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RESEARCH

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Financial literacy among Finnish adolescents in PISA 2018: the role of financial learning and dispositional factors

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Abstract

The aim of the present study was to examine the relative importance of financial education in school and families and dispositional factors (competitiveness, work mastery, meta-cognition) in predicting financial literacy among Finnish adolescents. The data on the 4328 Finnish 15-year-olds was drawn from the PISA 2018 assessment. Financial literacy was measured by tests, and financial education and dispositional factors were assessed by adolescent questionnaires. First, the results showed that financial education in school was positively associated with adolescents' financial literacy skills, whereas parental involvement in financial matters did not relate or related negatively to financial literacy scores. Second, dispositional factors, such as competitiveness, work mastery, and meta-cognition (effective strategies to understand/remember information, to summarize information, and to evaluate source credibility) were the strongest positive predictors of the financial literacy scores. Overall, the present study emphasizes that certain social factors (schools and families) and especially dispositional characteristics (personality/motivation and critical thinking/learning strategies) may shape the development of the financial skills of adolescents.

Keywords: Adolescents, PISA, Financial literacy, Financial learning, Dispositional factors

Introduction

Financial literacy—the ability to understand financial information and, based on it, make decisions about financial matters—has become a globally recognized essential life skill (Moreno-Herrero et al., 2018). Nowadays, financial markets are increasingly accessible to consumers due to major technological progress, and financial literacy plays a key role in helping to manage individual finances efficiently, which can improve the economic behavior and the quality of people's lives (Arellano et al., 2018). In order to manage their finances successfully, people have to take daily financial decisions about expenditures and savings and differentiate among a wide range of products, services, and providers of financial products (Arellano et al., 2014; Moreno-Herrero et al., 2018). Young people are an attractive market for financial service providers. However, they have limited abilities in taking correct financial decisions (Arellano et al., 2014). Therefore, young people, as early as secondary school, should already be exposed to some of the basic topics of

financial literacy as they need to be prepared to deal with increasingly complex financial decisions in the future. Financial education among young people, and their preparation for decision-making in adult life, has aroused increasing concern among governments and other international bodies (Arellano et al., 2014).

The OECD, in acknowledging the importance of being financially literate as early as in adolescence, added financial literacy as an international option to be assessed in the Programme for International Student Assessment (PISA) alongside reading, math, and science literacy. Finland tends to rank very high in international PISA comparisons overall, and in PISA 2018 Finnish adolescents' financial literacy ranked second to third together with Canada behind Estonia (OECD, 2020a). Despite the high ranking of Finnish 15-year-olds' PISA performance, little is known what factors may be associated with adolescents' financial literacy proficiency in Finland and elsewhere. Previous reports on PISA data often emphasized the role of socio-demographic background characteristics, for example, adolescent age, gender, parental education, and SES (OECD, 2020a). Thus, it remains unclear how several factors related to financial education, such as the opportunity to learn at school (Elliott & Bartlett, 2016) and implicit financial learning, such as adolescents' interactions about financial matters with parents (Vosylis & Erentaite, 2020) may relate to financial literacy. Moreover, dispositional adolescents' characteristics, such as motivation and personality-based psychological characteristics and approaches to learning, can also be related to the gains in financial literacy. Previous studies often considered these factors in isolation, whereas including them all at once would provide us with a more comprehensive understanding of the phenomenon of financial literacy. The status of the PISA assessment tool of financial literacy and its impact on educational policymaking are widely acknowledged, and therefore these results may have a highly applicable value in enhancing adolescents' financial literacy at schools. Consequently, the present study was set to investigate the relative importance of the financial education and dispositional factors in predicting PISA 2018 financial literacy scores among Finnish adolescents.

Financial literacy and its assessment in PISA

The PISA framework defines financial literacy as follows:

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

(OECD, 2020a, p. 128).

Financial literacy is often understood as an important aspect of increased financial capability and a determinant of financial behavior (Hilgert et al., 2003; Lyons et al., 2006; Mandell, 2006). For example, it has been shown that financial literacy relates to wiser choices in saving and investing (Lusardi & Mitchell, 2014), wealth accumulation (Behrman et al., 2012; Gustman et al., 2012), saving and retirement planning (Lusardi & Mitchell, 2007), contracting personal loans and mortgages with better conditions (Disney & Gathergood, 2013), low-cost borrowing and fee awareness (Bucher-Koenen et al., 2017), preventing the incurrence of debt (Huston, 2012; Lusardi et al., 2015), and stock

market participation (Abreu & Mendes, 2010; Christelis et al., 2010; Van Rooij et al., 2011).

Financial literacy was included in the PISA assessment of 2012 as its importance was recognized already at the secondary school level alongside that of the permanent main domains of reading, mathematics, and science. As such, financial literacy has been provided as an international option also in the two subsequent PISA assessments in 2015 and 2018. In all, in 2012 the optional assessment was conducted in a total of 18 countries (29,041 students), in 2015, 15 countries (125,574 students) took part, and in 2018, 20 countries participated (117,137 students). In 2018, Finland made its debut in the financial literacy assessment for adolescents, and thus we focus on the Finnish data set of financial literacy from PISA 2018. Although the data collection took place in 2018, the results were released on May 7, 2020. In the latest PISA 2018 assessment the mean score of financial literacy of Finnish adolescents was ranked second (attaining the mean score of 537). Finland's score was significantly above the OECD mean score (505), significantly lower than the score of Estonia (547), and statistically did not differ from the score of Canada provinces (532), which was ranked third (OECD, 2020a). Consequently, investigating predictors of financial literacy among Finnish adolescents can add to our understanding of what explains high financial literacy scores internationally.

