
395 ability to *apply* such capability through financial decision-making that counts as the ultimate outcome of their financial literacy (Huston, 2010). Operationalise financial behaviour as one's ability to solve real-world financial problems also make it feasible to capture financial behaviours within a one-hour test, with the result reflecting one's understanding, affinity and application of their financial
400 capability. The OECD paid particular attention to upholding financial literacy as an independent construct. Such consideration was important because one's

financial capability was known to covary with both numeracy (Geiger et al., 2020; Ozkale & Erdogan, 2020b,a; Sole, 2014) and literacy (Bay et al., 2014) skills. Empirical studies using diverse samples from the Philippines (Indenfenso & Yazon, 2020) to Sweden (Skagerlund et al., 2018) reported correlations between numeracy and financial knowledge/literacy to be between approximately .61 and .52. In order to minimise the impact of low arithmetic skills (Huston, 2010), financial formulæ were never required in any problem solving tasks and students may use the on-screen calculator at any time of the test. Furthermore, stimulus material and task statements were generally designed to be as clear, simple and brief as possible to minimise the impact of low reading ability on financial literacy scores.

Both financial knowledge and confidence are hypothesised to contribute to students' performance in finance-related problem solving:

H12: FC is positively related to FB.

H13: FA is positively related to FB.

2.3. Summary of Relationships between Constructs

As discussed in Section 1.3, learners' demographic attributes such as socio-economic status, immigration history and sex were used as control variables, leading to the following diagram summarises all hypothesised relationship between concepts introduced in this chapter:

3. Methods

3.1. Sample

This study drew its primary data source from OECD's PISA 2018 database. Responses from both student (OECD, 2020a) and school questionnaires (OECD, 2020d) were captured and merged into a master data file using R's (Version 4.0.5, R Core Team, 2021) intsvy package (Version 2.5, Caro & Biecek, 2017)

(see ?? for analysis code) including the following 20 participating countries²: Brazil, Bulgaria, Canada, Chile, Estonia, Finland, Georgia, Indonesia, Italy, Latvia, Lithuania, the Netherlands, Peru, Poland, Portugal, Russian Federation³, Serbia, Slovak Republic, Spain, and the USA. Twelve observations without school weights were dropped, leading to a sample size of 107,162 students nested in 6,631 schools (see ?? for detailed sample profile). Under PISA 2018 sampling design, all student candidates were born in the year 2002 in international grades 7 or higher (Chapter 4 of *PISA 2018 Technical Report*, OECD (2020c), p. 29) and will be referred to as “15-year-old” in this study.

3.2. Measures

3.2.1. School Climate Variables

Following Wang & Degol’s (2016) framework, this study selected variable FLSCHOOL “financial education in school lessons” as an indicator for the ACAD-
 DEMIC domain of school climate; FLFAMILY “parental involvement in matters of financial literacy” for the COMMUNITY engagement dimension (i.e., “financial socialisation”), NOBULLY (reverse coding of BEINGBULLIED such that larger numbers imply safer schools) as an indicator for school SAFETY, and lastly
 EDUSHORT “shortage of educational material” as an indicator of the resource availability aspect of the INSTITUTIONAL ENVIRONMENT of schools. All four measures were derived variables based on IRT scaling, with good scale reliabilities for most countries and constructs (see ?? for Cronbach’s alphas). In addition, the OECD has applied multi-group concurrent calibrations to all latent constructs using the root mean square deviance below 0.3 criterion (for a technical discussion on RMSD, see Buchholz & Hartig, 2019, p. 244) in order to ensure cross-country measurement invariance (see Chapter 9 of *Technical Report* (OECD, 2020c, pp. 14–15) for analytical details).

²Australia also participated in the 2018 PISA financial literacy test but chose to withhold its data from public release and is therefore not included in the current study.

³Moscow Region (CNTRYID = 982) and Tatarstan (983) have been merged into Russian Federation (643).

3.2.2. Financial Literacy Measures

455 *Financial Knowledge (FC)*. In order to ascertain candidates' current understanding of finance-related topics, FL164 of the financial literacy questionnaire presented 18 terminologies such as exchange rate, budget, and income tax and asked students to rate their familiarity with each term using a three-point scale: "Never heard of it", "Heard of it, but I don't recall the meaning" and "Learnt
460 about it, and I know what it means". Sum scores of FL164 were used to construct "familiarity with concepts of finance" variable (FCFMLRTY, Chapter 16 of *PISA 2018 Technical Report*, OECD (2020c), p. 23). This scale had good reliability properties evidenced by its high Cronbach's alphas in ??.

Financial Confidence (FA). PISA 2018 included a set of questions in FL162 asking
465 students about their confidence over six financial activities such as making money transfers, understanding bank statements, and plan their spendings using a four-point Likert scale ranging from "Not at all confident", "Not very confident", "Confident" to "Very confident". A variable "confidence about financial matters" was subsequently constructed using the IRT procedure (FLCONFIN,
470 OECD (2020c), p. 23). Cronbach's alphas in ?? suggested good reliability.

Financial Application (FB). The financial literacy application problems were drawn from 43 questions distributed across 24 booklets. The actual test bank remained confidential for reuse, but the OECD was able to provide examples that were comparable in style and difficulty in the *Analytical Framework* (OECD,
475 2019a, pp. 133–148). These exemplar questions illustrated the domains and content areas (see summary in ??) PISA 2018 covered for the purpose of constructing candidates' financial literacy scores. In order to succeed in the bank statement question (Figure 5.1, OECD (2019a), p. 133), for example, students should recognise that the necessary information was presented in multiple lo-
480 cations of the financial document and must be identified amongst distractions then summed together. This question covered the "money and transactions" content area of the "content" domain, the "identifying financial information" content area of the "process" domain, and the "home and family" content area

of the “contexts” domain. Both constructed- and selected-responses were used
 485 in question design and 30 out of 43 items were automatically coded by comput-
 ers. “Planned missingness” resultant from rotating booklet design was imputed
 into ten plausible values (von Davier, 2014) centred at 500 with standard devi-
 ations of 100 (OECD, 2019a). All ten plausible values (PV1FLIT to PV10FLIT,
 collectively written as FLIT from here on) have been used in subsequent analyses
 490 following procedures prescribed by Rubin (1987).

3.2.3. Control Variables

In the 2018 PISA cycle, the OECD simplified its computation of the students’
 economic, social and cultural status (ESCS) index by taking the arithmetic mean
 of three indicators: PARED (parental education), HISEI (parental occupational
 495 status) and HOMEPOS (home possessions). Figure 16.4 of the *Technical Report*
 (OECD, 2020c) visualised the ESCS formation procedure while Avvisati (2020)
 further examined the validity and reliability of the ESCS construct. Students’
 immigration status was determined by synthesising responses from student ques-
 tionnaire items ST019 (parents’ country of birth) and ST021 (students’ age of
 500 arrival in test country) (OECD, 2019b, pp. 212–213) into a categorical vari-
 able with levels 1 = Native, 2 = Second-Generation and 3 = First-Generation.
 This information enabled the derivation of two binary variables IMMI1GEN and
 IMMI2GEN to mark first- and second-generation migrants respectively, with na-
 tives being the reference group receiving zero entries for both categories. The
 505 variable ST004D01T from the student questionnaire (OECD, 2020a) represented
 students’ gender and was transformed into a binary variable with female being
 the reference group: 0 = female; 1 = male.

3.3. Multilevel Structural Equation Modelling (MSEM)

Conventional multilevel modelling approaches assume the observed group
 510 means to be perfectly reliable when individual-level characteristics are aggre-
 gated to the group-level—a particularly questionable assumption in current
 study. Thanks to recent advancement in both theoretical derivations (Lüdtke

et al., 2008; Marsh et al., 2009) and computation power (Muthén & Muthén, 1998–2017), the multilevel latent covariate (MLC) approach has enabled the
515 current project to decompose $L1$ school climate variables **FLSCHOOL**, **FLFAMILY**, **NOBULLY** as well as financial literacy scores **FLIT** into their corresponding within- and between-level components (subscript $_W$ and $_B$ respectively). This doubly latent MSEM approach controlled measurement error at both the student- and school-levels as well as sampling error due to the aggregation of $L1$ variables to
520 form $L2$ constructs (Lüdtke et al., 2009, 2011; Marsh et al., 2012). Subscript $_{ij}$ in the MSEM model below represents the within-group component of the MLC decomposition and subscript $_j$ stands for the between-group component:

Student-level ($L1$):

$$\begin{aligned}
\text{FCFMLRTY} &= \alpha_j^{M1} + \gamma_{11}\text{FLSCHOOL}_{ij} + \gamma_{21}\text{FLFAMILY}_{ij} + \gamma_{31}\text{NOBULLY}_{ij} \\
&\quad + \gamma_{41}\text{ESCS}_{ij} + \gamma_{61}\text{IMMI2GEN}_{ij} + \gamma_{71}\text{MALE}_{ij} + r_{ij}^{M1} \\
\text{FLCONFIN}_{ij} &= \alpha_j^{M2} + \gamma_{12}\text{FLSCHOOL}_{ij} + \gamma_{22}\text{FLFAMILY}_{ij} + \gamma_{32}\text{NOBULLY}_{ij} \\
&\quad + \gamma_{42}\text{ESCS}_{ij} + \gamma_{62}\text{IMMI2GEN}_{ij} + \gamma_{72}\text{MALE}_{ij} + r_{ij}^{M2} \\
\text{FLIT}_{ij} &= \alpha_j^Y + \beta_1\text{FCFMLRTY}_{ij} + \beta_2\text{FLCONFIN}_{ij} \\
&\quad + \gamma_1\text{FLSCHOOL}_{ij} + \gamma_2\text{FLFAMILY}_{ij} + \gamma_3\text{NOBULLY}_{ij} \\
&\quad + \gamma_4\text{ESCS}_{ij} + \gamma_5\text{IMMI1GEN}_{ij} + r_{ij}^{Yw}
\end{aligned} \tag{1}$$

School-level ($L2$):

$$\begin{aligned}
\alpha_j^Y &= \alpha_{00}^Y + a_1\text{FLSCHOOL}_j + a_2\text{NOBULLY}_j + a_3\text{FLFAMILY}_j + a_4\text{EDUSHTG}_j \\
&\quad + a_5\text{STRATIO}_j + \varepsilon_j^{YB}
\end{aligned} \tag{2}$$

525 with the residual distribution assumptions

$$\begin{pmatrix} r_{ij}^{M1} \\ r_{ij}^{M2} \\ r_{ij}^{Yw} \end{pmatrix} \sim \text{MVN} \left[\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_{M1}^2 & 0 & 0 \\ 0 & \sigma_{M2}^2 & 0 \\ 0 & 0 & \sigma_{Yw}^2 \end{pmatrix} \right], \text{ and } \varepsilon_j^{YB} \sim \mathcal{N}(0, \sigma_{YB}^2), \tag{3}$$

where $\text{MVN}(\cdot)$ and $\mathcal{N}(\cdot)$ stand for multivariate normal and normal distribution respectively.

