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Research Article

Metacognition, Strategies, Achievement, and Demographics: Relationships Across Countries

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Abstract

Learning strategies, such as memorization and elaboration strategies, have received both support and repudiation. The 2009 international PISA reading, science, and mathematics achievement test and survey of 15 year-olds in 65 countries was used. The findings indicated that self-reported use of learning strategies, which involve compensatory approaches like memorization, across a global sample was not strongly associated with higher achievement. However, metacognitive strategies which involve an awareness of thinking, as measured by the appropriate use of strategies within a context, were related to greater achievement. Although there were differences across gender and student SES, metacognitive strategies remained a significant predictor of achievement when controlling for SES and gender, and were on par with SES in predicting achievement. This study provides insight that may be particularly beneficial for males and lower SES students who underachieve in reading.

Keywords

Learning strategies • Student achievement • International data (PISA) • Demographics • Socio-economic status

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The factors influencing student learning is a shared concern internationally. The role of student demographics, the nature of their schools, and the wealth and inequality of their countries are established factors in academic achievement (Marchant & Finch, 2016). Identifying factors that impede learning is not a difficult task. Factors such as poverty, discrimination, and inequality all undermine efforts to educate children; however, it is more difficult to identify feasible and efficient solutions to improve learning outcomes or overcome disadvantages. Short of one-to-one instruction, the strategies students employ when approaching learning tasks may be one factor that could offset some of the other universal negatives.

A large body of research has examined the use of academic strategies, which entail a variety of tactics that may facilitate achievement (Boss & Vaughn, 2002; Ward & Traweek, 1993; Zimmerman, 2002). Although, multiple perspectives are discussed within the literature, and the terminology may differ slightly across these perspectives, some of the most common types of strategies include cognitive and metacognitive strategies (Cantrell et al., 2010; Pintrich, Smith, Garcia, & McKeachie, 1993). It should be noted that there are differences in the terminology and classification of academic strategies. Many have also classified various academic strategies into two broad categories of learning strategies and metacognitive strategies (PISA, 2009; Woolfolk, 2014). In particular, this perspective is consistent with the Programme for International Student Assessment (PISA, 2009) which served as the primary data source for this study. From this perspective, learning strategies may entail both cognitive strategies and control strategies that are used to optimize students' learning of content. Cognitive strategies include a variety of actions but some popular strategies include memorization, elaboration, or summarization (PISA, 2009; Pintrich et al., 1993; Woolfolk, 2014). A common theme among these strategies is that they enhance learning by compensating for limitations on one's cognitive abilities. For example, one may choose to use a memorization strategy, such as rote repetition or creating an acronym, because without the support of such a strategy, the number of pieces of information to be remembered would exceed or strain the learner's memory capacity. Relatedly, another cognitive strategy, elaboration, entails creating connections between prior learning and new information, which supports learning by capitalizing on cognitive predispositions to remember content that is connected to prior knowledge.

On the other hand, control strategies have been defined in multiple ways within the literature; however, PISA (2009) describes control strategies as the actions that students take to identify the key purpose of a task or identify the main concepts. From this perspective, control strategies are considered to be within the larger category of learning strategies because the identification of key information should enhance learning (Gardner, Brown, Sanders, & Menke, 1992).

In contrast to learning strategies, another class of strategies within the PISA, 2009 measures include metacognitive strategies, which help a learner "think about his or her thinking" (Bruning, Schraw, & Norby, 2011). For example, a metacognitive strategy to check one's understanding of a paragraph immediately after reading the paragraph might increase the reader's awareness that he or she did not understand the text. Similarly, one may summarize a paragraph into their own words to monitor how well they understood the text. A primary benefit of metacognitive strategies is that increased awareness, especially when a learner is struggling, provides an opportunity for the learner to take actions, such as utilizing learning strategies, to improve learning.

Learning Strategies, Metacognitive Strategies, and Achievement

Research has been relatively consistent in showing that metacognitive strategies are related to achievement and learning across many content areas, but especially reading, mathematics, and science. In addition, these findings have been found throughout the world, rather than merely in the United States. In Vietnam, increased metacognitive strategies from repeated-reading led to better awareness of the utility of reading fluency (Gorsuch & Taguchi, 2010). Training in metacognitive strategies resulted in better achievement in fractional mathematics in Nigeria (Onu, Eskay, & Igbo, 2012). In Israel, high school students who were taught to use metacognitive strategies during math performed better than peers who did not receive this training (Mevarech & Amrany, 2008). In addition, primary school children in Great Britain who performed the best at addition and subtraction, reportedly used more advanced metacognitive strategies (Throndsen, 2011). High school students who were better at comprehending geometric proofs were found to use more metacognitive strategies (Yang, 2012). When taught to eighth graders in Israel, meta-strategic knowledge, which is described as explicit general knowledge about thinking strategies, had dramatic short-term and long-term effects on scientific inquiry learning (Ben-David & Zohar, 2009). In that study, the effect was stronger for low-achieving students. In the United States, two measures of metacognitive strategies were significant predictors of middle school students' achievement levels in science (Sperling, Richmond, Ramsay, & Klapp, 2012). Measures of metacognitive awareness during mathematical problem solving predicted achievement performance in mathematical problem solving tasks as well as standardized test scores (Callan & Cleary, 2014). The use of metacognitive prompts during science instruction resulted in an increase in students' scientific knowledge and creative strategies for solving problems (Peters & Kitsantas, 2010). Thus, across many cultures, countries, and academic subjects, increased use of metacognitive strategies has been consistently linked to positive learning outcomes; however, findings have been more variable regarding learning strategies.

