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International Note: What factors are associated with reading, mathematics, and science literacy of Indian adolescents? A multilevel examination

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ABSTRACT

A sample of 15-year-olds in India took part in the Program for International Student Assessment (PISA) for the first time in 2010. The PISA reading, mathematics, and science literacy scores of Indian adolescents were considerably lower than their counterparts in most PISA participating countries. In order to explore potential reasons for this, the present study, therefore, drawing on data from the fourth cycle of PISA and employing multilevel modeling, examined the relations of student- and school-level factors to reading, mathematics, and science literacy among 4826 15-year-old students from 213 schools in India. Gender, metacognitive learning strategies, students' positive attitudes toward school, and students' positive perceptions of classroom climate were found to be significantly associated with Indian adolescents' performance on the PISA assessment.

Two states in India, Himachal Pradesh and Tamil Nadu, participated in the Program for International Student Assessment (PISA) for the first time in 2010 (Walker, 2011). Of the 74 participating countries/economies, the 15-year-olds in Himachal Pradesh ranked 73rd in reading and mathematics literacy and 74th in science literacy, while the 15-year-olds in Tamil Nadu ranked 72nd in reading, mathematics, and science literacy (Walker, 2011). Moreover, more than 80% of the 15-year-olds in Himachal Pradesh and Tamil Nadu performed below the PISA 2009 baseline level of proficiency in reading, mathematics, and science (Walker, 2011). Given the poor performance of Indian adolescents on the PISA reading, mathematics, and science assessments, it is of critical importance to examine the factors related to Indian adolescents' reading, mathematics, and science literacy.

Bronfenbrenner's (1979, 1992, 1994) ecological systems theory can be helpful in understanding the multiple contexts affecting school children's academic performance. According to the ecological systems theory, it is crucial to investigate not only the relations of student-level factors to academic performance but also the links between school-level factors and student performance. A substantial body of research has documented the relations of a myriad of student- and school-level factors to student academic performance. Although numerous studies have indicated gender differences in reading achievement, favoring females (e.g., Chiu & McBride-Chang, 2006), the findings of hitherto research on the effects of gender on mathematics and science achievement are mixed. Prior studies have demonstrated both gender similarities in mathematics (e.g., Lindberg, Hyde, Petersen, & Linn, 2010) and science (e.g., Haworth, Dale, & Plomin, 2010) and gender differences in mathematics (e.g., Penner & CadwalladerOlsker, 2012) and science (e.g., Becker, 1989), favoring males. Moreover, other

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student background characteristics such as speaking the language of the assessment at home and hailing from two-parent families and higher socioeconomic backgrounds were found to be positively linked to student achievement in reading, mathematics, and science as well (e.g., Areepattamannil & Kaur, 2013; Hampden-Thompson, 2013).

There is also growing evidence that students' learning strategies—cognitive and metacognitive learning strategies—may influence students' academic performance (e.g., Areepattamannil & Caleon, 2013). In some studies, the use of cognitive learning strategies such as memorization strategies has been shown to be related to beneficial outcomes (e.g., Zimmerman & Martinez-Pons, 1986); however, it has been shown to be either negatively linked or unrelated to academic outcomes in others (e.g., Areepattamannil & Caleon, 2013; Marsh, Hau, Artelt, Baumert, & Peschar, 2006). The use of metacognitive learning strategies such as control strategies has generally been found to be associated with positive academic outcomes (e.g., Areepattamannil & Caleon, 2013; Marsh et al., 2006). Finally, a large of body of research has also demonstrated that students' positive perceptions of classroom environment and positive attitudes toward school are positively linked to students' academic performance (e.g., Chionh & Fraser, 2009; Hattie, 2009).

The research findings to date on the impact of school size on students' academic outcomes are inconsistent. Prior studies have shown the positive effects of small, mid-sized, and large schools on student achievement and engagement (e.g., Leithwood & Jantzi, 2009). Moreover, a growing corpus of research also suggests that students in urban, public, and high SES schools tend to perform better than their peers in rural, private, and low SES schools (see Lubienski & Lubienski, 2005; Perry & McConney, 2010). However, lower student-teacher ratios, shortage of trained teachers, poor quality of schools' educational resources, and negative school climate may adversely affect student achievement and engagement (see Ingersoll & Perda, 2010; MacNeil, Prater, & Busch, 2009).

Thus, a large number of student- and school-level factors might be linked to students' academic performance. Nevertheless, the lion's share of these findings is primarily the offspring of Western theorizing and research, and the majority of research involved predominantly North American or European participants. Because the purpose of education is perceived differently among individuals in individualist and collectivist societies (Hofstede, Hofstede, & Minkov, 2010), it is important to

Table 1
Fixed effects estimates and variance–covariance estimates for models of the predictors of reading literacy.

	Unconditional model		Level-1 model		Full Level-2 model	
	B	*SE*	*B*	*SE*	*B*	*SE*
Intercept	315.79***	4.49	310.04***	4.83	322.08***	7.98
Level-1						
Gender (Female)			15.31***	3.07	15.18***	3.04
Home language (Language of test)			−4.05	4.17	0.98	4.17
Family structure (Single-parent family)			7.63	5.13	7.41	5.08
Economic, social, and cultural status			−0.39	1.39	−1.16	1.39
Metacognition: summarizing			1.12	1.59	1.30	1.60
Metacognition: understanding/remembering			5.55*	2.17	5.55*	2.16
Control strategies			6.28**	1.94	6.17**	1.94
Elaboration strategies			−1.50	1.67	−1.58	1.69
Memorization strategies			−0.98	2.20	−0.72	2.21
Attitude towards school			13.65***	1.51	13.56***	1.51
Disciplinary climate			11.37***	1.93	11.57***	1.91
Student teacher relations			3.80**	1.26	3.91**	1.24
Level-2						
School location (Rural)					−3.98	8.06
School size					0.02***	0.00
School type (Public)					−6.81	7.35
School mean ESCS					8.72	6.48
Student-teacher ratio					−0.20	0.32
Quality of school's educational resources					9.31***	2.62
Teacher shortage					5.79	5.14
Student behavior					3.30	4.10
Teacher behavior					−5.14	4.74
Intercept variance ($\hat{\tau}_{00}$)	2218.00		1883.11		1197.65	
Level 1 variance ($\hat{\sigma}^2$)	3378.15		2957.81		2957.13	
Intraclass correlation coefficient ($\hat{\rho}$)	0.40		0.39		0.29	
Variance in achievement between schools	NA		15%		46%	
Variance in achievement within schools	NA		12%		12%	

*$p < .05$. **$p < .01$. ***$p < .001$.