Using [Kaplan's \(2009\)](#) notation $\mathbf{y}_{ij} = \boldsymbol{\alpha}_j + \mathbf{B}_j \mathbf{y}_{ij} + \boldsymbol{\Gamma}_j \mathbf{x}_{ij} + \mathbf{r}_{ij}$ for student-level ($L1$) and random intercept $\boldsymbol{\alpha}_j = \boldsymbol{\alpha}_{00} + \mathbf{A} \mathbf{w}_j + \boldsymbol{\varepsilon}_j$ for school-level ($L2$),
 530 the model equations can be further condensed into the matrix form, with the corresponding path diagram in ??:

$$\begin{aligned}
 \begin{bmatrix} \text{FCFMLRTY}_{ij} \\ \text{FLCONFIN}_{ij} \\ \text{FLIT}_{ij} \end{bmatrix} &= \begin{pmatrix} \alpha_j^{M_1} \\ \alpha_j^{M_2} \\ \alpha_j^{Y_w} \end{pmatrix} + \begin{pmatrix} 0 & 0 & \beta_1 \\ 0 & 0 & \beta_2 \\ 0 & 0 & 0 \end{pmatrix}^T \begin{bmatrix} \text{FCFMLRTY}_{ij} \\ \text{FLCONFIN}_{ij} \\ \text{FLIT}_{ij} \end{bmatrix} \\
 &+ \begin{pmatrix} \gamma_{11} & \gamma_{12} & \gamma_1 \\ \gamma_{21} & \gamma_{22} & \gamma_2 \\ \gamma_{31} & \gamma_{32} & \gamma_3 \\ \gamma_{41} & \gamma_{42} & \gamma_4 \\ 0 & 0 & \gamma_5 \\ \gamma_{61} & \gamma_{62} & 0 \\ \gamma_{71} & \gamma_{72} & 0 \end{pmatrix}^T \begin{bmatrix} \text{FLSCHOOL}_{ij} \\ \text{FLFAMILY}_{ij} \\ \text{NOBULLY}_{ij} \\ \text{ESCS}_{ij} \\ \text{IMMI1GEN}_{ij} \\ \text{IMMI2GEN}_{ij} \\ \text{MALE}_{ij} \end{bmatrix} + \begin{pmatrix} r_{ij}^{M_1} \\ r_{ij}^{M_2} \\ r_{ij}^{Y_w} \end{pmatrix}, \quad (4) \\
 \begin{pmatrix} \alpha_j^{M_1} \\ \alpha_j^{M_2} \\ \alpha_j^{Y_w} \end{pmatrix} &= \begin{pmatrix} \alpha_{00}^{M_1} \\ \alpha_{00}^{M_2} \\ \alpha_{00}^{Y_w} \end{pmatrix} + \begin{pmatrix} 0 & 0 & a_1 \\ 0 & 0 & a_2 \\ 0 & 0 & a_3 \\ 0 & 0 & a_4 \\ 0 & 0 & a_5 \end{pmatrix}^T \begin{bmatrix} \text{FLSCHOOL}_j \\ \text{FLFAMILY}_j \\ \text{NOBULLY}_j \\ \text{EDUSHTG}_j \\ \text{STRATIO}_j \end{bmatrix} + \begin{pmatrix} 0 \\ 0 \\ \varepsilon_j^{Y_B} \end{pmatrix}.
 \end{aligned}$$

3.4. Missing Data Treatment

Missing data are the norm rather than the exception in empirical studies and they demand great care from the researchers to ensure analytical validity.
 535 While full information maximum likelihood has the benefit of being well understood and readily available in software, the multiple imputation (MI) approach outperforms (a) when the data set contains mixtures of incomplete categorical and continuous variables, (b) when dealing with questionnaire data where items usually come in parcels, (c) when auxiliary variables are required, and (d) when
 540 the missing completely at random assumption cannot be reasonably assumed ([Enders & Mansolf, 2018](#)). These considerations conclusively directed the cur-

rent study towards the multilevel MI under the assumption that data were missing at random (Little & Rubin, 2019). In addition, since PISA 2018 financial literacy source files contain missing data at both student- and school-levels and in both continuous and categorical variables, the joint modelling approach is adopted under the advisory of Grund et al. (2018). More specifically, ten sets of imputed data were ordered through *Mplus*'s (Version 8.5, Muthén & Muthén (1998–2017)) unrestricted variance-covariance model (“JM-AM H1”, Asparouhov & Muthén, 2010b), using the Bayes estimator with uninformative priors and 4-chain Gibbs sampler to verify convergence as per suggestion by Little & Rubin (2019, p. 230) and Lambert (2018, p. 314). Finally, the first 50,000 burn-in iterations were discarded and any two draws were separated by 5,000 iterations to avoid autocorrelation (see ?? for input file)—a safe setting even for moderate to high percentage missings (Grund et al., 2016). See ?? for imputation results and diagnostic plots.

3.5. Sampling Weights

Due to PISA's two-stage sampling design, schools and students were selected with *unequal* probabilities (Chapter 3, OECD (2009), pp. 47–56). A proper incorporation of sampling weights is therefore crucial for establishing unbiased estimations. This study has made use of both student and school weights. Under the advisory of Asparouhov (2006), *L1* weights were scaled such that they sum to the sample size in each cluster while *L2* weights were adjusted so that the product of the between- and within-weights sums to the total sample size (Muthén & Muthén, 2017, pp. 622–624).

3.6. Estimator

This study accepted *Mplus*'s default setting of pseudo maximum likelihood (MLR) estimator for the hierarchical modelling (Chapter 16, Muthén & Muthén, 2017, pp. 666 & 668). MLR's robust standard errors are in general Huber-White sandwich estimators (Huber, 1967; White, 1982) with asymptotic standard error corrections using observed residual variances. Literature has long recognised

MLR’s robust χ^2 tests and standard errors as being more accurate than the asymptotic tests when data are non-normal and when models are mis-specified (Chou et al., 1991; Curran et al., 1996). In the multilevel modelling context, robust χ^2 and standard errors may also provide protection against unmodelled
575 heterogeneity resultant from mis-specification at the group-level or from omitting a level (Hox et al., 2010).

3.7. Model Evaluation

Multiple imputation substantially complicates model fit interpretations. It is important to reflect that Rubin’s (1987) rules apply only to *model parameters*
580 under the assumption that over repeated samples, estimates eventually form normal curves peaked at some population values. The distributions of fit indices, on the other hand, are almost always unknown or non-normal, imposing high standards of proof on any proposed aggregation procedures. Early work such as Meng & Rubin (1992) on pooled likelihood-ratio statistic, the precursor
585 sor to many model fit indices, has been substantiated by simulation studies more recently with encouraging results that it is feasible to construct pooled information criteria (Claeskens & Consentino, 2008) as well as pooled model fit indices (Asparouhov & Muthén, 2010a) under MI. Enders & Mansolf (2018) further suggested that with large samples ($N > 100$) and low missing rates
590 ($< 30\%$ – 40%), common cut-off criteria such as Hu & Bentler (1999) remain valid. This study took advantage of **Mplus**’s capability of automatically pooling model fit information in the presence of MI. Supported by large sample size ($N = 107, 162$) and low missing rate (maximum 22.08%), conventional cut-offs of RMSEA $\leq .06$, SRMR $\leq .08$, CFI $\geq .95$ and TLI $\geq .95$ are likely to be
595 suitable for model comparison purposes.

Iterations whose model fit indices fell short of the abovementioned cut-off criteria were further investigated using modification indices and (fully standardised) expected parameter change (EPC). Modification indices (ModInd) suggest how much a model’s χ^2 statistic would decrease by should a fixed parameter
600 were freely estimated; a ModInd greater than 3.84 (critical value of χ^2_1 at

$\alpha = .05$) warrants further consideration for theoretical plausibility (Whittaker, 2012). The EPCs, in contrast, indicate the estimated value of a fixed parameter if it were added to a model and freely estimated, providing a more direct estimate of the size of the misspecification for the parameters under consideration.

605 Kaplan (1989) compared ModInd and EPC’s impact on empirical studies and concluded that the former had a tendency to suggest freeing implausible parameters while the latter were more likely to recommended reasonable candidates to the model. This study made use of the decision rule prescribed by Saris et al. (1987) to freely estimate a parameter when both ModInd and EPC are large.

610 Model modification decisions were applied sequentially under the advisory of MacCallum et al. (1992) and with close consideration to theoretical ground to ensure underlying substantive assumptions were justified.

Two operational concerns were relevant to the current study. Firstly, since **Mplus** Version 8.5 only accepts one data set for the modification procedures,

615 the file containing the first plausible value was selected for the model evaluation purposes. Secondly, three versions of the EPC were reported by **Mplus**: E.P.C. (Saris et al., 1987), Std E.P.C (Kaplan, 1989) and StdYX E.P.C. (Chou & Bentler, 1993). This study adopted the latter most version largely due to its invariance property resultant from both parameter and residual standardisations.

620 Improper solutions with standardised estimates greater than 1.0 and/or with negative variances (i.e., Heywood cases) were ignored during decision-making process.

4. Results

4.1. Descriptive Statistics and Correlations

625 ?? presents descriptive statistics of all measures included in the MSEM model. *L1* variable **NOBULLY** and *L2* variable **STRATIO** were highlighted as particularly non-normal due to sizeable disagreements between their means and medians in combination with significant skewness. The MLR estimator introduced in Section 3.6 explicitly takes non-normality into account when computing

robust standard errors, safeguard the validity of subsequent analyses. These asymmetric variables suggested that the majority of 15-year-olds experienced safe schools and classrooms overcrowding was uncommon in PISA 2018.

Correlations in ?? further suggested that schools and families cared about youth’s financial literacy in synchrony ($\bar{\rho} \approx .23$) and both efforts were associated with higher cognitive and affective outcomes ($\bar{\rho}$ between .17 and .28). Additionally, students’ ESCS were positively correlated with both familiarity with ($\bar{\rho} = .23$) and achievement in ($\bar{\rho} \approx .29$) financial literacy. Lastly, there was a positive correlation between familiarity and confidence ($\bar{\rho} \approx 0.23$) and a similar strength existed between confidence and performance ($\bar{\rho} = 0.23$).

Correlations at the school-level exhibited interesting patterns. Schools with strong emphases on financial education also tended to have engaging parents ($\bar{\rho} \approx .24$), a relationship similar to its *L1* counterpart in size and magnitude. Although the negative correlation between resource shortage and school safety ($\bar{\rho} \approx -.21$) was expected, it remained counterintuitive that schools that were less safe ($\bar{\rho} \approx -.47$) and were suffering from resource shortages ($\bar{\rho} \approx .31$) tended to be more active in delivering financial education programs. Finally, average performance tended to be higher in safer ($\bar{\rho} \approx .43$) and better equipped ($\bar{\rho} \approx -.44$) schools; while higher levels of school ($\bar{\rho} \approx -.53$) and family interventions ($\bar{\rho} \approx -.36$) have been observed from schools that under-performed in financial literacy.

4.2. Intraclass Correlation and Effective Sample Size

The intraclass correlation ρ_1 can be computed from the random effects ANOVA model (“Null model” in ??):

$$\rho_1 = \frac{\text{School-level residual variance}}{\text{Total residual variance}} = \frac{\text{var}(\varepsilon_j^{Y_B})}{\text{var}(r_{ij}^{Y_W}) + \text{var}(\varepsilon_j^{Y_B})} = \frac{5240}{6122 + 5240} = 0.461. \quad (5)$$

This result suggested that 46.1% of the variation in financial literacy performance was due to the clustering in schools.