In general, much of the research in the United States has indicated that more frequent use of learning strategies is related to increased learning (Pressley & Harris, 2006) and greater academic achievement (Robbins et al., 2004). However, the findings within other countries have been less consistent. For example, Chiu, Chow, and Mcbride-Chang (2007) studied learning and metacognitive strategies across 34 countries and found that although metacognitive strategies resulted in higher achievement, the use of memorization learning strategies resulted in lower scores. In contrast, another study found that learning strategies, such as elaboration, organization, and rehearsal, were all significant predictors of physics achievement in Turkey (Sezgin Selcuk, 2010).

Thus, it seems that learning strategies are not always beneficial for all students. Relatedly, research suggests that the deployment of learning strategies is dependent on contextual factors such as the academic domain, the type of tasks, or the difficulty of the task (Callan & Cleary, 2014; Cleary & Chen, 2009; Hadwin, Winne, Stockley, Nesbit, & Woszczyna, 2001). Some research also suggests that the use of learning strategies may depend on demographic factors such as SES or gender. For example, students from varying socio-economic groups utilize strategies differentially with greater SES positively relating to more frequent strategy use (Akyol, Sungur, & Tekkaya, 2010; Jensen, 2009; Lipina & Colombo, 2009). Interestingly, most of this research has examined individual differences in SES such as how one's family SES influence strategy use. Less research has examined more macro level influences on strategy use, such as the collective socio-economic status (SES) of one's country. Given that some research has shown there to be differences in academic motivation and beliefs across countries (Chiu & Chow, 2010), it is pertinent to consider whether students from higher or lower SES countries utilize strategies differently, and if these differences in strategy use account for unique variation in achievement after controlling for family SES.

In a related line of research, there is some evidence to suggest that males and females may utilize learning and metacognitive strategies differently, with females being more strategic than their male peers (Bembenutty, 2007; Zimmerman & Martinez-Pons, 1990). Given that there are persistent and significant differences in academic achievement between males and females in math and reading, and strategy use is related to achievement, it is pertinent to examine how males or females utilize strategies. Some research has addressed this issue. For example, Chuy and Nitulescu (2013) examined whether Canadian male and female students utilized strategies differentially for reading tasks and found that females tended to use learning strategies and metacognitive strategies more frequently than males. That study, and much of the literature addressing gender differences in strategy use, has focused on a single country, and research is needed to examine strategy use across a multi-national sample of students. Moreover, if differences emerge in strategy use, it is important to determine the extent to which variation in achievement is explained by such differences.

Research is needed to examine how metacognitive and particularly learning strategies relate to academic achievement and gender internationally. Specifically, it is important to understand if some types of strategies may be more useful than other strategies because this could have important implications for instruction. In this study, the authors examine the use of metacognitive and learning strategies across higher and lower SES countries, if these strategies relate to achievement across countries, and whether strategies account for unique variation after controlling for SES. In addition, because the majority of research examining gender differences in strategy use has focused on small sample sizes within the United States, we examine a cross national sample to address whether males and females utilize different strategies.

Research Questions

The research questions to be addressed in this study are as follows:

1. Across countries, what is the relationship of metacognitive and learning strategies to reading, math, and science achievement? Do metacognitive and learning strategies account for unique variation in achievement while controlling for demographics, including SES?
2. Does the SES of one's country significantly relate to the use of learning strategies and metacognitive strategies? In particular, do students from the countries with the 15 highest and 15 lowest SES utilize learning strategies differently?
3. Are there gender differences in learning and metacognitive strategies that might explain the traditional gender performance differences in reading and math?

Method

Participants

In the current study, we address the research questions above by examining individual level data from the Program for International Student Assessment (PISA) of 15-year-old's achievement in reading, mathematics, and science from 63 countries. A total of 475,460 students (50.3% female) were included in the study. Students are weighted to be representative of their country and school.