Factors of financial learning and financial literacy

Within the PISA framework, the Financial Literacy Expert Group (FEG) emphasized the importance of financial learning—or *access to information and education*—that can explain financial literacy scores (OECD, 2019). Access to information and education refers to the variety of sources of financial information and education that are available to adolescents (e.g., information and education provided by school, family, friends, or financial sector). In the present study, we investigated the frequency and availability of two access sources to the financial information: (1) lessons at schools and (2) parental involvement with financial matters. This decision stems from the theoretical framework of the Opportunity to Learn (OTL; Elliott & Bartlett, 2016; Stevens, 1996). According to OTL, school context is a defining factor in children's learning, which includes time spent on instruction, the content of instruction, and quality of interaction during instruction. In the PISA student questionnaire, adolescents were asked about the frequency with which they have heard/learned certain financial literacy concepts or solved financial literacy-related tasks during school lessons (i.e., the implemented curriculum). That is, theoretically, we had information on adolescents' perceptions of the instructional time and content allocated by teachers and schools for the topic of financial literacy. In addition, worth mentioning is the fact that financial literacy is an explicit part of the Finnish national core curriculum (i.e., intended curriculum in OTL model). Starting from year 2004, Finnish Grade 9 students have one course on financial literacy as a part of their social science studies (The Finnish National board of Education, 2004; Vitikka et al., 2012), and financial matters are taught as integrated part of mathematics and home economics in Grade 7. Thus, Finnish participants of PISA 2018 were exposed to this curriculum. Moreover, financial literacy can be viewed as the attained curriculum. Although PISA does not cover all that is taught as part of the Finnish curriculum,

we expect there to be a significant overlap between the Finnish curriculum and the PISA Financial Literacy framework. Thus, theoretically, the present study may provide evidence on how intended curriculum (financial literacy being taught in Finnish schools) manifests through implemented curriculum (adolescents' perceptions of the frequency of the financial literacy content at school) on attained curriculum (financial literacy scores). Previous research shows that along with students from Australia, Indonesia, and the Russian Federation, Finnish adolescents in PISA 2018 reported the greatest exposure to financial literacy tasks in school lessons (OECD, 2020a). Previous research shows that the provision of financial education at school has at least short-time effects on attitudes and spending behavior (Batty et al., 2015), as it provides information and also offers skill-building and motivation (Hilgert et al., 2003). In the recent meta-analysis of 126 studies, Kaiser and Menkhoff (2017) found that financial education significantly predicted financial literacy and financial behavior. Based on the PISA 2012 results, the availability of financial education has a significant and positive relation with adolescents' financial literacy scores (Cordero et al., 2019). This positive link was persistent regardless of the educational strategy applied (e.g., financial literacy classes being compulsory or not, courses taught separately or within other subjects, being taught by school teachers, or being taught by people outside the school).

Another source of access to financial information is parental involvement in financial matters at home. Parents play an important role in their children's financial learning through communicating information on financial matters to their children (Bowen, 2002; Danes & Yang, 2014; Gudmundson & Danes, 2011; Kagotho et al., 2017; Shim et al., 2010; Vosylis & Erentaite, 2020). Implicit learning takes place through the resources that parents make available to their children, observation or imitation of parental behaviors, communication about financial issues and through the creation of opportunities that allow young people to participate in financial practices (Sherraden et al., 2011). Parental involvement in financial matters with a child, in particular the frequency of discussing financial matters, was also shown to be positively related to students' financial literacy in nine (i.e., Australia, Belgium, Brazil, Chile, Lithuania, the Netherlands, Poland, the Russia Federation, and the Slovak Republic) out of 15 countries participating in PISA 2015 (Moreno-Herrero et al., 2018). Similar positive results were found in other studies (Mimura et al., 2015), which suggests that parents are the primary financial socializers of children, and children who discuss financial matters with their parents are stimulated to think about financial matters which in turn increases their financial awareness (Jorgensen & Savla, 2010). Apart from adolescents' experiences with own money, the frequency of parental involvement in adolescent financial decision making (e.g., spending and saving) is the key factor of access to money and financial products (Drever et al., 2015). Interestingly, based on the latest PISA 2018 assessment, parental involvement in financial matters with their children was the lowest in Estonia and Finland (OECD, 2020a). Taken together, both financial education in school lessons and the frequency with which young people discuss financial matters with their parents were hypothesized to be positively related to financial literacy (Moreno-Herrero et al., 2018; Tang & Peter, 2015). Thus, this was also our expectation.

Dispositional factors and financial literacy

Dispositional factors are psychological personality-based contexts in which students approach learning (OECD, 2019). Two types of dispositional predictors of financial literacy were investigated in the present study: (1) achievement motivation and (2) meta-cognition. First, we considered two *achievement motivation* factors that relate to how adolescents approach learning: competitiveness and work mastery (Elliot & McGregor, 2001; Helmreich et al., 1978). Competitiveness has been defined as a dispositional desire to outperform others, whereas work mastery refers to a dispositional desire to work hard to master tasks (OECD, 2019). In previous PISA assessments both constructs were combined to represent one variable of achievement motivation. This achievement motivation in PISA 2015 was associated with financial literacy in the Slovak Republic (Moreno-Herrero et al., 2018). However, it did not contribute to explaining variance of financial literacy in the remaining 14 countries of the PISA 2015 assessment (Moreno-Herrero et al., 2018) or a pool of all countries in the PISA 2012 assessment (Arellano et al., 2018). Therefore, based on the previous results of the PISA assessment (Baranik et al., 2007; Murayama & Elliot, 2012; Spence & Helmreich, 1983), competitiveness and work mastery in PISA 2018 were measured separately. The present study was the first to report results on these two constructs. Generally, work mastery is widely understood as a positive aspect of motivation and is often encouraged, whereas opinions about competitiveness are often divided. According to the Analytical Framework of PISA 2018 (OECD, 2019), competitiveness alone can be problematic, and thus its benefits need to be evaluated in a context of work mastery. Thus, we expected that work mastery (e.g., adolescents working hard and persisting in tasks till they are finished) would positively relate to financial literacy scores, whereas positive expectations for competitiveness (e.g., outperform others) are of a more explorative nature. Taken together, it is possible that both of these personality/motivation related factors can be positively associated with financial literacy, and therefore they were both investigated in the present study.