For sample size adjustment, [Snijders & Bosker \(2012\)](#) advised to first of all calculate the design effect of one’s multilevel model:

$$\text{design effect} = 1 + (\text{average group size} - 1)\rho_1 = 1 + \left(\frac{107,162}{6,631} - 1 \right) \times 0.461 = 7.989, \quad (6)$$

then compute the effective sample size:

$$N_{\text{effective}} = \frac{N_{\text{original}}}{\text{design effect}} = \frac{107,162}{7.989} = 13,414. \quad (7)$$

This result signaled that students from the same school were so similar in their financial literacy outcomes that the sample size of 107,162 used by this study was equivalent to a simple random sample using 13,414 students. This result not only provided assurance of a sufficiently large sample size required by asymptotic theories but also highlighted the strong effect of schools for understanding youth’s financial literacy development.

4.3. Intermediate Models

In order to separate the incremental effect attributable to school-level variables, a student-level only model was first established as a reference (“Single-level model” in ??). Even with *L1*-only variables, model fit indices CFI = .97, TLI = .927 and SRMR = .016 jointly suggested that the proposed input (school climate)–mediator (FC & FA)–output (FB) model was a meaningful one. Next, school-level variables were allowed to covary between one other on top of the *L1* structure, forming a two-level saturated model. This procedure had an effect of decomposing the total residual variances into student- and school-levels. As a result, *L1* residual variance reduced by more than a quarter from 7,866 to 5,764, indicating the necessity of the *L2* structure.

4.4. Full Model

Relationships amongst school-level variables were further introduced at *L2*, transforming the saturated model into the final MSEM model illustrated in ??.

4.4.1. Model Fit

680 Model fit indices CFI = .968, SRMR_{L1} = .015 and SRMR_{L2} = .030 all satisfied the cut-off criteria suggested by Hu & Bentler (1999) while TLI = .903 fell slightly short of being good but still acceptable—a penalty on the growing number of variables introduced. On balance, there was sufficient evidence suggesting good fit between the proposed MSEM model and financial literacy
685 data.

4.4.2. Student-level Relationships

School Climate Variables. All three L1 school climate variables shared statistically significant relationships with financial literacy performance (FLIT). A safe school environment (NOBULLY) was positively correlated with financial literacy
690 via both the direct pathway and through mediation with familiarity (FCFMLRTY).

Efforts by schools (FLSCHOOL) and families (FLFAMILY), on the other hand, had more nuanced relationships with the cognitive outcome. Both variables had strong positive associations with FLIT via mediation pathways, but statistically significant *negative* relationships via direct pathways. Such positive-negative
695 pair happened to cancel each other for FLFAMILY, leading to a non-significant result should financial socialisation and financial literacy were correlated superficially. The negative cognitive path overshadowed the positive affective pathways for FLSCHOOL, leading to a seemingly paradoxical negative overall relationship between classroom efforts and financial literacy scores.

700 *Demographic Attributes.* The strongest covariation identified by this study was between students' ESCS and their financial literacy outcomes. Substantial positive associations have been observed along both the direct and indirect pathways. Having controlled ESCS as a confounder is therefore essential for the study of school climate effects.

705 The relationship between one's immigration history and their financial literacy performance also delivered important insight. Children who relocated to the host country between births and reaching 15-year-old (IMMI1GEN = 1) seemed

to possess less application skills in financial matters whereas the offspring of migrants did not show deficiency via knowledge and confidence.

710 Meanwhile, school curricula addressing students' affinity towards finance-related topics would likely to benefit not only second-generation migrants but also young girls. This conjecture was made based on the observed male advantage in financial literacy performance—everything
715 else being equal, 15-year-old boys on average demonstrated higher financial capability, a fully mediated effect particularly through higher confidence.

4.4.3. School-level Relationships

Shortages in either capital or labour resources were associated with lower average financial literacy outcomes at the school-level. The MSEM showed a negative relationship between the fourth element of school climate variable, educational resource shortage **EDUSHORT**, and average **FLIT**. In fact, the association
720 between schools' physical capital and their educational output remained one of the strongest statistical relationships identified by this study, over twice the size of that between labour arrangement (student-teacher ratio **STRATIO**) and financial literacy achievement.

725 4.4.4. Contextual Effects

One particular strength of an MSEM is its ability to model contextual effects. In a school research context, there exists a *contextual effect* when school-level characteristics contribute to individual learners' outcomes beyond what can be explained by student-level characteristics. Following Marsh et al. (2009)'s pro-
730 cedure, this study obtained the point estimate of the unstandardised contextual effect for **FLSCHOOL**:

$$\text{Unstandardised contextual effect} = \hat{a}_1 - \hat{\gamma}_1 = -49.339 - (-7.078) = -42.261, \quad (8)$$

and its standardised solution:

$$\begin{aligned}
& \text{Standardised contextual effect} \\
&= \frac{\text{Unstandardised contextual effect} \times \sqrt{\widehat{\text{var}}(\text{FLSCHOOL}_B)}}{\sqrt{\widehat{a}_1^2 \cdot \widehat{\text{var}}(\text{FLSCHOOL}_B) + \widehat{\text{var}}(\text{FLIT}_B) + \widehat{\gamma}_1^2 \cdot \widehat{\text{var}}(\text{FLSCHOOL}_W) + \widehat{\text{var}}(\text{FLIT}_W)}} \\
&= \frac{(-42.261) \times \sqrt{0.114}}{\sqrt{(-49.339)^2 \times 0.114 + 3226.753 + (-7.078)^2 \times 1.009 + 6576.975}} \\
&= -0.163, (-0.142 \text{ if calculated manually due to cumulative rounding errors}) \tag{9}
\end{aligned}$$

while the associated standard error can be obtained using the delta method (Raykov & Marcoulides, 2004). ?? summarised the contextual effect estimates for FLSCHOOL, FLFAMILY, and NOBULLY. These results suggested that students' financial literacy performance was not only affected by individual characteristics and endeavour but also heavily influenced by the larger school environment surrounding the learners. Lastly, the effect size (ES) statistics in ?? further suggested that the significant contextual effect findings were unlikely to be a mere statistical artefact out of large sample sizes, evidenced by their large sizes ($|\text{ES}| \approx .38$ and $.33$) and robustness against various of calculation methods (conventional ES1 by Tymms (2004) and recent innovations ES2 and ES3 by Marsh et al. (2009)).

5. Discussion

5.1. Overview

"It takes a village to raise a child." This study looked into the dual mechanisms of how factors associated with 15-year-old students' financial literacy related to each other (RQ 1) and how the surrounding school environment may facilitate such relationships (RQ 2). MSEM results showed that 33.5% of the variation in students' FLIT scores can be explained by student-level variables and 47.7% by school-level factors (see ??), suggesting the importance of schools in cultivating youth's financial literacy outcomes. By accounting for the hierarchical data structure, sampling weights, missing data imputation, as well

as measurement error and sampling error, this study was able to ascertain the
755 marginal effects of the four school climate variables: ACADEMIC, COMMUNITY,
SAFETY and INSTITUTIONAL ENVIRONMENT (Wang & Degol, 2016) respectively
(see ?? and ??). This study added empirical evidence to Kutsyuruba et al.'s
(2015) review article by showing the importance of school safety for students'
financial knowledge, confidence, and application behaviour. The student-level
760 model extended Jorgensen & Savla's (2010) structural equation approach to fi-
nancial literacy and confirmed the key roles financial knowledge ($R^2 = .136$) and
confidence ($R^2 = .077$) played in mediating youth's financial literacy achieve-
ment.

This study also revealed a key insight that was initially less intuitive. At
765 both individual- and school-levels, the associations between explicit teaching
of finance-related topics (FEdu) and contemporaneous financial literacy perfor-
mance (FB) were found to be *negative*. In addition, the relationships between
parental involvement (FSoc) for cultivating youth's financial literacy outcomes
were shown to be positive along the mediation pathways (via FC and FA) but
770 negative along the application pathway (FB). These two effects were similar
in size but opposite in sign. At the school-level, both classroom activities and
parental care, on average, tended to be more visible around students who were
yet to demonstrate their mastery of financial capabilities. Sizeable contextual ef-
fects further suggested schools rather than learners as the source of the observed
775 negative correlations between financial literacy outcome (FB) and teaching ef-
forts (FEdu), and between FB and financial socialisation (FSoc).

5.2. Responses to the Research Questions and Hypotheses

5.2.1. Research Question 1

All four school climate variables explained variation in youth's financial lit-
780 eracy outcomes. Financial knowledge (FC) and confidence (FA) played signif-
icant mediation roles for explaining financial literacy scores (FB), confirming
Hypotheses 12 and 13. This result was partially consistent with Jorgensen
& Savla's (2010) mediation model in which the author focused solely on the

relationships between parental influence and financial behaviour, mediated by
 785 financial knowledge and attitude. This study effectively corrected [Jorgensen & Savla's \(2010\)](#) omitted variable problem by adding back FEdu, Safety and more demographic controls at *L1* and an additional structure at *L2*, subsequently re-establishing FC as a significant mediator. Such result was fully expected under the family financial socialisation theory ([Danes & Haberman, 2007](#)) where
 790 financial knowledge development shall be an important component.

Financial education (FEdu) showed positive effects along the mediation pathways (confirming H1, H2) but a negative effect along the direct pathway (contradicting H3) with financial literacy scores (FB). Since the direct effect overshadowed the mediation effects, the total effect between FEdu and FB ap-
 795 peared to be negative. This result positioned the current study in line with a series of papers reporting non-significant or negative findings. Studies using the test-retest design ([Mandell & Klein, 2009](#)), randomised experiment with treatment-control groups ([Becchetti et al., 2013](#); [Collins, 2013](#)) as well as an archival study using PISA 2012 data ([Farinella et al., 2017](#)) all questioned the ef-
 800 fectiveness of financial education courses. Additionally, [Mountain et al.'s \(2020\)](#) 5-year-horizon longitudinal study identified a negative association between long-term financial behaviours and attending workshops and seminars, mediated by financial knowledge. In light of these publications, the negative direct pathway identified by the current study shall not be dismissed as an statistical irregularity
 805 but an invitation for further considerations (see [Section 5.3](#)).

Similar to FEdu, Parental involvement at home (FSoc) had positive media-
 tion pathways (confirming H4 and H5) but an equi-magnitude negative direct pathway (contradicting H6), leading to a non-significant total relationship be-
 tween FSoc and FB. This result shall be differentiated from the positive FSoc-
 810 FB association by [Moreno-Herrero et al. \(2018\)](#) since the latter design did not involve FEdu, Safety or any mediators, leading to a possible redistribution of explanatory power from the omitted variables into FSoc.

Safety was found to have positive effects for students' financial knowledge, confidence, as well as application behaviour (confirming H7, H8 and H9), linking

815 [Kutsyuruba et al.’s \(2015\)](#) school safety review to the financial literacy research.

5.2.2. *Research Question 2*

All four school climate variables at the school-level were shown to be statistically significant for explaining the variation in school-average financial literacy scores. MSEM results revealed that educational resource shortages as well as
820 high student-teacher ratios both correlated with lower average financial literacy performance, confirming H10 and H11 and the applicability of prior studies ([Finn & Achilles, 1999](#); [Miles & Darling-Hammond, 1998](#); [Uline & Tschannen-Moran, 2008](#)) to the field of financial literacy research.