Instrument

PISA is an international achievement test designed to determine students' ability to apply reading, science, and mathematics content to real-life situations. In addition to the test, a survey is administered to collect demographic data. The 2009 administration of PISA included two metacognitive indexes and three learning strategy use indexes (the 2009 PISA data is the most recent that contains these measures). Metacognitive strategies was measured as knowledge of effective metacognitive strategies for text comprehension. Students were presented with scenarios and then evaluated the quality and usefulness of strategies for reaching an intended goal. The ratings of the strategies were compared to an optimal ratings developed by experts. Two metacognitive indexes were created: The index of Understanding and Remembering and the index of Summarizing. Additionally there were three learning strategy use indexes: The frequency of use of Memorization Strategies, Elaboration Strategies, and Control Strategies. Student use of these strategies was compared to ratings deemed effective by experts to create indexes. The index scores for the two metacognitive and three learning strategy measures were entered into a principal components analysis with Varimax rotation, and based on proportion of variance explained and conceptual coherence, a 2-component solution was retained, accounting for 70 percent of the variance (see Table 1). The first component (*Learning Strategies*) contained the three strategy indexes related to control, elaboration, and memorization, and the second component (*Metacognitive Strategies*) contained the two metacognitive strategy indexes.

Table 1
Principal Components Analysis Results for PISA Learning Factors

	Factors	
	Learning	Metacognitive
Control strategies	.85	.23
Elaboration strategies	.80	-.01
Memorization strategies	.80	-.09
Meta-cognitive summarizing	.01	.85
Meta-understanding and remembering	.05	.84

Data Analysis

The components were then entered into the subsequent analyses. In order to ascertain the relationship of learning and metacognitive strategies to achievement test scores, after controlling for demographic factors and SES, hierarchical regression (HR) analysis was used. For each of the academic domains of Reading, Math, and Science, HR was used in which the first stage included SES, gender, language spoken at home (language of exam or other language), and immigration status (native born or immigrant). The second stage of the HR included the two components described above. Of particular interest was the amount of additional variance explained by learning and metacognitive strategies after controlling for the demographic variables. Analyses were conducted across all 63 PISA countries, as well as for the 15 wealthiest (based on GDP) collectively, and 15 poorest collectively, and for each of these nations individually.

Results

Strategies Factors, Achievement, and Demographics

The Learning Strategies component demonstrated a weak correlation to achievement (r = .02 for reading, r = -.03 for math, and r = -.01 for science). Although statistically significant due to the large sample size (all $p < .001$), the practical implication for these relations is near zero. The same cannot be said of the Metacognitive Strategies component, which demonstrated a strong correlation to achievement across all subject areas even though the measurement of Metacognitive Strategies was situated only within a reading context ($r = .50$ for reading, $r = .46$ for math, and $r = .48$ for science; all $p < .001$).

The two components were also significantly correlated to all of the demographic variables ($p < .001$). As was true for the achievement variables, these relationships were very weak. The Learning Strategies factor exhibited a very weak, positive relationship with SES ($r = .02$), language at home ($r = .02$; more likely to use strategies when the language spoken at home was the same as the achievement measure), and immigration status ($r = .02$; native born more likely to use the strategies). In addition, there was a weak, statistically significant, negative relationship between gender and learning strategies ($r = -.07$; males were slightly less likely to use the Learning Strategies). On the other hand, Metacognitive Strategies displayed stronger correlations with most of the demographic variables. The Metacognitive Strategies factor was related to SES ($r = .25$), gender ($r = -.13$; males were significantly less likely to use metacognitive strategies), and language at home ($r = -.09$; less likely to use Metacognitive Strategies when home language was the same as test). The correlation coefficient between Metacognitive Strategies and immigration was negligible in value ($r = .01$).

Predicting Achievement with Learning and Metacognitive Strategy Components and Demographics

Across all PISA nations, the demographic variables and the two strategy components were significant predictors ($a = 0.05$) of achievement for all three subject areas (see Tables 2-4). The demographics accounted for approximately 28 percent of the variance in the first step of the multiple regressions ($R^2 = 0.28$ for reading and science, $R^2 = 0.29$ for math), and the Learning Strategy components accounted for a little less than half of that in the second step (R^2 *change* = 0.14 for reading, 0.12 for math, and 0.13 for science). The standardized β coefficients for the model across all countries revealed a strong contribution by the Metacognitive Strategies component (β = 0.39 for reading, β = 0.36 for math, and β = 0.38 for science), approaching that of the SES index (β = 0.40 for reading, β = 0.43 for math, and β = 0.42 for science). The relationship of demographics and strategies to achievement was similar for high and low SES countries.