Second, *meta-cognition*—that is, learning strategies used in the learning process—can improve adolescents' learning (Artelt et al., 2001; Brown, Palinscar, & Armbruster, 2004). The PISA framework identified three such meta-cognitive strategies: understanding/memorizing, summarizing, and evaluating the credibility of the source (OECD, 2019). Two strategies—understanding/memorizing and summarizing—have traditionally been measures in many PISA assessments and were shown to correlate with reading performance (median correlation 0.46 and 0.39 for understanding/memorizing and summarizing, respectively [Artelt & Schneider, 2015]). By acknowledging the rapid progress of digitalization in many spheres of life, the PISA 2018 assessment recognized the importance of the critical evaluation of digital online material. Based on Coiro and Dobler's (2007) suggestion, this need to efficiently evaluate online material before making decisions and actions (e.g., selecting the most relevant links and avoiding distracting information) is becoming crucial in facilitating reading goals. Thus, a new item—assessing credibility—was developed. Although all three scales measuring meta-cognitive strategies have originally been designed to capture them associated with reading literacy in PISA, one could argue that the same strategies of understanding and critical evaluation of written information can also be useful in other domains, especially when enhancing financial literacy (OECD, 2019, 2020a). This could be the case because financial literacy

requires a certain level of proficiency in reading literacy. That is, financial literacy covers different content (e.g., deciding which of two consumer items would be better value for money according to the needs and circumstances, understanding the reasons for paying or receiving interest, and identifying which providers are trustworthy). Taken together, financial literacy tasks are typically presented in texts that include numbers. That is, numbers are presented in a certain context. Thus, the task for a student is to understand the context behind a situation and to make optimal decisions in regard to it by evaluating all the available information. Thus, we argue that meta-cognitive learning strategies are not only useful in predicting adolescents' reading skills but also in predicting such life skills as financial literacy. Consequently, we expected that meta-cognition in terms of understanding and remembering, summarizing, and assessing access credibility would be positively associated with financial literacy scores.

The present study

The aim of the present study was to investigate the relative importance of financial learning and dispositional factors in predicting financial literacy among Finnish adolescents in the PISA 2018 assessment. Two research questions guided our investigation:

RQ1 To what extent do the factors of financial learning (financial education in school and parental involvement) are associated with financial literacy scores? Based on previous studies, we expected to find that higher exposure to and help with financial matters at school and home would be positively associated with adolescents' financial literacy (Cordero et al., 2019; Moreno-Herrero et al., 2018).

RQ2 To what extent do dispositional factors (competitiveness, work mastery, and meta-cognition) are associated with financial literacy scores? Based on previous research, we expected competitiveness and work mastery to be associated with financial literacy scores positively (OECD, 2019). In addition, we expected that meta-cognition (understanding and remembering, summarizing, and assessing access credibility) would be positively associated with adolescents' financial literacy skills (Artelt & Schneider, 2015; Coiro & Dobler, 2007).

Socio-demographic background characteristics (e.g., child gender, grade level, parental education, and family wealth) can also be related to financial learning, dispositional factors, or to the development of adolescents' financial literacy (Arellano et al., 2018; Cordero et al., 2019; Lusardi & Lopez, 2016). As socio-demographic factors need to be taken into account when analyzing financial literacy, we controlled our main results for their effect.

Methods

Participants

The participants were 4328 Finnish adolescents taking part in the PISA 2018 assessment. The adolescents were randomly selected using stratified sampling. First, participating schools were randomly selected, and then students within sampled schools were randomly selected. The PISA eligible students' age should be between 15 years and three

months and 16 years and two months. In Finland, the assessment was administered in April and May 2018, and the students were born between February 1, 2002 and January 31, 2003. This sample represented a total of 57,500 adolescents from Finland. In our Finnish sample, 49.2% ($n=2129$) of the participants were female, and 50.8% ($n=2199$) were male. The modal grade for the age cohort in Finland was the 9th grade. In terms of students' grade level, 0.5% ($n=21$) were enrolled in Grade 7, 12.6% ($n=546$) in Grade 8, 86.9% ($n=3760$) in Grade 9, and 0.02% ($n=1$) in Grade 10 (the first year of upper secondary education). Using the ISCED 1997 classification (UNESCO, 2006), the highest education of parents of the participating students was as follows: 0.3% ($n=11$) of adolescents were placed in the category "no education", 0.1% ($n=4$) were categorized as primary education, 1.3% ($n=57$) were lower secondary, 17.7% ($n=768$) were vocational/pre-vocational upper secondary and non-tertiary post-secondary, 17.0% ($n=735$) were vocational tertiary, 61.5% ($n=2,660$) were theoretically oriented tertiary and post-graduate, and for 2.1% ($n=93$) data were missing.

Measures

Students solved financial literacy test tasks and answered questionnaires online as part of the PISA test. The cognitive part was a 2-h test, and questionnaires were answered for 50 min, after a break. Students were asked to solve a set of financial literacy items from a full battery of tasks (not all tasks). Following this, students solved mathematics or reading items for 60 min. Students answered two background questionnaires: Financial Literacy Questionnaire and Student Questionnaire. In the datasets that are available in the OECD PISA-data repository, Financial Literacy test scores are presented in the form of 10 plausible values, and all the composite scores of the questionnaires were standardized to have an OECD mean of 0 and a standard deviation of 1. Description of the measures is presented in Table 1 (including item stimulus, response categories, the number of items, and the text for the items). Descriptive statistics for the WLE scores (Warm's Mean Weighted Likelihood estimates, where individual participant scores were transformed to have an OECD mean of zero and an OECD standard deviation of one) of all study variables are presented in Table 2 (including sample size, mean, standard deviation, minimum and maximum values, and Cronbach's α).