Adding to existing literature, FEdu, FSoc and Safety were all shown to have
825 significant contextual effects, suggesting individual students’ financial literacy capability was strongly affected by their school environment. Along with the higher R^2 observed at $L2$ (see ??), and the strong design effect calculated in [Equation \(6\)](#), the current study consistently highlighted school-level factors as the driving force behind the systematic variations in students’ PISA 2018 financial literacy performance.
830

5.3. *Conjectures about Negative Pathways*

Although causal inferences could not be established from a correlational study design, a negative association between input and output variables may still *suggest* some interesting possibilities for future studies. If one hypothesises
835 a causal direction $FLSCHOOL \rightarrow FLIT$, the negative relationship between the two variables could signal potential improvement opportunities for current financial education practices. While students have benefited from educational interventions with growing knowledge and confidence, existing pedagogy may yet to explicitly train students to link their learning to real-world finance problem-solving. Bridging the disconnect between minds and hands has long been emphasised in science ([Harlen, 1999](#)) and mathematics ([Smith et al., 1996](#)) education and voices for learning from sister subjects’ success started to grow in the field of financial education ([Marley-Payne et al., 2021](#)). Parents may simi-

larly adapt by introducing financial problem-solving skills in addition to sharing
 845 knowledge and affects at home. Alternatively, a causal direction $FLSCHOOL \leftarrow$
 $FLIT$ may suggest that educational and parental attention was being directed
 preferentially towards students who were most in need of developing problem-
 solving skills—it was not the quality of interventional efforts but the insufficient
 quantity that needed to be addressed. Future research may investigate the
 850 plausibility of such constraint optimisation behaviour by teachers and parents
 and estimate the sizes of the Lagrange multipliers as evidence for the potential
 marginal improvement should schooling and parenting resources were expanded.
 A third possibility involves a hidden confounder $FLSCHOOL \leftarrow \text{confound} \rightarrow$
 $FLIT$. Jappelli's (2010) observation that students' financial literacy tended to
 855 be lower in countries with stronger social safety net could serve as a starting
 point for this line of investigation under the reasonable assumption that such
 countries also devote higher social resources into education input. Should this
 direction of study become fruitful, financial educators would then be reminded
 the importance of social arrangement as a moderator, where it would be de-
 860 sirable to re-allocate educational resources taking into account each society's
 social contracts.

A non-linear relationship could be a fourth possibility for the negative asso-
 ciation between $FLSCHOOL$ and $FLIT$. Using 2015 TIMSS data, Teig et al. (2018)
 demonstrated a curvilinear relationship between inquiry-based teaching practice
 865 and students' science achievement with high frequency inquiry-based teaching
 being linked to a reduced performance. A quadratic relationship was reported
 between learning time and science achievement using PISA 2015 data (Zhang
 et al., 2021) especially in Eastern cultures, possibly indicating that non-linearity
 could become a relative common consideration when analysing large-scale inter-
 870 national assessment data. A verification of similar curvilinear relationship in the
 financial literacy field is important so that educational and parental resources
 can be further optimised.

A final hypothesis can be made based on the implementation lags observed
 by Bernheim et al. (2001). Financial literacy could be unique in a sense that

875 it requires a longer time for FEdu and FSoc to be consolidated, incorporated
and then turned into observable behaviour improvement, including application
and problem-solving behaviour. That is to say the negative relationship between
FLSCHOOL_t and FLIT_{t-1} reflected the maturing effect of financial skill acquisition
process. A longitudinal study is required in order to confirm this intertemporal
880 growth model.

5.4. Limitations

The correlational research design used by this study limited the possible
causal inferences. Using [Shadish et al.'s \(2002\)](#) taxonomy, this study demon-
strated strong statistical conclusion validity by showing both the presence and
885 strength of the covariation between school climate variables and students' fi-
nancial literacy outcomes. It was unable to, however, demonstrate whether
school climate preceded financial literacy in time, neither was it able to exclude
all other relationships as plausible explanations for the covariation between the
two. By this measure, the current study's internal validity is not yet strong. As
890 the scholarly world is yet to reach consensus on the best construct to represent
financial literacy, this study inherited one particular version of financial literacy
operationalised by the PISA organiser, whose construct validity continues to
attract scrutiny by both theorists and practitioners ([Schuhen & Schürkmann,](#)
[2014](#)). Lastly, statistical parameters derived in this study were based on data
895 drawn from predominantly industrialised countries, questioning its strength on
external validity.

The other limitation originated from the data design. Since this study pooled
all 20 participating countries into a global data structure, the subsequent analy-
ses and statistical results must be interpreted as the global, rather than country-
900 specific outcomes. This observation is important for education policy making
since global averages may not serve the interests of local conditions correctly.
Since industrialised economies were over-represented in the 20-country sam-
ple, pedagogical and policy implications may be skewed towards countries with
similar socio-economic profiles. Further studies are encouraged to replicate pro-

cedures employed by this project by counties in order to obtain evidence better
situated with the local environment.

Based on the limitations discussed above, future research efforts may consider upgrading the study design from a correlational to a causal one by using, amongst others, instrumental variable (Pokropek, 2016) or panel data (Salas-
Velasco, 2019) techniques. Country-by-country comparisons would also provide
additional insight into the similarities and differences across economies, aiding
pedagogy design and education policy formation processes.

5.5. Contribution and Conclusions

This research project contribute to financial literacy literature in a number of ways. It first of all linked a substantive theoretical framework of school
climate to youth’s financial literacy development process in order to examine
how individuals’ capability is formed *in the context of* their school environment.
This person-ecological approach reconciled two strands of research efforts that
focused either on students or on schools into one unified structure. In terms of
methodology, this study attempted a recent development in the MSEM literature
using a multilevel latent covariate approach (MLC, Lüdtke et al. (2008);
“doubly-latent model”, Marsh et al. (2009)) to correct for unreliability at higher-
level when lower-level constructs were aggregated up. The successful application
of this new technique to the most recent PISA 2018 data set showcased the advancement
in the field of educational measurement.

A well-functioning society relies on citizens’ financial literacy for the betterment of their own well-being and that of the collective. Policy-makers, school
leaders, teachers and parents all have progressively come to terms with the cost
of neglect and demanded evidence-based action plans. The current research
project answered this call by exploring four aspects of school climate using the
latest international large-scale assessment data—Education matters. Parenting
matters. Safety and resource fundings do matter. These conclusions shed light
to the policy priorities that can be actioned upon without delay. This study
served only as a starting point for a vibrant scholarly conversation about bet-

935 ter preparing our young for an ever-challenging future. May they benefit and
succeed.

References

- Agarwal, S., Amromin, G., Ben-David, I., Chomsisengphet, S., & Evanoff, D. D.
(2015a). Financial literacy and financial planning: Evidence from India. *Jour-*
940 *nal of Housing Economics*, 27, 4–21. doi:[10.1016/j.jhe.2015.02.003](https://doi.org/10.1016/j.jhe.2015.02.003).
- Agarwal, S., Chomsisengphet, S., & Zhang, Y. (2015b). How does financial
literacy affect mortgage default? *SSRN Electronic Journal*, . doi:[10.2139/
ssrn.2601025](https://doi.org/10.2139/ssrn.2601025).
- Agnew, S., & Cameron-Agnew, T. (2015). The influence of consumer sociali-
945 sation in the home on gender differences in financial literacy. *International
Journal of Consumer Studies*, 39, 630–638. doi:[10.1111/ijcs.12179](https://doi.org/10.1111/ijcs.12179).
- Agnew, S., & Harrison, N. (2015). Financial literacy and student attitudes to
debt: A cross national study examining the influence of gender on personal
finance concepts. *Journal of Retailing and Consumer Services*, 25, 122–129.
950 doi:[10.1016/j.jretconser.2015.04.006](https://doi.org/10.1016/j.jretconser.2015.04.006).
- Akben-Selcuk, E., & Altioek-Yilmaz, A. (2014). Financial literacy among Turk-
ish college students: The role of formal education, learning approaches, and
parental teaching. *Psychological Reports*, 115, 351–371. doi:[10.2466/31.11.
pr0.115c18z3](https://doi.org/10.2466/31.11.pr0.115c18z3).
- 955 Ali, P., Anderson, M., McRae, C., & Ramsay, I. (2016). The financial literacy
of young people: Socio-economic status, language background, and the rural-
urban chasm. *Australian & International Journal of Rural Education*, 26,
53–65. URL: [http://web.a.ebscohost.com/ehost/pdfviewer/pdfviewer?
vid=2&sid=f7900e91-7c14-4983-9c5e-41979ed77f10@sidc-v-sessmgr03](http://web.a.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=2&sid=f7900e91-7c14-4983-9c5e-41979ed77f10@sidc-v-sessmgr03).
- 960 Ali, P., Anderson, M. E., McRae, C. H., & Ramsay, I. (2014). The financial liter-
acy of young Australians: An empirical study and implications for consumer




- protection and ASIC's National Financial Literacy Strategy. *Company and Securities Law Journal*, 32, 334–352. URL: <https://ssrn.com/abstract=2490154>.
- 965 Amagir, A., Groot, W., van den Brink, H. M., & Wilschut, A. (2018).
A review of financial-literacy education programs for children and adolescents. *Citizenship, Social and Economics Education*, 17, 56–80. doi:[10.1177/2047173417719555](https://doi.org/10.1177/2047173417719555).
- Arceo-Gómez, E. O., & Villagómez, F. A. (2017). Financial literacy among
970 Mexican high school teenagers. *International Review of Economics Education*, 24, 1–17. doi:[10.1016/j.iree.2016.10.001](https://doi.org/10.1016/j.iree.2016.10.001).
- Arellano, A., Cámara, N., & Tuesta, D. (2014). *The effect of self-confidence on financial literacy*. Working Paper No. 14/28 BBVA Research. URL: [https://www.bbvaresearch.com/wp-content/uploads/2014/](https://www.bbvaresearch.com/wp-content/uploads/2014/10/WP14-28The-effect-of-self-confidence-on-financial-literacy1.pdf)
975 [10/WP14-28The-effect-of-self-confidence-on-financial-literacy1.pdf](https://www.bbvaresearch.com/wp-content/uploads/2014/10/WP14-28The-effect-of-self-confidence-on-financial-literacy1.pdf).
- Arthur, C. (2016). Financial literacy education as a public pedagogy: Consumerizing economic insecurity, ethics and democracy. In C. Aprea, E. Wuttké, K. Breuer, N. K. Koh, P. Davies, B. Greimel-Fuhrmann, & J. S. Lopus (Eds.), *International Handbook of Financial Literacy* (pp. 113–125). Springer.
980 doi:[10.1007/978-981-10-0360-8_9](https://doi.org/10.1007/978-981-10-0360-8_9).
- Asparouhov, T. (2006). General multi-level modeling with sampling weights. *Communications in Statistics — Theory and Methods*, 35, 439–460. doi:[10.1080/03610920500476598](https://doi.org/10.1080/03610920500476598).
- 985 Asparouhov, T., & Muthén, B. (2010a). *Chi-square statistics with multiple imputation* (Version 2). Muthén & Muthén. URL: <https://www.statmodel.com/download/MI7.pdf>.
- Asparouhov, T., & Muthén, B. (2010b). *Multiple imputation with Mplus* (Ver-