Table 2
Multiple Regression Results with Demographics (Step 1) and Learning Factors (Step 2) Predicting Reading Achievement for 15 Highest and Lowest SES Countries

			Standardized Beta Coefficients					
Country	Demo R^2	Learning Factors R^2 Change	SES	Gender	Home Lang	Immi-gration	Learning Strategies	Meta-cognitive
Iceland	.18	.13	.17	-.12	-.09	.01*	.06	.44
Qatar	.26	.11	.16	-.17	-.10	.35	.09	.35
Canada	.13	.15	.24	-.10	-.05	-.01	.07	.39
Norway	.18	.17	.20	-.18	-.11	-.02	.10	.41
Dubai (UAE)	.29	.16	.28	-.16	-.06	.21	.01*	.42
Finland	.21	.18	.20	-.17	-.10	-.04	.07	.45
Australia	.17	.20	.25	-.09	-.01	-.01	.09	.45
Sweden	.21	.19	.25	-.14	-.11	-.04	.08	.44
Denmark	.20	.19	.27	-.10	-.08	-.03	-.01*	.45
Netherlands	.14	.27	.24	-.06	-.00*	-.02	-.02	.53
United King	.17	.16	.28	-.07	-.08	.01	.07	.41
Belgium	.21	.24	.28	-.04	-.03	-.05	-.01	.52
Luxembourg	.23	.17	.34	-.11	-.04	-.01*	-.00*	.43
Germany	.24	.20	.30	-.14	-.08	-.03	.03	.46
United States	.20	.14	.35	-.08	-.01	.02	-.03	.39
High SES	.19	.16	.32	-.09	-.03	.01	-.00	.41
Azerbaijan	.12	.06	.25	-.16	.06	.01	.13	.22
Kyrgyzstan	.27	.09	.32	-.23	.09	.04	.06	.32
Uruguay	.27	.13	.38	-.17	-.03	-.00*	.04	.38
Macao-China	.13	.12	.15	-.18	-.29	.01	.17	.30
Hong Kong	.13	.17	.16	-.14	-.18	-.04	.13	.40
Panama	.26	.14	.36	-.12	-.12	-.02	.10	.39
Albania	.23	.12	.31	-.23	-.02	.01	.13	.34
Colombia	.19	.17	.31	-.07	-.03	-.00	-.01	.43
Brazil	.19	.13	.31	-.12	-.04	-.04	.08	.37
Turkey	.27	.14	.38	-.18	-.04	-.02	.05	.38
Tunisia	.14	.09	.29	-.16	-.01	-.02	.10	.28
Mexico	.20	.16	.30	-.12	-.10	-.05	.07	.41
Thailand	.23	.11	.33	-.23	-.01	-.01	.18	.27
Peru	.34	.10	.45	-.10	-.14	-.03	-.05	.32
Indonesia	.19	.12	.26	-.26	.03	-.10	.08	.35
Low SES	.18	.13	.30	-.16	-.03	-.02	.05	.37
All Countries	.28	.14	.40	-.12	-.03	.00	.00	.39

Note. * = not significant.

Table 3
Multiple Regression Results with Demographics (Step 1) and Learning Factors (Step 2) Predicting Math Achievement for 15 Highest and Lowest SES Countries

Country	Demo R^2	Learning Factors R^2 Change	Standardized Beta Coefficients: SES	Gender	Home Lang	Immi-gration	Learning Strategies	Meta-cognitive
Iceland	.10	.16	.22	.14	-.05	.01*	.08	.41
Qatar	.29	.13	.18	.06	.09	.34	.07	.37
Canada	.12	.14	.28	.17	.01	-.04	.03	.38
Norway	.13	.14	.24	.12	-.11	-.02	.07	.38
Dubai (UAE)	.26	.16	.29	.09	.10*	.20	-.03	.41
Finland	.09	.17	.21	.18	-.06	-.03	.03	.43
Australia	.16	.17	.29	.16	.06	-.03	.09	.41
Sweden	.17	.16	.29	.10	-.10	-.02	.07	.41
Denmark	.16	.15	.27	.18	-.07	-.04	-.06	.41
Netherlands	.16	.23	.26	.18	-.02	-.03	-.04	.50
United King	.19	.13	.32	.19	-.06	.00*	.04	.36
Belgium	.22	.20	.30	.21	-.01	-.08	-.04	.47
Luxembourg	.21	.14	.35	.20	-.03	-.02	-.02	.39
Germany	.22	.19	.32	.17	-.07	-.01	.01	.45
United States	.21	.12	.38	.17	-.02	.04	-.06	.36
High SES	.19	.15	.34	.17	-.03	.02	-.03	.40
Azerbaijan	.02	.06	.06	.10	-.06	-.02	.12	.24
Kyrgyzstan	.22	.13	.33	.03	.08	.06	.06	.38
Uruguay	.25	.14	.38	.12	-.02	.00*	.01*	.39
Macao-China	.03	.12	.11	.12	-.09	-.02	.18	.29
Hong Kong	.11	.17	.20	.14	-.14	-.07	.11	.40
Panama	.21	.17	.35	.08	-.03	.00*	.11	.43
Albania	.12	.14	.28	.04	-.04	.01*	.10	.34
Colombia	.25	.18	.33	.23	-.02	.01	.01	.45
Brazil	.19	.12	.33	.13	-.03	-.05	.04	.36
Turkey	.24	.12	.43	.15	-.01	-.00	-.00*	.36
Tunisia	.18	.09	.38	.12	-.06	.23	.03	.29
Mexico	.18	.18	.29	.14	-.07	-.05	.07	.43
Thailand	.14	.10	.32	.07	.03	.02	.20	.24
Peru	.34	.12	.46	.14	-.11	-.02	-.05	.34
Indonesia	.14	.18	.29	.04	.01	-.07	.09	.43
Low SES	.17	.13	.32	.10	-.05	.01	.03	.37
All Countries	.29	.12	.43	.11	-.04	.01	-.04	.36