Cognitive assessment

Financial literacy

The PISA cognitive assessment was conducted over a two-hour period, followed by approximately 50 min to respond to a background questionnaire. The financial literacy portion of the assessment consisted of 26 units with 43 items in total. These 26 units were split into two separate clusters that were administered in alternating order. Students participating in the Financial Literacy assessment had 60 min to respond to the financial literacy items, and 60 min to respond to either mathematics or reading literacy items. The items for the subjects were also administered in alternating order. Of the 43 financial literacy items, 29 were non-interactive items developed for the 2012 and 2015 PISA assessments. An additional 14 items were created for the 2018 assessment. These items included interactive elements so that they would add to the sense of reality and maintain interest for students. PISA 2018 included items in a variety of formats to

Table 1 Description of measures used in the present study to predict financial literacy (see OECD, 2019, 2020a, b)

Variable	# items	Item stimulus/used indices	Response categories	Items
Financial learning factors				
Financial education in school lessons	6	How often have you encountered the following types of tasks or activities in a school lesson in the last 12 months?	3-point scale: 1 = <i>Never</i> 2 = <i>Sometimes</i> 3 = <i>Often</i>	Describing the purpose and uses of money Exploring the difference between spending money on needs and wants Exploring ways of planning to pay an expense Discussing the rights of consumers when dealing with financial institutions Discussing the ways in which money invested in the stock market changes value over time Analyzing advertisements to understand how they encourage people to buy things
Parental involvement in matters of financial literacy	4	How often do you discuss the following matters with your parents (or guardians or relatives)?	4-point scale: 1 = <i>Never or hardly ever</i> 2 = <i>Once or twice a month</i> 3 = <i>Once or twice a week</i> 4 = <i>Almost every day</i>	Your spending decisions Your savings decisions The family budget Money for things you want to buy
Dispositional factors				
Competitiveness	3	How much do you agree with the following statements about yourself?	4-point scale: 1 = <i>Strongly disagree</i> 2 = <i>Disagree</i> 3 = <i>Agree</i> 4 = <i>Strongly agree</i>	I enjoy working in situations involving competition with others It is important for me to perform better than other people on a task I try harder when I'm in competition with other people
Work mastery	3	How much do you agree with the following statements about yourself?	4-point scale: 1 = <i>Strongly disagree</i> 4 = <i>Strongly agree</i>	I find satisfaction in working as hard as I can Once I start a task, I persist until it is finished Part of the enjoyment I get from doing things is when I improve on my previous performances
Meta-cognition (3 scenarios)				

Table 1 (continued)

Variable	# items	Item stimulus/used indices	Response categories	Items
1. Understanding and remembering	6	You have to understand and remember the information in a text. How do you rate the usefulness of the following strategies for understanding and memorizing the text?	The adolescents were asked to give a score for each category between 1–6: 1 = <i>Not useful at all</i> to 6 = <i>Very useful</i>	Six strategies were presented: I concentrate on the parts of the text that are easy to understand I quickly read through the text twice After reading the text, I discuss its content with other people I underline important parts of the text I summarize the text in my own words I read the text aloud to another person
2. Summarizing	5	You have just read a long and rather difficult two-page text about fluctuations in the water level of a lake in Africa. You have to write a summary. How do you rate the usefulness of the following strategies for writing a summary of this two-page text?	The adolescents were asked to give a score between 1–6 for each strategy: 1 = <i>Not useful at all</i> to 6 = <i>Very useful</i>	Five strategies were presented: I write a summary. Then I check that each paragraph is covered in the summary because the content of each paragraph should be included I try to copy out accurately as many sentences as possible Before writing the summary, I read the text as many times as possible I carefully check whether the most important facts in the text are represented in the summary I read through the text, underlining the most important sentences. Then I write them in my own words as a summary
3. Assessing credibility	5	You have received a message in your inbox from a well-known mobile phone operator telling you that you are one of the winners of a smartphone. The sender asks you to click on the link to fill out a form with your data so they can send you the smartphone. In your opinion, how appropriate are the following strategies in reaction to this email?	The adolescents were asked to give a score between 1 and 6 for each category: 1 = <i>Not useful at all</i> to 6 = <i>Very useful</i>	Five strategies were presented: Answer the email and ask for more information about the smartphone Check the sender's email address Click on the link to fill out the form as soon as possible Delete the email without clicking on the link Check the website of the mobile phone operator to see whether the smartphone offer is mentioned
Socio-demographic factors				

Table 1 (continued)

Variable	# items	Item stimulus/used indices	Response categories	Items
Gender	1		1 = female 2 = male	
Grade level	1		1 = Grade 7 2 = Grade 8 3 = Grade 9 4 = Grade 10	
Family wealth possessions	4	WEALTH Family wealth possessions index: Which of the following are in your home?	0 = No 1 = Yes	Availability of household items: A room of your own A link to the Internet Laptop Alarm system
	7	How many of these are there in your home?	0 = None 1 = One 2 = Two 3 = Three or more	Televisions Cars Rooms with a bath or shower Cell phones with Internet access (e.g., smartphones) Computers (desktop computer, portable laptop, or notebook) Tablet computers (e.g., iPad®, BlackBerry® PlayBook™) E-book readers (e.g., Kindle™, Kobo, Bookleen)
Parental education	1	HISCED The index of highest educational level of parents	ISCED1 to ISCED 6	

This table presents descriptions of the items used in the study. All the items are drawn from PISA 2018 assessment and analytical framework document (OECD, 2019). Table presents variable names, number of items, the stimulus used, response categories and the exact items

Table 2 Descriptive statistics of the used variables

Variables	N	Min	Max	M	SD	Cronbach's α
<i>Financial learning factors</i>						
Financial education in school lessons (WLE) ^a	4050	-1.56	2.32	0.474	0.896	0.883
Parental involvement in matters of financial literacy (WLE) ^a	4027	-1.99	2.40	-0.151	0.870	0.819
<i>Dispositional factors</i>						
Competitiveness (WLE) ^a	4134	-2.35	2.01	-0.041	0.977	0.800
Work mastery (WLE) ^a	4065	-2.74	1.82	-0.312	0.964	0.746
Meta-cognition: understanding and remembering (WLE) ^a	4060	-1.64	1.50	-0.112	1.020	
Meta-cognition: summarizing (WLE) ^a	4032	-1.72	1.36	0.006	1.010	
Meta-cognition: assess credibility (WLE) ^a	4007	-1.41	1.33	0.196	1.002	
<i>Control variables</i>						
Gender						
Female	2129					
Male	2199					
Student international grade (Derived)	4328	7	10	8.860	0.357	
Highest education of parents—alternate definition (HISCED)	4233	0	6	5.370	0.969	
Family wealth (WLE) ^a	4272	-4.65	4.14	0.216	0.743	0.552

This table presents descriptive statistics for the variables used. The scales of these variables were defined in Table 1. First, the number of participating students on each variable is presented, then minimum and maximum values followed by mean and standard deviation are provided. Cronbach's alpha presents the internal consistency of the scale variables

^a Warm's Mean Weighted Likelihood Estimates (WLE) are computed for the PISA indices used in our study. These values are drawn from the PISA data repository. The WLE estimates are standardized across OECD countries and have a mean of zero and standard deviation of one

minimize the possibility that item format has an influence on adolescent performance. Depending on the task, the adolescents provided their responses by providing short descriptive responses, more direct responses of one or two sentences, a calculation, or checking the box. Most of the items were coded dichotomously (correct or incorrect), whereas for some items the scoring was more nuanced, and a partial credit was awarded.