- sion 2). Muthén & Muthén. URL: <https://www.statmodel.com/download/Imputations7.pdf>.
990
- Atkinson, A., & Messy, F.-A. (2011). Assessing financial literacy in 12 countries: an OECD/INFE international pilot exercise. *Journal of Pension Economics and Finance*, 10, 657–665. doi:[10.1017/s1474747211000539](https://doi.org/10.1017/s1474747211000539).
- Avvisati, F. (2020). The measure of socio-economic status in PISA: A review
995 and some suggested improvements. *Large-scale Assessments in Education*, 8, 1–37. doi:[10.1186/s40536-020-00086-x](https://doi.org/10.1186/s40536-020-00086-x).
- Barnard, C. R., Billing, J., Brotherston, D., Jeffery, T., Mansell, P., & Wright, J. (2021). Money, knowledge and power. *British Actuarial Journal*, 26, 1–26. doi:[10.1017/s1357321721000039](https://doi.org/10.1017/s1357321721000039).
- 1000 Bay, C., Catasús, B., & Johed, G. (2014). Situating financial literacy. *Critical Perspectives on Accounting*, 25, 36–45. doi:[10.1016/j.cpa.2012.11.011](https://doi.org/10.1016/j.cpa.2012.11.011).
- Becchetti, L., Caiazza, S., & Coviello, D. (2013). Financial education and investment attitudes in high schools: Evidence from a randomized experiment. *Applied Financial Economics*, 23, 817–836. doi:[10.1080/09603107.2013.767977](https://doi.org/10.1080/09603107.2013.767977).
1005
- Belás, J., Nguyen, A., Smrčka, L., Kolembus, J., & Cipovová, E. (2016). Financial literacy of secondary school students. Case study from the Czech Republic and Slovakia. *Economics & Sociology*, 9, 191–206. URL: https://publikace.k.utb.cz/bitstream/handle/10563/1006945/Fulltext_1006945.pdf. doi:[10.14254/2071-789x.2016/9-4/12](https://doi.org/10.14254/2071-789x.2016/9-4/12).
1010
- Bernheim, B., Garrett, D. M., & Maki, D. M. (2001). Education and saving: The long-term effects of high school financial curriculum mandates. *Journal of Public Economics*, 80, 435–465. doi:[10.1016/s0047-2727\(00\)00120-1](https://doi.org/10.1016/s0047-2727(00)00120-1).
- Birbili, M., & Kontopoulou, M. (2015). Financial education for preschoolers:
1015 Preparing young children for the 21st Century. *Childhood Education*, 91, 46–53. doi:[10.1080/00094056.2015.1001670](https://doi.org/10.1080/00094056.2015.1001670).

- Böhm, P., Böhmová, G., Šimková, V., & Gazdíková, J. (2021). The impact of secondary education on the level of financial literacy: The case of Slovakia. *Problems of Education in the 21st Century*, 79, 13–33. doi:[10.33225/pec/21.79.13](https://doi.org/10.33225/pec/21.79.13).
1020
- Boisclair, D., Lusardi, A., & Michaud, P.-C. (2017). Financial literacy and retirement planning in Canada. *Journal of Pension Economics and Finance*, 16, 277–296. doi:[10.1017/s1474747215000311](https://doi.org/10.1017/s1474747215000311).
- Borges Ramalho, T., & Forte, D. (2019). Financial literacy in Brazil—Do knowledge and self-confidence relate with behavior? *RAUSP Management Journal*, 54, 77–95. doi:[10.1108/RAUSP-04-2018-0008](https://doi.org/10.1108/RAUSP-04-2018-0008).
1025
- Bottazzi, L., & Lusardi, A. (2020). *Stereotypes in financial literacy: Evidence from PISA* (NBER Working Paper No. 28065). National Bureau of Economic Research. URL: https://www.nber.org/system/files/working_papers/w28065/w28065.pdf.
1030
- Bover, O., Hospido, L., & Villanueva, E. (2018). *The impact of high school financial education on financial knowledge and saving choices: Evidence from a randomized trial in Spain*. Working paper No. 1801 Banco de España. URL: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3116054. doi:[10.2139/ssrn.3116054](https://doi.org/10.2139/ssrn.3116054).
1035
- Bowen, C. F. (2002). Financial knowledge of teens and their parents. *Journal of Financial Counseling and Planning*, 13, 93–102. URL: <https://afcpe.buckeyedev.com/wp-content/uploads/2018/10/vol1328.pdf>.
- Breitbach, E., & Walstad, W. B. (2016). Financial literacy and financial behavior among young adults in the United States. In E. Wuttke, J. Seifried, & S. Schumann (Eds.), *Economic competence and financial literacy of young adults* (pp. 81–98). Verlag Barbara Budrich. doi:[10.2307/j.ctvbkk29d.7](https://doi.org/10.2307/j.ctvbkk29d.7).
1040
- Brown, M., Grigsby, J., van der Klaauw, W., Wen, J., & Zafar, B. (2016).

- Financial education and the debt behavior of the young. *Review of Financial Studies*, 29, 2490–2522. doi:[10.1093/rfs/hhw006](https://doi.org/10.1093/rfs/hhw006).
1045
- Buccioli, A., & Veronesi, M. (2014). Teaching children to save: What is the best strategy for lifetime savings? *Journal of Economic Psychology*, 45, 1–17. doi:[10.1016/j.joep.2014.07.003](https://doi.org/10.1016/j.joep.2014.07.003).
- Bucher-Koenen, T., Alessie, R., Lusardi, A., & van Rooij, M. (2021). *Fearless girl: Woman's financial literacy and stock market participation*. Discussion Paper No. 21-015 Leibniz Centre for European Economic Research. URL: <http://ftp.zew.de/pub/zew-docs/dp/dp21015.pdf>.
1050
- Bucher-Koenen, T., Lusardi, A., Alessie, R., & van Rooij, M. (2017). How financially literate are women? An overview and new insights. *Journal of Consumer Affairs*, 51, 255–283. doi:[10.1111/joca.12121](https://doi.org/10.1111/joca.12121).
1055
- Buchholz, J., & Hartig, J. (2019). Comparing attitudes across groups: An IRT-based item-fit statistic for the analysis of measurement invariance. *Applied Psychological Measurement*, 43, 241–250. doi:[10.1177/0146621617748323](https://doi.org/10.1177/0146621617748323).
- Cao-Alvira, J. J., Novoa-Hoyos, A., & Núñez-Torres, A. (2020). On the financial literacy, indebtedness, and wealth of Colombian households. *Review of Development Economics*, (pp. 1–16). doi:[10.1111/rode.12739](https://doi.org/10.1111/rode.12739).
1060
- Carlin, B. I., & Robinson, D. T. (2012). What does financial literacy training teach us? *Journal of Economic Education*, 43, 235–247. doi:[10.1080/00220485.2012.686385](https://doi.org/10.1080/00220485.2012.686385).
- Caro, D. H., & Biecek, P. (2017). intsvy: An package for analyzing international large-scale assessment data. *Journal of Statistical Software*, 81, 1–44. doi:[10.18637/jss.v081.i07](https://doi.org/10.18637/jss.v081.i07).
1065
- Chambers, R. G., & Asarta, C. J. (2018). Gender, country-level variables, and financial knowledge. *Empirische Pädagogik*, 32, 310–328. URL: <https://bit.ly/2Pw1HFs>.
1070

- Chambers, R. G., Asarta, C. J., & Farley-Ripple, E. N. (2019). Gender, parental characteristics, and financial knowledge of high school students: Evidence from multicountry data. *Journal of Financial Counseling and Planning*, 30, 91–109. URL: <https://files.eric.ed.gov/fulltext/EJ1241100.pdf>.
- 1075 Chen, Z., & Garand, J. C. (2018). On the gender gap in financial knowledge: Decomposing the effects of don't know and incorrect responses. *Social Science Quarterly*, 99, 1551–1571. doi:[10.1111/ssqu.12520](https://doi.org/10.1111/ssqu.12520).
- Chou, C.-P., & Bentler, P. (1993). Invariant standardized estimated parameter change for model modification in covariance structure analysis. *Multivariate*
1080 *Behavioral Research*, 28, 97–110. doi:[10.1207/s15327906mbr2801_6](https://doi.org/10.1207/s15327906mbr2801_6).
- Chou, C.-P., Bentler, P. M., & Satorra, A. (1991). Scaled test statistics and robust standard errors for non-normal data in covariance structure analysis: A monte carlo study. *British Journal of Mathematical and Statistical Psychology*, 44, 347–357. doi:[10.1111/j.2044-8317.1991.tb00966.x](https://doi.org/10.1111/j.2044-8317.1991.tb00966.x).
- 1085 Claeskens, G., & Consentino, F. (2008). Variable selection with incomplete covariate data. *Biometrics*, 64, 1062–1069. doi:[10.1111/j.1541-0420.2008.01003.x](https://doi.org/10.1111/j.1541-0420.2008.01003.x).
- Cole, S., Paulson, A., & Shastry, G. K. (2016). High school curriculum and financial outcomes: The impact of mandated personal finance and mathematics
1090 courses. *Journal of Human Resources*, 51, 656–698. doi:[10.3368/jhr.51.3.0113-5410r1](https://doi.org/10.3368/jhr.51.3.0113-5410r1).
- Cole, S., Sampson, T., & Zia, B. (2009). *Financial literacy, financial decisions, and the demand for financial services: Evidence from India and Indonesia*. Working Paper 09-117 Harvard Business School. URL: http://www1.worldbank.org/prem/poverty/ie/dime_papers/1107.pdf.
1095
- Collins, J. M. (2013). The impacts of mandatory financial education: Evidence from a randomized field study. *Journal of Economic Behavior & Organization*, 95, 146–158. doi:[10.1016/j.jebo.2012.08.011](https://doi.org/10.1016/j.jebo.2012.08.011).

- 1100  Core Team (2021). : *A language and environment for statistical computing* (Version 4.0.5) [Computer software].  Foundation for Statistical Computing. URL: <https://www.R-project.org/>.
- Cornell, D. G., & Mayer, M. J. (2010). Why do school order and safety matter? *Educational Researcher*, 39, 7–15. doi:[10.3102/0013189X09357616](https://doi.org/10.3102/0013189X09357616).
- Cox, R., Brounen, D., & Neuteboom, P. (2015). Financial literacy, risk aversion
1105 and choice of mortgage type by households. *Journal of Real Estate Finance and Economics*, 50, 74–112. doi:[10.1007/s11146-013-9453-9](https://doi.org/10.1007/s11146-013-9453-9).
- Cupak, A., Fessler, P., Silgoner, M., & Ulbrich, E. (2018). *Exploring differences in financial literacy across countries: The role of individual characteristics and institutions*. Working Paper 220
1110 Oesterreichische Nationalbank. URL: <https://www.oenb.at/dam/jcr:c6506da3-61d3-4be8-abee-cf19468c13fa/WP220.pdf>.
- Curran, P. J., West, S. G., & Finch, J. F. (1996). The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. *Psychological Methods*, 1, 16–29. doi:[10.1037/1082-989X.1.1.16](https://doi.org/10.1037/1082-989X.1.1.16).
- 1115 Danes, S. M., & Haberman, H. R. (2007). Teen financial knowledge, self-efficacy, and behavior: A gendered view. *Journal of Financial Counseling and Planning*, 18, 48–60. URL: <https://files.eric.ed.gov/fulltext/EJ1104367.pdf>.
- Davies, P. (2015). Towards a framework for financial literacy in the context
1120 of democracy. *Journal of Curriculum Studies*, 47, 300–316. doi:[10.1080/00220272.2014.934717](https://doi.org/10.1080/00220272.2014.934717).
- De Beckker, K., De Witte, K., & Van Campenhout, G. (2019). Identifying financially illiterate groups: An international comparison. *International Journal of Consumer Studies*, 43, 490–501. doi:[10.1111/ijcs.12534](https://doi.org/10.1111/ijcs.12534).
- 1125 Drew, J. M., & Cross, C. (2016). Fraud and its PREY: Conceptualising social engineering tactics and its impact on financial literacy outcomes. In T. Har-