Note. * = not significant.

Table 4
Multiple Regression Results with Demographics (Step 1) and Learning Factors (Step 2) Predicting Science Achievement for 15 Highest and Lowest SES Countries

Country	Demo R^2	Learning Factors R^2 Change	Standardized Beta Coefficients: SES	Gender	Home Lang	Immi-gration	Learning Strategies	Meta-cognitive
Iceland	.08	.18	.19	.14	-.07	.02*	.05	.43
Qatar	.26	.12	.16	-.06	-.02	.36	.08	.36
Canada	.11	.15	.26	.13	-.06	-.02	.04	.39
Norway	.14	.15	.23	.07	-.15	-.02	.08	-.38
Dubai (UAE)	.26	.17	.27	-.05	-.06	.23	.01	.43
Finland	.10	.19	.20	.08	-.10	-.04	.03	.46
Australia	.15	.19	.27	.11	-.01	-.03	.08	.44
Sweden	.17	.18	.26	.10	-.12	-.04	.05	.44
Denmark	.17	.16	.27	.15	-.11	-.03	-.01	.42
Netherlands	.15	.26	.26	.11	-.03	-.05	-.02	.53
United King	.17	.16	.31	.12	-.09	.03	.06	.40
Belgium	.20	.22	.28	.14	-.02	-.08	-.01	.49
Luxembourg	.23	.16	.37	.14	-.03	-.02	.01*	.41
Germany	.23	.19	.31	.13	-.14	-.01	.04	.45
United States	.19	.13	.36	.12	-.03	.02	-.04	.37
High SES	.18	.15	.32	.12	-.05	.00	-.01	.41
Azerbaijan	.07	.07	.18	-.04	.11	.01	.09	.27
Kyrgyzstan	.18	.11	.28	-.06	.07	.08	.10	.35
Uruguay	.25	.14	.38	.05	-.01	.02	.04	.39
Macao-China	.06	.14	.12	.05	-.25	-.01*	.18	.32
Hong Kong	.09	.18	.16	.08	-.17	-.05	.13	.41
Panama	.20	.18	.33	.05	-.09	.00*	.08	.44
Albania	.15	.15	.29	-.07	-.02	.02	.11	.38
Colombia	.20	.19	.30	.14	-.01	-.01	.01	.45
Brazil	.18	.13	.33	.05	-.03	-.03	.06	.37
Turkey	.20	.17	.38	.02	-.04	-.01	.06	.43
Tunisia	.12	.09	.32	.03	-.02	-.01	.07	.30
Mexico	.18	.17	.31	.09	-.08	-.04	.07	.41
Thailand	.14	.10	.30	-.04	-.00*	-.01	.17	.27
Peru	.20	.10	.43	.05	-.13	-.02	-.02	.33
Indonesia	.11	.17	.26	-.03	.06	-.06	.12	.41
Low SES	.15	.14	.30	.03	-.05	.00	.05	.38
All Countries	.28	.13	.42	.03	.05	.09	-.02	.38

Note. * = not significant.

Strategy Factors and Achievement in High and Low SES Countries

Demographics and the Metacognitive Strategy components significantly predicted achievement for students in both the high and low SES countries across the three subject areas (see Tables 2-4). The Standardized β weights for both the SES index and for the Metacognitive Strategies component were slightly higher for students in the higher rather than lower SES countries.

The students from the high SES countries scored an average of 84 to 104 points higher than students from the lower SES countries across subject areas (see Tables 5 and 6). Students in low SES countries used Learning Strategies more (by 0.23 points), and students from high SES countries scored higher on the Metacognitive Strategies factor (by 0.34 points). In other words, students from low SES countries were more likely to use strategies that were not strongly related to achievement, and less likely to use the strategies that are more strongly related to achievement. The gender difference in Metacognitive Strategies was striking, with females scoring significantly higher on the metacognitive strategies component ($p < .001$), especially in the higher SES countries (see Table 7).