The final score for the PISA 2018 financial literacy assessment was provided in the form of 10 plausible values for each student. In Finland, the mean score across the 10 plausible values was 537 ($SD=102$). Technically, plausible values are random draws from the estimated ability distribution of proficiency estimates of every student (Mislevy et al., 1992; Wu, 2005). These plausible values can be interpreted as the range of abilities that a student might reasonably have (The Finnish National Board of Education, 2014; Wu, 2005). All 10 plausible values need to be taken into account when performing analyses in order to avoid problems associated with bias and inefficiency (Mislevy, 1993; OECD, 2019). To allow for the estimation of sampling variance for the point estimates, PISA includes in the data 80 replicate weights that can be used for such purpose.

Contextual background questionnaires

Financial learning factors

Information on two variables was collected: financial education in school lessons and parental involvement in matters of financial literacy (Tables 1 and 2).

Dispositional factors

Information on competitiveness, work mastery, and three metacognitive strategies was collected (Tables 1 and 2). To expand on meta-cognition, the students' meta-cognition of processing written information was assessed by three scenarios: (1) understanding and remembering, (2) summarizing, and (3) assessing credibility. Each scenario consisted of (a) a stem, which was a reading task, and (b) a set of strategies. Students were asked to rate the strategies regarding their usefulness for solving the reading task. All strategies were also rated by reading experts regarding their usefulness via multiple pairwise comparisons. This rating resulted in a hierarchy of all strategies for each task, and it was based on all the pairs agreed upon by at least 80% of the experts. Based on this agreed rating order, pairwise rules were then created to construct a score for each student indicating the number of times he or she chose a more useful over a less useful strategy. The final scores assigned to each student for each task ranged from 0 to 1 and can be interpreted as the proportion of the total number of expert pairwise relations that are consistent with the student ordering. The higher the score, the higher the number of times a student chose an expert-validated strategy over a less useful one. The rules for each scenario were as follows. First, the expert-rated strategy order for understanding and remembering was Strategies 3, 4 and 5 > Strategies 1, 2, and 6. Second, the expert-rated strategy order for summarizing was Strategies 4 and 5 > Strategies 1 and 3 > Strategy 2. Finally, for assessing credibility, there were six (3×2) pairwise rules based on this order: Strategy 4 > Strategy 1; Strategy 4 > Strategy 3; Strategy 2 > Strategy 1; Strategy 2 > Strategy 3; Strategy 5 > Strategy 1; and Strategy 5 > Strategy 3. Consequently, for example, a student following four of these rules would receive a score of $4/6 = 0.67$.

Socio-demographic control factors

Information on gender, grade, the highest educational level of parents, and family wealth possessions was presented when describing the sample and in Tables 1 and 2.

Analysis strategy

When analyzing PISA data, one needs to take the 10 plausible values of financial literacy scores and the 80 specific weights into account (OECD, 2020b). Therefore, for the preliminary analyses (e.g., correlations in Table 3) we used an IEA IDBAnalyzer (a macro of SPSS 24.0) that was specifically designed for the purposes of analyzing PISA data and takes the complexity of PISA data into account. To answer our research questions, we used the Mplus statistical package (version 8.4; Muthén & Muthén, 2017). To analyze the data, 10 data sets were created with different plausible value in each. Thus, the estimations were repeated 10 times with each plausible value and then combined by using Rubin's rules (Rubin, 1987). We used the general weight and 80 replicate weights, the analysis type COMPLEX (which takes students' nesting within schools into account), estimator MLR, and REPSE = FAY (0.05).

To answer the main two research questions, a set of path models was built in the following steps. First, to account for the importance of the financial learning, financial education in school lessons and parental involvement in matters of financial literacy were specified to predict the financial literacy (Model 1). Second, only dispositional predictors were specified to predict financial literacy (Model 2). Third, both financial learning

Table 3 Correlations between all study variables

	1	2	3	4	5	6	7	8	9	10	11
1 Financial literacy	1										
2 Financial education in matters of financial literacy	0.18***	1									
3 Parental involvement in matters of financial literacy	0.01	0.275**	1								
4 Competitiveness	0.19***	0.102**	0.114**	1							
5 Work mastery	0.25***	0.188**	0.175**	0.338**	1						
6 Meta-cognition: Understanding and remembering	0.31***	0.057**	0.045**	0.039*	0.218**	1					
7 Meta-cognition: summarizing	0.35***	0.063**	0.040*	0.050**	0.241**	0.530**	1				
8 Meta-cognition: assess credibility	0.44***	0.077**	0.002	0.067**	0.180**	0.374**	0.473**	1			
9 Gender (1 female, 2 male)	-0.03	0.018	-0.041**	0.137**	-0.074**	-0.280**	-0.321**	-0.185**	1		
10 Grade	0.23***	0.246**	0.047**	.0380*	0.034*	0.064**	0.046**	0.080**	-0.042**	1	
11 Highest education of parents	0.20***	0.029	0.041**	0.086**	0.088**	0.104**	0.102**	0.086**	-0.001	0.074**	1
12 Family wealth possessions	0.03	0.051**	0.078**	0.094**	0.024	-0.031*	-0.039*	-0.037*	0.059**	0.035*	0.151**