- rison (Ed.), *Financial Literacy and the Limits of Financial Decision-Making* (pp. 325–340). Springer. doi:[10.1007/978-3-319-30886-9_16](https://doi.org/10.1007/978-3-319-30886-9_16).
- 1130 Driva, A., Lührmann, M., & Winter, J. (2016). Gender differences and stereotypes in financial literacy: Off to an early start. *Economics Letters*, *146*, 143–146. doi:[10.1016/j.econlet.2016.07.029](https://doi.org/10.1016/j.econlet.2016.07.029).
- Enders, C. K., & Mansolf, M. (2018). Assessing the fit of structural equation models with multiply imputed data. *Psychological Methods*, *23*, 76–93. doi:[10.1037/met0000102](https://doi.org/10.1037/met0000102).
- 1135 Erner, C., Goedde-Menke, M., & Oberste, M. (2016). Financial literacy of high school students: Evidence from Germany. *Journal of Economic Education*, *47*, 95–105. doi:[10.1080/00220485.2016.1146102](https://doi.org/10.1080/00220485.2016.1146102).
- Esposito, C. (1999). Learning in urban blight: School climate and its effect on the school performance of urban, minority, low-income children. *School*
1140 *Psychology Review*, *28*, 365–377. doi:[10.1080/02796015.1999.12085971](https://doi.org/10.1080/02796015.1999.12085971).
- Farinella, J., Bland, J., & Franco, J. (2017). The impact of financial education on financial literacy and spending habits. *International Journal of Business, Accounting, and Finance*, *11*, 1–12. URL: <http://www.iabpad.com/the-impact-of-financial-education-on-financial-literacy-and-spending-habits/>.
- 1145 Fernandes, D., Lynch, J. G., & Netemeyer, R. G. (2014). Financial literacy, financial education, and downstream financial behaviors. *Management Science*, *60*, 1861–1883. doi:[10.1287/mnsc.2013.1849](https://doi.org/10.1287/mnsc.2013.1849).
- Ferragina, E., Seeleib-Kaiser, M., & Spreckelsen, T. (2015). The four worlds of ‘welfare reality’—Social risks and outcomes in Europe. *Social Policy and*
1150 *Society*, *14*, 287–307. doi:[10.1017/s1474746414000530](https://doi.org/10.1017/s1474746414000530).
- Finlayson, A. (2009). Financialisation, financial literacy and asset-based welfare. *The British Journal of Politics and International Relations*, *11*, 400–421. doi:[10.1111/j.1467-856x.2009.00378.x](https://doi.org/10.1111/j.1467-856x.2009.00378.x).

- 1155 Finn, J. D., & Achilles, C. M. (1999). Tennessee's class size study: Findings, implications, misconceptions. *Educational Evaluation and Policy Analysis*, 21, 97–109. doi:[10.3102/01623737021002097](https://doi.org/10.3102/01623737021002097).
- Fonseca, R., Mullen, K. J., Zamarro, G., & Zissimopoulos, J. (2012). What explains the gender gap in financial literacy? The role of household decision making. *Journal of Consumer Affairs*, 46, 90–106. doi:[10.1111/j.1745-6606.2011.01221.x](https://doi.org/10.1111/j.1745-6606.2011.01221.x).
1160
- Freiberg, H. J., & Stein, T. A. (1999). Measuring, improving and sustaining healthy learning environments. In H. J. Freiberg (Ed.), *School climate: Measuring, improving and sustaining healthy learning environments* (pp. 11–29). RoutledgeFalmer.
- 1165 Gale, W. G., Harris, B. H., & Levine, R. (2012). Raising household saving: Does financial education work? *Social Security Bulletin*, 72, 39–48. URL: <https://www.ssa.gov/policy/docs/ssb/v72n2/v72n2p39.pdf>.
- Gamble, K. J., Boyle, P. A., Yu, L., & Bennett, D. A. (2015). Aging and financial decision making. *Management Science*, 61, 2603–2610. doi:[10.1287/mnsc.2014.2010](https://doi.org/10.1287/mnsc.2014.2010).
1170
- Gee, J. (2018). *Annual fraud indicator 2017: Identifying the cost of fraud to the UK economy*. Growe UK. URL: <https://www.crowe.com/uk/croweuk/-/media/Crowe/Firms/Europe/uk/CroweUK/PDF-publications/Annual-Fraud-Indicator-report-2017>.
- 1175 Geiger, V., Yasukawa, K., Bennison, A., Wells, J. F., & Sawatzki, C. (2020). Facets of numeracy: Teaching, learning and practices. In J. Way, C. Attard, J. Anderson, J. Bobis, H. McMaster, & K. Cartwright (Eds.), *Research in mathematics education in Australasia 2016–2019* (pp. 59–89). Springer. doi:[10.1007/978-981-15-4269-5_4](https://doi.org/10.1007/978-981-15-4269-5_4).
- 1180 Gerardi, K., Goette, L., & Meier, S. (2010). Financial literacy and subprime mortgage delinquency: Evidence from a survey matched to administrative

- data [Working paper 2010-10]. *Federal Reserve Bank of Atlanta Working Paper Series*, . URL: <https://www.atlantafed.org/-/media/documents/research/publications/wp/2010/wp1010.pdf>.
- 1185 Gilbert, N. (2002). *Transformation of the welfare state: The silent surrender of public responsibility*. Oxford University Press.
- Gottfredson, G. D., Gottfredson, D. C., Payne, A. A., & Gottfredson, N. C. (2005). School climate predictors of school disorder: Results from a national study of delinquency prevention in schools. *Journal of Research in Crime and Delinquency*, 42, 412–444. doi:10.1177/0022427804271931.
- 1190
- Gramatki, I. (2017). A comparison of financial literacy between native and immigrant school students. *Education Economics*, 25, 304–322. doi:10.1080/09645292.2016.1266301.
- Grohmann, A. (2016). The gender gap in financial literacy: Income, education, and experience offer only partial explanations. *DIW Economic Bulletin*, 6, 531–537. URL: <https://www.econstor.eu/bitstream/10419/148080/1/872886581.pdf>.
- 1195
- Grund, S., Lüdtke, O., & Robitzsch, A. (2016). Multiple imputation of multilevel missing data: An introduction to the package *pan*. *SAGE Open*, (pp. 1–17). doi:10.1177/2158244016668220.
- 1200
- Grund, S., Lüdtke, O., & Robitzsch, A. (2018). Multiple imputation of missing data for multilevel models: Simulations and recommendations. *Organizational Research Methods*, 21, 111–149. doi:10.1177/1094428117703686.
- Gudmunson, C. G., & Danes, S. M. (2011). Family financial socialization: Theory and critical review. *Journal of Family and Economic Issues*, 32, 644–667. doi:10.1007/s10834-011-9275-y.
- 1205
- Harlen, W. (1999). Purposes and procedures for assessing science process skills. *Assessment in Education: Principles, Policy & Practice*, 6, 129–144. doi:10.1080/09695949993044.

- 1210 Hastings, J. S., Madrian, B. C., & Skimmyhorn, W. L. (2013). Financial literacy, financial education, and economic outcomes. *Annual Review of Economics*, 5, 347–373. doi:[10.1146/annurev-economics-082312-125807](https://doi.org/10.1146/annurev-economics-082312-125807).
- Hospido, L., Izquierdo, S., & Machelett, M. (2021). *The gender gap in financial competences*. Economic Bulletin 1/2021 Banco de España.
- 1215 URL: <https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/InformesBoletinesRevistas/ArticulosAnaliticos/21/T1/descargar/Files/be2101-art05e.pdf>.
- Hox, J. J., Maas, C. J. M., & Brinkhuis, M. J. S. (2010). The effect of estimation method and sample size in multilevel structural equation modeling. *Statistica Neerlandica*, 64, 157–170. doi:[10.1111/j.1467-9574.2009.00445.x](https://doi.org/10.1111/j.1467-9574.2009.00445.x).
- 1220
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, 6, 1–55. doi:[10.1080/10705519909540118](https://doi.org/10.1080/10705519909540118).
- 1225
- Huber, P. J. (1967). The behavior of maximum likelihood estimates under non-standard conditions. In J. M. Le Cam, & J. Neyman (Eds.), *Proceedings of the fifth Berkeley symposium on mathematical statistics and probability* (pp. 221–233). University of California Press volume 1: Theory of statistics. URL: https://digitalassets.lib.berkeley.edu/math/ucb/text/math_s5_v1_article-13.pdf.
- 1230
- Huston, S. J. (2010). Measuring financial literacy. *Journal of Consumer Affairs*, 44, 296–316. doi:[10.1111/j.1745-6606.2010.01170.x](https://doi.org/10.1111/j.1745-6606.2010.01170.x).
- Huston, S. J. (2012). Financial literacy and the cost of borrowing. *International Journal of Consumer Studies*, 36, 566–572. doi:[10.1111/j.1470-6431.2012.01122.x](https://doi.org/10.1111/j.1470-6431.2012.01122.x).
- 1235
- Indefenso, E. E., & Yazon, A. D. (2020). Numeracy level, mathematics problem

- skills, and financial literacy. *Universal Journal of Educational Research*, 8, 4393–4399. doi:[10.13189/ujer.2020.081005](https://doi.org/10.13189/ujer.2020.081005).
- Jappelli, T. (2010). Economic literacy: An international comparison. *The Economic Journal*, 120, F429–F451. doi:[10.1111/j.1468-0297.2010.02397.x](https://doi.org/10.1111/j.1468-0297.2010.02397.x).
1240
- Jimerson, S. R., Hart, S. R., & Renshaw, T. L. (2012). Conceptual foundations for understanding youth engaged in antisocial and aggressive behaviors. In S. Jimerson, A. Nickerson, M. J. Mayer, & M. J. Furlong (Eds.), *Handbook of School Violence and School Safety* (pp. 3–14). Routledge. (2nd ed.). doi:[10.4324/9780203841372](https://doi.org/10.4324/9780203841372).
1245
- Jorgensen, B. L., & Savla, J. (2010). Financial literacy of young adults: The importance of parental socialization. *Family Relations*, 59, 465–478. doi:[10.1111/j.1741-3729.2010.00616.x](https://doi.org/10.1111/j.1741-3729.2010.00616.x).
- Kaiser, T., & Menkhoff, L. (2020). Financial education in schools: A meta-analysis of experimental studies. *Economics of Education Review*, 78, 1–15. doi:[10.1016/j.econedurev.2019.101930](https://doi.org/10.1016/j.econedurev.2019.101930).
1250
- Kaplan, D. (1989). Model modification in covariance structure analysis: Application of the expected parameter change statistic. *Multivariate Behavioral Research*, 24, 285–305. doi:[10.1207/s15327906mbr2403_2](https://doi.org/10.1207/s15327906mbr2403_2).
- Kaplan, D. (2009). *Structural equation modeling: Foundations and extensions*. (2nd ed.). SAGE. doi:[10.4135/9781452226576](https://doi.org/10.4135/9781452226576).
1255
- Karakurum-Ozdemir, K., Kokkizil, M., & Uysal, G. (2019). Financial literacy in developing countries. *Social Indicators Research*, 143, 325–353. doi:[10.1007/s11205-018-1952-x](https://doi.org/10.1007/s11205-018-1952-x).
- Khoirunnisaa, J., & Johan, I. R. (2020). The effects of financial literacy and self-control towards financial behavior among high school students in Bogor. *Journal of Consumer Sciences*, 5, 73–86. doi:[10.29244/jcs.5.2.73-86](https://doi.org/10.29244/jcs.5.2.73-86).
1260