Table 5
Means, Standard Deviations, Frequencies for High SES Countries

	Scores				Demographic %			Factors	
Country	Math	Reading	Science	SES	Male	Lang	Cntry	Learn	Meta
Iceland	507 (86)	500 (93)	495 (92)	.72 (.89)	50	97	94	-.30 (1.07)	.02 (.99)
Qatar	368 (93)	372 (112)	379 (99)	.51 (.91)	51	61	72	.66 (1.15)	-.36 (1.04)
Canada	527 (83)	524 (87)	529 (86)	.50 (.83)	50	85	88	-.10 (1.08)	.23 (.99)
Norway	498 (80)	503 (88)	500 (85)	.47 (.74)	49	93	95	-.45 (1.03)	.11 (.97)
Dubai (UAE)	453 (94)	459 (104)	466 (101)	.42 (.79)	51	50	55	.57 (.92)	.12 (.99)
Finland	541 (77)	536 (83)	554 (85)	.37 (.78)	50	96	97	-.37 (.93)	.26 (.99)
Australia	514 (89)	515 (96)	527 (98)	.34 (.75)	49	91	87	-.10 (1.07)	.19 (1.02)
Sweden	494 (89)	497 (96)	495 (96)	.33 (.81)	49	92	94	-.03 (.96)	.01 (1.03)
Denmark	503 (82)	495 (81)	499 (88)	.30 (.87)	50	96	95	-.21 (.90)	.39 (.94)
Netherlands	526 (86)	508 (86)	522 (93)	.27 (.86)	50	94	95	-.29 (.88)	.21 (1.03)
United King	492 (83)	494 (92)	514 (95)	.20 (.79)	49	94	93	-.01 (.93)	.23 (.96)
Belgium	515 (101)	506 (99)	507 (102)	.20 (.93)	51	78	91	-.23 (.90)	.47 (1.00)
Luxembourg	489 (92)	472 (101)	484 (100)	.19 (1.10)	49	11	81	.09 (.98)	.08 (1.03)
Germany	513 (95)	497 (92)	520 (97)	.18 (.90)	51	90	93	.14 (.90)	.45 (1.01)
United States	487 (86)	500 (94)	502 (91)	.17 (.93)	51	87	93	-.12 (1.15)	-.01 (1.00)
High SES Countries	497 (89)	501 (93)	509 (95)	.22 (.90)	51	88	92	-.09 (1.00)	.12 (1.00)
All Countries	454 (101)	461 (99)	463 (101)	-.51 (1.21)	50	86	96	.00* (1.00)	.00* (1.00)

Table 6
Means, Standard Deviations, Frequencies for Low SES Countries

	Scores				Demographic %			Factors	
Country	Math	Reading	Science	SES	Male	Lang	Cntry	Learn	Meta
Azerbaijan	431 (58)	362 (71)	373 (67)	-.64 (.99)	51	93	98	.72 (1.16)	-.77 (.95)
Kyrgyzstan	331 (75)	314 (95)	330 (84)	-.65 (.93)	49	81	98	.52 (.99)	-.74 (.92)
Uruguay	427 (86)	426 (96)	427 (91)	-.70 (1.22)	47	98	98	-.00 (1.03)	-.03 (.99)
Macao-China	525 (79)	487 (73)	511 (71)	-.70 (.87)	51	89	81	-.37 (.89)	-.05 (.92)
Hong Kong	555 (90)	533 (81)	549 (83)	-.80 (1.02)	53	93	77	-.04 (.92)	-.24 (1.01)
Panama	360 (77)	370 (96)	376 (85)	-.81 (1.33)	50	94	95	.58 (1.02)	-.34 (1.01)
Albania	377 (85)	385 (96)	391 (84)	-.95 (1.04)	51	99	99	.65 (.80)	.20 (.93)
Colombia	381 (71)	413 (83)	402 (76)	-1.15 (1.27)	48	100	99	.38 (.99)	-.18 (.99)
Brazil	386 (78)	412 (91)	405 (80)	-1.15 (1.21)	47	99	99	.09 (.95)	-.19 (.94)
Turkey	445 (89)	464 (79)	454 (76)	-1.17 (1.22)	52	96	99	.22 (.84)	-.12 (.94)
Tunisia	371 (72)	404 (81)	401 (76)	-1.20 (1.31)	48	100	99	.35 (.95)	-.23 (.88)
Mexico	419 (75)	425 (81)	416 (73)	-1.22 (1.30)	49	97	98	.05 (1.00)	.02 (.98)
Thailand	419 (74)	421 (69)	425 (74)	-1.31 (1.19)	43	51	100	-.07 (.79)	-.41 (.93)
Peru	365 (85)	370 (95)	369 (83)	-1.31 (1.25)	51	95	99	.32 (.93)	-.23 (.95)
Indonesia	371 (65)	402 (63)	383 (63)	-1.55 (1.10)	50	36	99	.15 (.71)	-.35 (.95)
Poor Countries	395 (80)	414 (83)	405 (79)	-1.28 (1.21)	49	77	99	.14 (0.9)	-.22 (1.0)
All Countries	454 (101)	461 (99)	463 (101)	-.51 (1.21)	50	86	96	.00* (1.00)	.00* (1.00)