This correlation matrix presents the correlations between all the variables used in the study. These include the variables used as financial learning factors, dispositional factors, and control variables

* $p < .05$ ** $p < .01$ *** $p < 0.001$

and dispositional factors were specified to predict financial literacy simultaneously (Model 3). Finally, a set of socio-demographic control variables (i.e., gender, grade, the highest educational level of parents, and family wealth possessions) was added to the model to predict financial literacy (Model 4). This was our final model. Taken together, our RQ1 and RQ2 were answered by exposing our variables to increasing complexity of the models, thus resulting in more robust results. Chi-square statistics and modification indices are not available when estimating models with replicate weights. The only scalable model fit index that is printed in Mplus outputs when using replicate weights is SRMR (Standardized Root Mean Square Residual). SRMR values below 0.08 indicate a good model fit, values below 0.10 indicate an adequate/acceptable fit, and values above 0.10 indicate a poor model fit (Hu & Bentler, 1999).

Results

Path analysis

Correlations are presented in Table 3. A set of four path models was estimated (presented in Table 4). First, Model 1 had a good model fit ($SRMR < 0.001$) and included financial learning factors that explained 3.5% of the financial literacy score. The results showed that financial education in school lessons was positively associated with financial literacy among Finnish adolescents ($\beta = 0.193$, $p < 0.001$). Parental involvement in matters of financial literacy negatively related (weak, but statistically significant association) to financial literacy scores ($\beta = -0.044$, $p = 0.010$). This result came in contrast to our expectation to find positive association, therefore will be interpreted with caution.

Second, Model 2 investigated importance of the dispositional factors in explaining financial literacy. A good model fit was obtained ($SRMR < 0.001$), and the model explained 27.1% of variation in the financial literacy scores. The results showed that both achievement motivation factors—competitiveness ($\beta = 0.122$, $p < 0.001$) and work mastery ($\beta = 0.102$, $p < 0.001$)—were positively significantly associated with financial literacy scores. Furthermore, meta-cognition in terms of understanding and remembering ($\beta = 0.094$, $p < 0.001$), summarizing ($\beta = 0.126$, $p < 0.001$), and access credibility ($\beta = 0.326$, $p < 0.001$) were positively significantly associated with financial literacy scores, as well.

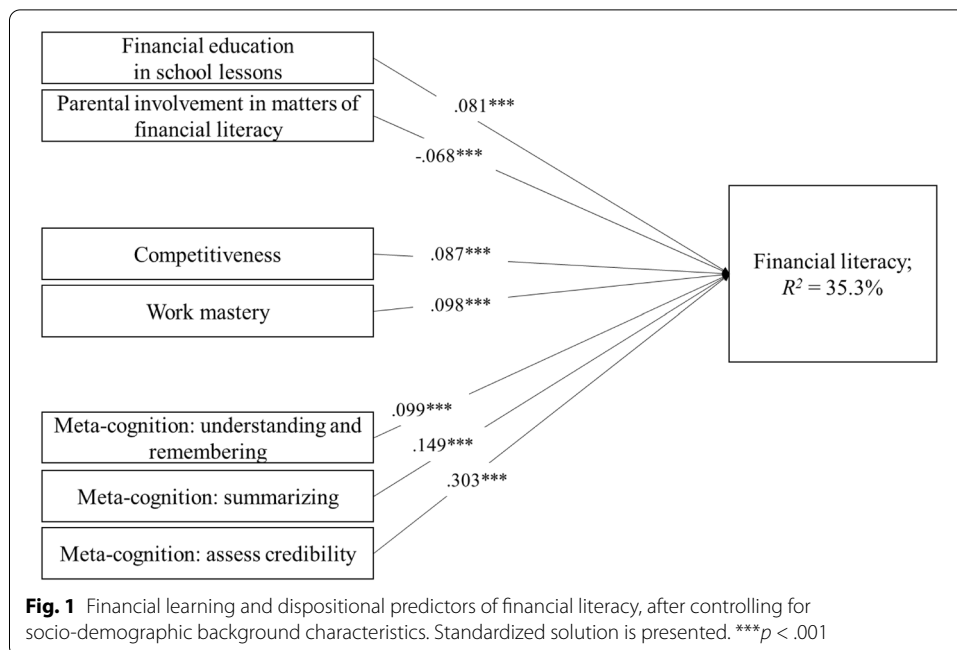
Third, Model 3 reports relative importance of the financial literacy and dispositional factors combined in one model. This model had a good model fit ($SRMR < 0.001$), and explained 28.8% of financial literacy scores. Interestingly, the results of the Model 3 were similar to the ones reported by the two separate models (Model 1 and Model 2) (only less than one tenth decimal places difference between the estimates), suggesting robustness of the previous findings.

Finally, we added control variables to the Model 3, to obtain stronger results. The model had a good model fit ($SRMR = 0.075$), and explained 32.4% of the financial literacy variation among Finnish PISA 2018 participants. Adding covariates did not change our main results in terms of direction of association and significance. All final results are presented in Table 4 (Model 4), and the main results of the current study are summarized in Fig. 1. In particular, to answer our first research question, financial literacy was positively associated with financial education in school lessons ($\beta = 0.081$, $p < 0.001$), but negatively associated with parental involvement in matters of financial

Table 4 Predicting financial literacy by financial learning and dispositional factors, controlling for demographics