- 1265 Kiliyanni, A. L., & Sivaraman, S. (2016). The perception-reality gap in financial literacy: Evidence from the most literate state in India. *International Review of Economics Education*, 23, 47–64. doi:[10.1016/j.iree.2016.07.001](https://doi.org/10.1016/j.iree.2016.07.001).
- Klapper, L., & Lusardi, A. (2019). Financial literacy and financial resilience: Evidence from around the world. *Financial Management*, (pp. 1–26). doi:[10.1111/fima.12283](https://doi.org/10.1111/fima.12283).
- 1270 Krippner, G. R. (2005). The financialization of the American economy. *Socio-Economic Review*, 3, 173–208. doi:[10.1093/ser/mwi008](https://doi.org/10.1093/ser/mwi008).
- Kuperminc, G. P., Leadbeater, B. J., Emmons, C., & Blatt, S. J. (1997). Perceived school climate and difficulties in the social adjustment of middle school students. *Applied Developmental Science*, 1, 76–88. doi:[10.1207/s1532480xads0102_2](https://doi.org/10.1207/s1532480xads0102_2).
- 1275 Kutsyuruba, B., Klinger, D. A., & Hussain, A. (2015). Relationships among school climate, school safety, and student achievement and well-being: A review of the literature. *Review of Education*, 3, 103–135. doi:[10.1002/rev3.3043](https://doi.org/10.1002/rev3.3043).
- Lambert, B. (2018). *A student's guide to Bayesian statistics*. SAGE.
- 1280 Lee, J., & Stankov, L. (2018). Non-cognitive predictors of academic achievement: Evidence from TIMSS and PISA. *Learning and Individual Differences*, 65, 50–64. doi:[10.1016/j.lindif.2018.05.009](https://doi.org/10.1016/j.lindif.2018.05.009).
- Little, R. J. A., & Rubin, D. B. (2019). *Statistical analysis with missing data*. (3rd ed.). Wiley. doi:[10.1002/9781119482260](https://doi.org/10.1002/9781119482260).
- 1285 Longobardi, S., Pagliuca, M. M., & Regoli, A. (2018). Can problem-solving attitudes explain the gender gap in financial literacy? Evidence from Italian students' data. *Quality & Quantity*, 52, 1677–1705. doi:[10.1007/s11135-017-0545-0](https://doi.org/10.1007/s11135-017-0545-0).

- 1290 Lüdtke, O., Marsh, H. W., Robitzsch, A., & Trautwein, U. (2011). A 2×2
taxonomy of multilevel latent contextual models: Accuracy–bias trade-offs in
full and partial error correction models. *Psychological Methods*, *16*, 444–467.
doi:[10.1037/a0024376](https://doi.org/10.1037/a0024376).
- 1295 Lüdtke, O., Marsh, H. W., Robitzsch, A., Trautwein, U., Asparouhov, T., &
Muthén, B. (2008). The multilevel latent covariate model: A new, more
reliable approach to group-level effects in contextual studies. *Psychological
Methods*, *13*, 203–229. doi:[10.1037/a0012869](https://doi.org/10.1037/a0012869).
- 1300 Lüdtke, O., Robitzsch, A., Trautwein, U., & Kunter, M. (2009). Assessing the
impact of learning environments: How to use student ratings of classroom
or school characteristics in multilevel modeling. *Contemporary Educational
Psychology*, *34*, 120–131. doi:[10.1016/j.cedpsych.2008.12.001](https://doi.org/10.1016/j.cedpsych.2008.12.001).
- Lührmann, M., Serra-Garcia, M., & Winter, J. (2015). Teaching teenagers
in finance: Does it work? *Journal of Banking & Finance*, *54*, 160–174.
doi:[10.1016/j.jbankfin.2014.11.009](https://doi.org/10.1016/j.jbankfin.2014.11.009).
- 1305 Lusardi, A. (2012). Financial literacy and financial decision-making in older
adults. *Generations*, *36*, 25–32. URL: <https://www.jstor.org/stable/26555907>.
- Lusardi, A. (2015). Financial literacy skills for the 21st Century: Evidence from
PISA. *Journal of Consumer Affairs*, *49*, 639–659. doi:[10.1111/joca.12099](https://doi.org/10.1111/joca.12099).
- 1310 Lusardi, A., & Mitchell, O. S. (2007). Baby Boomer retirement security: The
roles of planning, financial literacy, and housing wealth. *Journal of Monetary
Economics*, *54*, 205–224. doi:[10.1016/j.jmoneco.2006.12.001](https://doi.org/10.1016/j.jmoneco.2006.12.001).
- Lusardi, A., & Mitchell, O. S. (2008). Planning and financial literacy: How
do women fare? *American Economic Review: Papers & Proceedings*, *98*,
413–417. doi:[10.1257/aer.98.2.413](https://doi.org/10.1257/aer.98.2.413).

- 1315 Lusardi, A., & Mitchell, O. S. (2014). The economic importance of financial literacy: Theory and evidence. *Journal of Economic Literature*, 52, 5–44. doi:[10.1257/jel.52.1.5](https://doi.org/10.1257/jel.52.1.5).
- Lusardi, A., Mitchell, O. S., & Curto, V. (2010). Financial literacy among the young. *Journal of Consumer Affairs*, 44, 358–380. doi:[10.1111/j.1745-6606.2010.01173.x](https://doi.org/10.1111/j.1745-6606.2010.01173.x).
1320
- Lusardi, A., Schneider, D., & Tufano, P. (2015). The economic crisis and medical care use: Comparative evidence from five high-income countries. *Social Science Quarterly*, 96, 202–213. doi:[10.1111/ssqu.12076](https://doi.org/10.1111/ssqu.12076).
- MacCallum, R. C., Roznowski, M., & Necowitz, L. B. (1992). Model modifications in covariance structure analysis: The problem of capitalization on
1325 chance. *Psychological Bulletin*, 111, 490–504. doi:[10.1037/0033-2909.111.3.490](https://doi.org/10.1037/0033-2909.111.3.490).
- Mandell, L., & Klein, L. S. (2009). The impact of financial literacy education on subsequent financial behavior. *Journal of Financial Counseling and Planning*,
1330 20, 15–24. URL: <https://files.eric.ed.gov/fulltext/EJ859556.pdf>.
- Marley-Payne, J., Dituri, P., & Davidson, A. (2021). *Financial education and conceptual understanding: Learning from best practices in mathematics*. Financial Life Cycle Education Corp. URL: <https://fifecycle.org/wp-content/uploads/2021/04/FINAL-Financial-Education-and-Conceptual-Understanding.pdf>.
1335
- Marsh, H. W., Lüdtke, O., Nagengast, B., Trautwein, U., Morin, A. J. S., Abduljabbar, A. S., & Köller, O. (2012). Classroom climate and contextual effects: Conceptual and methodological issues in the evaluation of group-level effects. *Educational Psychologist*, 47, 106–124. doi:[10.1080/00461520.2012.670488](https://doi.org/10.1080/00461520.2012.670488).
1340
- Marsh, H. W., Lüdtke, O., Robitzsch, A., Trautwein, U., Asparouhov, T., Muthén, B., & Nagengast, B. (2009). Doubly-latent models of school con-

- textual effects: Integrating multilevel and structural equation approaches to control measurement and sampling error. *Multivariate Behavioral Research*, 44, 764–802. doi:[10.1080/00273170903333665](https://doi.org/10.1080/00273170903333665).
- 1345 Meng, X.-L., & Rubin, D. B. (1992). Performing likelihood ratio tests with multiply-imputed data sets. *Biometrika*, 79, 103–111. doi:[10.1093/biomet/79.1.103](https://doi.org/10.1093/biomet/79.1.103).
- Miles, K. H., & Darling-Hammond, L. (1998). Rethinking the allocation of teaching resources: Some lessons from high-performing schools. *Educational Evaluation and Policy Analysis*, 20, 9–29. doi:[10.3102/01623737020001009](https://doi.org/10.3102/01623737020001009).
- 1350 Montoya, D. Y., & Scott, M. L. (2013). The effect of lifestyle-based depletion on teen consumer behavior. *Journal of Public Policy & Marketing*, 32, 82–96. doi:[10.1509/jppm.10.086](https://doi.org/10.1509/jppm.10.086).
- 1355 Moreno-Herrero, D., Salas-Velasco, M., & Sánchez-Campillo, J. (2018). Factors that influence the level of financial literacy among young people: The role of parental engagement and students' experiences with money matters. *Children and Youth Services Review*, 95, 334–351. doi:[10.1016/j.childyouth.2018.10.042](https://doi.org/10.1016/j.childyouth.2018.10.042).
- 1360 Morgan, R. E. (2021). *Financial fraud in the United States, 2017*. U.S. Department of Justice. URL: <https://www.bjs.gov/content/pub/pdf/ffus17.pdf>.
- Mountain, T. P., Kim, N., Serido, J., & Shim, S. (2020). Does type of financial learning matter for young adults' objective financial knowledge and financial behaviors? A longitudinal and mediation analysis. *Journal of Family and Economic Issues*, (pp. 1–20). doi:[10.1007/s10834-020-09689-6](https://doi.org/10.1007/s10834-020-09689-6).
- 1365 Muthén, L. K., & Muthén, B. O. (1998–2017). **Mplus** (Version 8.5) [Computer software]. Muthén & Muthén. URL: <http://www.statmodel.com/>.

- Muthén, L. K., & Muthén, B. O. (2017). **Mplus** user's guide. Muthén
 1370 & Muthén. URL: [https://www.statmodel.com/download/usersguide/
 Mplus%20user%20guide%20Ver_7_r6_web.pdf](https://www.statmodel.com/download/usersguide/Mplus%20user%20guide%20Ver_7_r6_web.pdf).
- Norvilitis, J. M., & MacLean, M. G. (2010). The role of parents in college
 students' financial behaviors and attitudes. *Journal of Economic Psychology*,
 31, 55–63. doi:10.1016/j.joep.2009.10.003.
- 1375 OECD (2009). *PISA data analysis manual*. (SPSS 2nd ed. ed.). OECD Pub-
 lishing. doi:10.1787/9789264056275-en.
- OECD (2019a). PISA 2018 financial literacy framework. In *PISA 2018
 assessment and analytical framework* (pp. 119–164). OECD Publishing.
 doi:10.1787/a1fad77c-en.
- 1380 OECD (2019b). *PISA 2018 results: What school life means for students' lives*.
 OECD Publishing. doi:10.1787/acd78851-en.
- OECD (2020a). *Financial literacy data file* [Data set]. OECD Publishing. URL:
https://webfs.oecd.org/pisa2018/SPSS_STU_FLT.zip.
- OECD (2020b). *PISA 2018 results: Are students smart about money?*. OECD
 1385 Publishing. doi:10.1787/48ebd1ba-en.
- OECD (2020c). *PISA 2018 technical report*. OECD Publisher. URL: [https:
 //www.oecd.org/pisa/data/pisa2018technicalreport/](https://www.oecd.org/pisa/data/pisa2018technicalreport/).
- OECD (2020d). *School questionnaire data file* [Data set]. OECD Publisher.
 URL: https://webfs.oecd.org/pisa2018/SPSS_SCH_QQQ.zip.
- 1390 Opletalová, A. (2015). Financial education and financial literacy in the Czech
 education system. *Procedia – Social and Behavioral Sciences*, 171, 1176–1184.
 doi:10.1016/j.sbspro.2015.01.229.
- Ozkale, A., & Erdogan, E. O. (2020a). An analysis of the interaction between
 mathematical literacy and financial literacy in PISA. *International Journal*