Table 7
Metacognitive Component Means and Standard Deviations by SES and Gender

	SES	
Gender	High	Low
Male	-.05 (1.01)	-.32 (.95)
Female	.28 (.99)	-.14 (.97)

Discussion

In this study, we examined three primary research questions. First, we examined the relationship of Metacognitive Strategies and Learning Strategies to reading, math, and science achievement and whether Metacognitive Strategies and Learning Strategies predicted achievement after controlling for SES. Second, we examined how the use of Learning Strategies and Metacognitive Strategies compare across countries with the highest and the lowest SES. Finally, we examined if there are gender differences in Learning and Metacognitive Strategies that might explain the traditional gender performance differences in reading and math.

Although researchers differ regarding whether they conceptualize metacognitive strategies and learning strategies as distinct or inseparable categories of learning tactics, in this study, we conceptualized them as unique categories. This was consistent with general procedures for examining PISA data and was also further supported by factor analytic results that indicated a two factor structure. In the current study, Metacognitive Strategies entailed tactics that aid a learner's "thinking about thinking," such as checking one's understanding of content (i.e., understanding and remembering) and summarizing information into one's own words (i.e., summarizing). In contrast, Learning Strategies were conceptualized as both cognitive strategies (i.e., memorization & elaboration) and control strategies. As opposed to Metacognitive Strategies, Learning Strategies are useful for managing the cognitive demands of learning new information.

In regard to the relationship of Metacognitive and Learning Strategies with achievement in reading, math, and science, we found that the self-reported use of Metacognitive Strategies was significantly related to achievement for all three academic subjects and remained a significant predictor of achievement for all three academic domains even after controlling for SES. These findings are consistent with the prior literature that has shown metacognitive strategies to be strongly related to achievement for a variety of academic subjects and across various countries (Gorsuch & Taguchi, 2010; Mevarech & Amrany, 2008; Onu et al., 2012); however, our findings contribute to the literature because we explored the relations of Metacognitive Strategies and achievement across a global population. Thus, our results, in conjunction with the prior literature, support the notion that teaching students how to effectively utilize Metacognitive Strategies should support their academic achievement in all core academic areas regardless of their nation of origin or their SES.

In contrast, our results showed that Learning Strategies, such as memory strategies, elaboration strategies, or control strategies, were not strongly associated with higher achievement after controlling for SES. These findings contrast a vast body of research that has supported the use of Learning Strategies for students within the United States (Cho & Ahn, 2003; Robbins et al., 2004; Tait & Entwhistle, 1996; Vrugt & Oort, 2008). Some prior research examining multi-national samples has also indicated similar findings that Learning Strategies may not be universally effective for students from all countries (Chiu et al., 2007; Ghiasvand, 2010). Thus, our findings support this prior research but also contribute by examining a more globally representative sample.

It is interesting that Metacognitive Strategies strongly predicted achievement but Learning Strategies did not. It seems plausible that some recent research could shed light on these findings. In particular, research suggests that the use of learning strategies is influenced significantly by contextual variables (Hadwin et al., 2001). That is, the learning strategies that a student will employ depend greatly on factors such as the academic domain (e.g., reading, math, science), the type of task within the domain (e.g., completing math homework problems compared to studying for a math test), or even the difficulty level of that task (Callan & Cleary, 2014; Cleary & Chen, 2009). Interestingly, some initial, albeit limited research suggests that contextualized measures of learning strategies emerge as stronger predictors of achievement compared to decontextualized measures of learning strategies (Callan & Cleary, 2014; Cleary, Callan, Malatesta, & Adams, 2015). Finally, it appears that metacognitive strategies may not be as contextually sensitive as learning strategies (Van Der Stel & Veenman, 2008).

In the current study, the Learning Strategies were measured in relation to a broad task, test-taking. Thus, it could be the case that students' self-reported use of Learning Strategies for test-taking in general was too broad, or generalized, to be meaningful to their achievement within the domains of reading, mathematics, and science. In contrast, Metacognitive Strategies were measured in relation to the context of reading. First, the task of reading is essential to success in all three domains of reading, math, and science compared to test-taking strategies, and therefore, it might be expected that Metacognitive Strategies better related to achievement. Second, if metacognitive strategies are more global in nature, the context in which metacognitive strategies are measured may not be as important as the context in which learning strategies are measured. Thus, the authors caution against an interpretation that learning strategies are unimportant or that they should be ignored. Instead, further research is needed to better understand the most appropriate ways to measure metacognitive and learning strategies; however, it is clear from our findings that metacognitive strategies are a significant factor in student achievement.