Financial literacy												
	Model 1 <i>R</i> ² = 3.5%			Model 2 <i>R</i> ² = 27.1%			Model 3 <i>R</i> ² = 28.8%			Model 4 <i>R</i> ² = 32.4%		
	β	S.E	<i>p</i>	β	S.E	<i>p</i>	β	S.E	<i>p</i>	β	S.E	<i>p</i>
<i>Financial learning factors</i>												
Financial education in school lessons	0.193	0.021	< 0.001				0.130	0.017	< 0.001	0.081	0.017	< 0.001
Parental involvement in matters of financial literacy	-0.044	0.017	0.010				-0.071	0.015	< 0.001	-0.068	0.014	< 0.001
<i>Dispositional factors</i>												
Competitiveness				0.122	0.016	< 0.001	0.122	0.016	< 0.001	0.087	0.017	< 0.001
Work mastery				0.102	0.016	< 0.001	0.091	0.016	< 0.001	0.098	0.016	< 0.001
Meta-cognition: understanding and remembering				0.094	0.017	< 0.001	0.094	0.017	< 0.001	0.099	0.017	< 0.001
Meta-cognition: summarizing				0.126	0.019	< 0.001	0.128	0.019	< 0.001	0.149	0.017	< 0.001
Meta-cognition: assess credibility				0.326	0.015	< 0.001	0.317	0.015	< 0.001	0.303	0.015	< 0.001
<i>Control variables</i>												
Gender (1 female, 2 male)										0.108	0.018	< 0.001
Grade										0.164	0.016	< 0.001
Highest education of parents										0.119	0.016	< 0.001
Family wealth										0.003	0.015	0.842

In bold—significant predictors at the *p* < .05 level



literacy ($\beta = -0.068, p < 0.001$). To answer the second research question, out of all dispositional characteristics, effective meta-cognitive strategy use—understanding-remembering ($\beta = 0.099, p < 0.001$), summarizing ($\beta = 0.149, p < 0.001$), and especially access credibility ($\beta = 0.303, p < 0.001$)—was positively associated with financial literacy skills. The better meta-cognitive skills adolescents had, the higher scores of financial literacy they achieved. In addition, both personality/motivational factors—competitiveness ($\beta = 0.087, p < 0.001$) and work mastery ($\beta = 0.098, p < 0.001$)—also were positively associated with financial literacy. This is an interesting result, indicating that higher levels of two seemingly contradicting dispositional characteristics relate to better financial literacy scores. Although not in focus of the current investigation, boys ($\beta = 0.108, p < 0.001$), students from higher grades ($\beta = 0.164, p < 0.001$), and children from families of higher educated parents ($\beta = 0.119, p < 0.001$) obtained better financial literacy scores, whereas family wealth was not related to financial literacy ($\beta = 0.003, p = 0.842$).

Discussion

The current study investigated financial learning and dispositional predictors of the financial literacy scores among Finnish adolescents taking part in the PISA 2018 assessment. Overall, the present study emphasizes that paying attention to financial learning at schools, achievement motivation, and, especially, effective usage of meta-cognitive learning strategies can be related to the development of financial skills in adolescence.

Financial literacy and financial learning factors

To answer our first research question, in line with previous findings (e.g., PISA 2012 by Cordero et al., 2019), we found a positive association between financial education in school lessons and financial literacy. Thus, theoretically, based on the Opportunity

to Learn framework (Elliott & Bartlett, 2016; Stevens, 1996), the present study provides support for the idea that the intended curriculum (financial literacy being taught in Finnish schools) manifests through implemented curriculum (student reports on the actual frequency of the exposure to financial literacy content at school) on attained curriculum (financial literacy scores). However, unlike in previous studies, our associations were relatively weak after controlling for financial learning, dispositional and demographic factors. This might be due to the fact that not all adolescents in Finland have yet been exposed to financial literacy lessons. According to the core curriculum for participating students, in Finland financial education started in Grade 9, and some of our participants were still attending Grades 7 or 8. Also, schools and teachers may adopt different strategies of teaching financial literacy (Cordero et al., 2019). Some financial literacy programs/lessons can expose adolescents to basic concepts, but others may present well-developed frameworks/lessons. Noteworthy, financial education courses are not compulsory in most countries, ranging from only 3% of schools in Spain to 73% in the Czech Republic, based on PISA 2012 (Cordero et al., 2019). In PISA 2018, Finland was among the countries with the highest frequency of financial education at schools (OECD, 2020a). This was perhaps due to its financial education classes for Grade 9 students. Despite this, a cross-curricular approach is sometimes applied, as financial education can be integrated flexibly into the curriculum as a part of math, humanities, or social sciences. Also, teachers often have the freedom to decide whether or not to include aspects of financial literacy within their subjects. These aspects of financial education may expose our results to a large variety of ways that financial literacy is exercised across schools and classrooms (Atkinson & Messy, 2013; Cordero et al., 2019; Grifoni & Messy, 2012), and thus the link is somewhat weak but significant. To conclude, empirical findings from PISA 2012 (Cordero et al., 2019) seem to confirm that the availability of financial education at school is the key aspect that persistently shows a relation to students' higher financial literacy scores. Other aspects, such as financial education being compulsory, taught separately versus using a cross-curricular approach, taught by the teachers versus finance professionals, did not have an effect (Cordero et al., 2019).

Second, although schooling in financial literacy accounts for the variability of the financial literacy scores, parental involvement in financial matters does not so much. Similar results have been reported in some previous studies. For example, in PISA 2012 among Estonian children, the frequency of discussions of money matters at home was not related to financial literacy scores (Riitsalu & Pöder, 2016). In addition, although Moreno-Herrero et al. (2018) found that nine out of the 15 countries in PISA 2018 had positive associations between parental involvement and adolescents' financial literacy, for six countries the associations were not significant (i.e., Canada, China, Italy, Peru, Spain, and USA). In the present study, we measured some aspects of financial learning at home that occurred through direct communication about financial issues; in particular, the frequency of discussion of financial matters, such as spending and saving decisions, family budget and money for purchases. However, as noted by the authors (Moreno-Herrero et al., 2018), due to the lack of financial resources themselves or due to differences in ideas about when and how children should be included, parents educate their children differently. Moreover, not all parents are financially literate themselves, and therefore they might not be able to transmit accurate and appropriate information

(OECD, 2020a). There might also be another reason for our results. It is possible that we did not find a positive relation between parental involvement and children's financial literacy skills because, in Finland, parents were overall perceived as the least involved parents among all 20 participating countries in PISA 2018 (OECD, 2020a). This could be the case because Finnish adolescents participating in PISA 2018 were the most experienced in financial services among all participating countries: almost 90% of adolescents reported holding an account at a bank, around 75% held a payment or debit card, and around 80% had bought something online (OECD, 2020a). Thus, this relative independence/autonomy of Finnish adolescents in financial matters might be one of the reasons for a lack of positive relation between the frequencies of parental involvement and financial literacy scores at the age of 15.