- 1395 of *Mathematical Education in Science and Technology*, (pp. 1–21). doi:[10.1080/0020739x.2020.1842526](https://doi.org/10.1080/0020739x.2020.1842526).
- Ozkale, A., & Erdogan, E. O. (2020b). A conceptual model for the interaction of mathematical and financial literacies. *International Journal of Progressive Education*, 16, 288–304. doi:[10.29329/ijpe.2020.277.18](https://doi.org/10.29329/ijpe.2020.277.18).
- 1400 Pak, T.-Y. (2018). Financial literacy and high-cost borrowing: Exploring the mechanism. *International Journal of Consumer Studies*, 42, 283–294. doi:[10.1111/ijcs.12429](https://doi.org/10.1111/ijcs.12429).
- Pokropek, A. (2016). Introduction to instrumental variables and their application to large-scale assessment data. *Large-scale Assessments in Education*, 4, 1–20. doi:[10.1186/s40536-016-0018-2](https://doi.org/10.1186/s40536-016-0018-2).
- 1405 Potrich, A. C. G., Vieira, K. M., Coronel, D. A., & Bender Filho, R. (2015a). Financial literacy in Southern Brazil: Modeling and invariance between genders. *Journal of Behavioral and Experimental Finance*, 6, 1–12. doi:[10.1016/j.jbef.2015.03.002](https://doi.org/10.1016/j.jbef.2015.03.002).
- 1410 Potrich, A. C. G., Vieira, K. M., & Kirch, G. (2015b). Determinants of financial literacy: Analysis of the influence of socioeconomic and demographic variables. *Revista Contabilidade & Finanças*, 26, 362–377. doi:[10.1590/1808-057x201501040](https://doi.org/10.1590/1808-057x201501040).
- Preston, A. C., & Wright, R. E. (2019). Understanding the gender gap in financial literacy: Evidence from Australia. *Economic Record*, 95, 1–29. doi:[10.1111/1475-4932.12472](https://doi.org/10.1111/1475-4932.12472).
- 1415 Raykov, T., & Marcoulides, G. A. (2004). Using the delta method for approximate interval estimation of parameter functions in SEM. *Structural Equation Modeling: A Multidisciplinary Journal*, 11, 621–637. doi:[10.1207/s15328007sem1104_7](https://doi.org/10.1207/s15328007sem1104_7).
- 1420

- Regan, S., & Paxton, W. (2003). *Beyond bank accounts: Full financial inclusion*. IPPR. URL: https://www.ippr.org/files/images/media/files/publication/2011/05/beyond_bank_accounts_1297.pdf.
- 1425 Reiter, S., & Beckmann, E. (2020). *How financially literate is CESEE? Insights from the OeNB Euro Survey*. Technical Report Oesterreichische Nationalbank. URL: https://www.oenb.at/dam/jcr:578c0407-1d22-4094-a312-b7ce3e82ae76/03_feei_Q3_20_How-financially-literate-is-CESEE.pdf.
- 1430 Rubin, D. B. (1987). *Multiple imputation for nonresponse in surveys*. John Wiley & Sons. doi:[10.1002/9780470316696](https://doi.org/10.1002/9780470316696).
- Rust, K. (2014). Sampling, weighting, and variance estimation in international large-scale assessments. In L. Rutkowski, M. von Davier, & D. Rutkowski (Eds.), *Handbook of international large-scale assessment: Background, technical issues, and methods of data analysis* (pp. 117–153). CRC Press. doi:[10.1201/b16061-11](https://doi.org/10.1201/b16061-11).
- 1435 Salas-Velasco, M. (2019). The educational performance of Spanish secondary schools in PISA, 2003–2012. *Current Politics and Economics of Europe*, 30, 189–218. URL: <https://www.proquest.com/docview/2279748994/fulltext/3AFA8983FDCC4D84PQ/>.
- 1440 Saris, W. E., Satorra, A., & Sörbom, D. (1987). The detection and correction of specification errors in structural equation models. In C. C. Clogg (Ed.), *Sociological methodology* (pp. 105–129). American Sociological Association. doi:[10.2307/271030](https://doi.org/10.2307/271030).
- 1445 Schuhen, M., & Schürkmann, S. (2014). Construct validity of financial literacy. *International Review of Economics Education*, 16, 1–11. doi:[10.1016/j.iree.2014.07.004](https://doi.org/10.1016/j.iree.2014.07.004).
- Seeleib-Kaiser, M. (2016). The end of the conservative German welfare state

- model. *Social Policy & Administration*, 50, 219–240. doi:[10.1111/spol.12212](https://doi.org/10.1111/spol.12212).
- 1450 Serido, J., & Deenanath, V. (2016). Financial parenting: Promoting financial self-reliance of young consumers. In J. J. Xiao (Ed.), *Handbook of consumer finance research* (pp. 291–300). Springer. doi:[10.1007/978-3-319-28887-1_24](https://doi.org/10.1007/978-3-319-28887-1_24).
- 1455 Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Wadsworth Cengage Learning.
- Silgoner, M., Greimel-Fuhrmann, B., & Weber, R. (2015). Financial literacy gaps of the Austrian population. *Monetary Policy & the Economy*, Q2, 35–51. URL: https://www.oenb.at/dam/jcr:a23bbdba-3696-4ed8-a4d5-656bbf09e0e0/mop_2015_q2_analyses02.pdf.
- 1460 Skagerlund, K., Lind, T., Strömbäck, C., Tinghög, G., & Västfjäll, D. (2018). Financial literacy and the role of numeracy—How individuals’ attitude and affinity with numbers influence financial literacy. *Journal of Behavioral and Experimental Economics*, 74, 18–25. doi:[10.1016/j.socsec.2018.03.004](https://doi.org/10.1016/j.socsec.2018.03.004).
- 1465 Skiba, R., Ritter, S., Simmons, A., Peterson, R., & Miller, C. (2006). The safe and responsive schools project: A school reform model for implementing best practices in violence prevention. In S. R. Jimerson, & M. Furlong (Eds.), *Handbook of school violence and school safety: From research to practice* (pp. 631–650). Lawrence Erlbaum. URL: <https://psycnet.apa.org/record/2006-03632-041>.
- 1470 Smith, G., Wood, L., Coupland, M., Stephenson, B., Crawford, K., & Ball, G. (1996). Constructing mathematical examinations to assess a range of knowledge and skills. *International Journal of Mathematical Education in Science and Technology*, 27, 65–77. doi:[10.1080/0020739960270109](https://doi.org/10.1080/0020739960270109).
- 1475

- Snijders, T. A. B., & Bosker, R. J. (2012). *Multilevel analysis: An introduction to basic and advanced multilevel modeling*. SAGE.
- Sole, M. A. (2014). Financial literacy: An essential component of mathematics literacy and numeracy. *Journal of Mathematics Education at Teachers College*, 5, 55–62. URL: https://academicworks.cuny.edu/cgi/viewcontent.cgi?article=1011&context=nc_pubs.
1480
- Stone, D. M., Simon, T. R., Fowler, K. A., Kegler, S. R., Yuan, K., Holland, K. M., Ivey-Stephenson, A. Z., & Crosby, A. E. (2018). *Vital signs: Trends in state suicide rates — United States, 1999–2016 and circumstances contributing to suicide — 27 states, 2015. Morbidity and Mortality Weekly Report*, 67, 617–624. doi:10.15585/mmwr.mm6722a1.
1485
- Sutter, M., Weyand, M., Untertrifaller, A., & Froitzheim, M. (2020). *Financial literacy, risk and time preferences—Results from a randomized educational intervention*. Discussion Paper 2020/17 Max Planck Institute for Research on Collective Goods. URL: https://homepage.coll.mpg.de/pdf_dat/2020_17online.pdf.
1490
- Tang, N. (2017). Like father like son: How does parents’ financial behavior affect their children’s financial behavior? *Journal of Consumer Affairs*, 51, 284–311. doi:10.1111/joca.12122.
- Taylor, S. M., & Wagland, S. (2013). The solution to the financial literacy problem: What is the answer? *Australasian Accounting, Business and Finance Journal*, 7, 69–90. doi:10.14453/aabfj.v7i3.5.
1495
- Teig, N., Scherer, R., & Nilsen, T. (2018). More isn’t always better: The curvilinear relationship between inquiry-based teaching and student achievement in science. *Learning and Instruction*, 56, 20–29. doi:10.1016/j.learninstruc.2018.02.006.
1500
- Thomson, S., & De Bortoli, L. (2017). *PISA 2015: Financial literacy in Australia*. Australian Council for Educational Re-

- search. URL: <https://research.acer.edu.au/cgi/viewcontent.cgi?article=1028&context=ozpisa>.
- 1505
- Tymms, P. (2004). Effect sizes in multilevel models. In I. Schagen, & K. Elliot (Eds.), *But what does it mean? The use of effect sizes in educational research* (pp. 55–66). NFER and Institute of Education University of London. URL: <https://dro.dur.ac.uk/23722/1/23722.pdf>.
- 1510
- Uline, C., & Tschannen-Moran, M. (2008). The walls speak: The interplay of quality facilities, school climate, and student achievement. *Journal of Educational Administration*, 46, 55–73. doi:10.1108/09578230810849817.
- Utkarsh, B., Pandey, A., Ashta, A., Spiegelman, E., & Sutan, A. (2020). Catch them young: Impact of financial socialization, financial literacy and attitude
- 1515
- towards money on financial well-being of young adults. *International Journal of Consumer Studies*, 44, 531–541. doi:10.1111/ijcs.12583.
- von Davier, M. (2014). Imputing proficiency data under planned missingness in population models. In L. Rutkowski, M. von Davier, & D. Rutkowski (Eds.), *Handbook of international large-scale assessment: Background, technical issues, and methods of data analysis* (pp. 175–201). CRC Press.
- 1520
- doi:10.1201/b16061-13.
- Wang, M.-T., & Degol, J. L. (2016). School climate: A review of the construct, measurement, and impact on student outcomes. *Educational Psychology Review*, 28, 315–352. doi:10.1007/s10648-015-9319-1.
- 1525
- White, H. (1982). Maximum likelihood estimation of misspecified models. *Econometrica*, 50, 1–25. doi:10.2307/1912526.
- Whittaker, T. A. (2012). Using the modification index and standardized expected parameter change for model modification. *Journal of Experimental Education*, 80, 26–44. doi:10.1080/00220973.2010.531299.
- 1530
- Yoshino, N., Morgan, P. J., & Wignaraja, G. (2015). *Financial education in Asia: Assessment and recommendations*. Working Paper Series No. 534 Asian

Development Bank Institute. URL: <https://www.adb.org/sites/default/files/publication/161053/adbi-wp534.pdf>.

1535 Zhang, X., Wan, Q., Lyu, S., Li, O., & Liu, Y. (2021). Overlearning is as ineffective as underlearning? A cross-culture study from PISA 2015. *Learning and Individual Differences*, 88, 1–10. doi:[10.1016/j.lindif.2021.102005](https://doi.org/10.1016/j.lindif.2021.102005).