Regarding our second research question to compare strategy use in high and low SES countries, we found that use of Learning Strategies and Metacognitive Strategies did differ. In particular, students in high SES countries tended to use Metacognitive Strategies more frequently than their peers in low SES countries while students from low SES countries tended to use Learning Strategies more frequently than their peers from high SES countries. It is interesting that students from low SES countries tended to utilize strategies that were not strongly related to success more often than their high SES peers. Moreover, students from high SES countries not only utilized Metacognitive Strategies more often, our data indicates that, even after controlling for individual SES, Metacognitive Strategies were more strongly related to higher achievement in high SES countries. Although some prior research has shown that family SES relates to the number and type of strategies that students use while learning (Akyol et al., 2010; Lipina & Colombo, 2009), to the authors' knowledge, no prior study has shown that the SES of one's country relates to frequency of learning strategy and metacognitive strategy use. Thus, our findings contribute uniquely to the literature in this regard. Although we did not address particular political or societal ideologies, our findings seem related to prior research indicating that academic motivation may differ due to the beliefs and philosophies of one's country (Chiu & Chow, 2010). Furthermore, the authors speculate that it is also possible that countries of varying SES levels may employ different curricula and pedagogical practices and these differences may also impact how students are taught to learn. Further research to better understand particular beliefs among high and low SES countries and how these beliefs may impact the use of strategies would be particularly beneficial.

Our third objective was to determine if there were gender differences in learning and metacognitive strategies. We found that females were significantly more likely to use both Learning Strategies and Metacognitive Strategies. Interestingly, this difference was much more pronounced for Metacognitive Strategies than for Learning Strategies. Moreover, the difference in Metacognitive Strategies interacted with the SES of one's country in that there was a larger difference between males and females use of Metacognitive Strategies from high SES countries than in low SES countries.

The prior literature examining the use of learning strategies between males and females has been mixed. That is, some of the prior literature has suggested that, within the United States, females utilize a greater number of learning strategies than males (Bembenutty, 2007), but other research has suggested that there is no difference between males and females in the use of memorization, elaboration, and control strategies (Ablard & Lipschultz; Zimmerman & Martinez-Pons, 1990). On the other hand, the literature regarding metacognitive strategies and gender has been more consistent within both the United States and international samples. Contrary to our findings, much of this literature has suggested there is no significant difference between males' and females' use of metacognitive strategies (Bembenutty, 2007; Tang & Neber, 2008). Our findings contrast this prior literature by showing that within a global sample of students, females use significantly more Metacognitive Strategies than males. Given that metacognitive strategies are so strongly related to achievement, our findings suggest that under-achieving males, especially in poor countries may benefit from training in metacognitive strategies.

Our findings are important and raise several questions for further research. First, more research is needed to examine gender differences in both learning and metacognitive strategies, especially to better understand why these differences may exist. Although our findings indicate that one possible factor that could influence the use of strategies is the collective SES of a country, more research is needed to better understand other factors that could further explain this difference between genders. Doing so could have important implications for underachieving males in low SES countries and low SES families given that Metacognitive Strategies are so strongly related to achievement.

Limitations

There are some limitations regarding the current study that should be noted. In particular, the current study does not address all of the potential learning and metacognitive strategies that are available for students to engage or consider. Moreover, the authors acknowledge the inherent limitations of self-report questionnaire methodologies for measuring the types and frequency with which students use learning and metacognitive strategies. Although other methodologies are available, such as think-alouds, observations, microanalysis, or teacher ratings, the use of self-report questionnaires may be the only feasible measurement methodology to examine massive sample sizes as was the case in the current study. Further research that can collect more fine grained data regarding strategy use with other measurement methodologies may be particularly important. In addition, further research should also examine similar research questions regarding individual types of learning and metacognitive strategies to determine the relationships of specific strategies with achievement and gender.

Conclusions

Although SES and gender were strongly related to achievement and the use of metacognitive strategies; "demography is not destiny" (Cavanagh, 2007). One role of educational psychology in public policy is to point the way for possible improvements in education. Our findings indicate that the relations between metacognitive strategies and achievement were as large as the relations between SES and achievement. Although the directionality in regression analyses is always in question, and we also do not suggest that metacognitive strategies alone can ameliorate all of the negative effects of low SES, our findings are encouraging because students can be taught to use metacognitive strategies effectively (Perry, VandeKamp, & Mercer, 2000). Moreover, there was a significant difference between how males and females utilize learning and metacognitive strategies. In light of a large achievement gap between males and females in reading that has continued to widen in the last decade (Organisation for Economic Co-operation and Development, 2010), these results prompt the need for further research to examine the role of metacognitive strategies as a means of closing the reading achievement gap for males. Thus, our findings are particularly important for lower SES students and males underachieving in reading who less frequently utilize metacognitive strategies appropriately.

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