Financial literacy and dispositional factors

To answer our second research question, the results showed that dispositional characteristics that we studied were positively associated with financial literacy. In particular, effective strategy use (i.e., meta-cognition: understanding-remembering, summarizing, and access credibility) was the most strongly associated with financial literacy skills out of all the variables that we used. Even though meta-cognition was originally designed to assess students' strategies concerning their PISA reading tasks (Artelt & Schneider, 2015), research evidence suggests a strong correlation between financial literacy, mathematics, and reading scores (OECD, 2019). It could be the case that both math and reading are needed to understand the terms of complex financial services. For instance, mathematics may be needed for calculating costs and earnings, and critical reading for finding relevant information in marketing messages and surviving information overload.

Evaluation of credibility of the source was the most strongly associated with financial literacy out of all the variables used. This is not surprising because financial literacy tasks measured adolescents' understanding of money and transactions, risks and rewards, planning and managing finances, and evaluating the financial landscape (OECD, 2019). The financial landscape, in particular, deals with issues such as identifying which providers are trustworthy, whom to ask for advice when choosing financial products, awareness and alertness of existing and potential financial crimes, and taking precautions to protect personal data and avoid scams. Knowing that the meta-cognitive strategy of assessing credibility measured adolescents' reactions to an email about the winning of a smart phone, the strong associations we found are not surprising. Perhaps these interdisciplinary tasks could be encouraged in future PISA assessments, as they deepen our evidence-based understanding across subject-matters and provide highly applicable tools in promoting knowledge about and the learning of certain domains, for example, financial literacy.

In line with previous research (Baranik et al., 2007; Moreno-Herrero et al., 2018; Murayama & Elliot, 2012), we found that achievement motivational factors, such as competitiveness and work mastery, can be positively associated with financial literacy scores. In case of work mastery, the results are clear and expected, as adolescents who are intrinsically motivated to work hard, to persist at completing tasks, and to improve on previous performances would perhaps want to excel also in developing their financial literacy skills. Unfortunately, work mastery was measured in general, and not specific

to financial literacy. Thus, future research measuring work mastery in financial matters may find even stronger associations. In regard to competitiveness, we also found a positive relation with financial literacy, which was somewhat similar in strength to the one concerning work mastery. Thus, this answers our explorative question that enjoying competition with others, trying harder when competing with others, and finding it important to outperform others can indeed increase financial literacy skills. Two aspects are worth mentioning here in response to criticism that competitiveness may represent a problematic characteristic. First, the connotation of competitiveness may depend on the degree of competitiveness a person has. That is, some degree of competitiveness may encourage higher achievement, trying harder, and putting more effort into completing tasks (see correlation between competitiveness and work mastery: 0.338, $p < 0.001$). Only high levels of competitiveness might be problematic. Second, competitiveness can be internal (not expressed/shown to others) and external (visible to others). Thus, despite promoting financial literacy skills, competitiveness might become problematic for one's own well-being and for relationships with others. Investigating these characteristics of competitiveness and their outcomes is out of the scope and methodology of the current study. However, this could be an interesting and useful direction for future research.

Limitations

There are at least four limitations that need to be acknowledged. First, the data we used, as is the case with all PISA assessments, was cross-sectional (concurrent). Thus, alternative explanations of the results obtained are possible. For example, adolescents who are good in financial literacy can be better equipped in recognizing non-credible sources, etc. rather than the other way around. That is, the relations we reported are correlational in nature and do not imply causal effect. Unfortunately, the current design of PISA studies does not allow investigating reciprocal longitudinal associations or conduct experiments to clarify the direction of influence. Thus, clarifying the direction of prediction remains a challenge for the future research. Second, whereas financial literacy was assessed by tests, the other variables were assessed by self-reported questionnaires. This may expose the results to social desirability and common method biases. Although questionnaires for parents and teachers are developed and are available to use in parallel to adolescents' tests and questionnaires, in PISA 2018 Finland did not collect data from parents and teachers. Third, while most of the study variables were financial literacy specific, some were general (e.g., competitiveness, work mastery), possibly restricting the strength of associations. Fourth, the data came from Finland, a Nordic welfare state that scored high in the latest PISA assessment on financial literacy, and it has often scored near the top in other subjects (e.g., reading, math, and science) across many PISA assessments throughout the years (e.g., 2012, 2015). Thus, associations described here can describe a certain cultural and educational environment and should be generalized to other countries with caution.

Practical implications

Our results suggest some recommendations that might increase financial literacy skills among adolescents. First, it seems that financial education at schools needs to be encouraged in order to develop adolescents' financial literacy skills. This is important

because financial literacy benefits individuals and households, since individuals can make better and more informed decisions, and policymakers increasingly perceive the development of financial skills among young people as essential (Moreno-Herrero et al., 2018). In addition, students' wishes to excel and achieve good results in certain domains of studies should be encouraged as these characteristics may contribute to the development of financial literacy skills. Finally, adolescents should become familiar with and encouraged to use effective meta-cognitive strategies in understanding texts and contextual information (being able to understand-remember, summarize, and assess credibility), as critical evaluation of the information (its source and relevance) is essential in many life-domains, including financial literacy. This is especially relevant nowadays, as digital financial services and products carry new risks (e.g., worries about security and privacy, and quick access to credit products with hidden and potentially harmful conditions). Lack of financial experience makes adolescents easy targets for deliberate scams, and therefore usage of meta-cognitive strategies can help in managing online and digital financial information. Overall, adolescents need to be empowered with age-appropriate information and support in order to develop their digital and financial skills, as these skills will help them make optimal financial decisions now and in the future.

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Authors' contributions

GS prepared the initial draft of the analyses and manuscript text. AKA provided the data, guidance concerning the analyses, and read and approved the manuscript. TAW read and commented on the analyses and the manuscript and approved the final manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets analyzed during the current study are available in the OECD PISA-data repository <https://www.oecd.org/pisa/data/2018database/>.

Declarations

Competing interests

The authors declare that they have no competing interests.

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