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Cognitive ability and locus of control: the effect of parental involvement on the academic performance of elementary and secondary school students

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Abstract
The purpose of this study is to investigate the mechanism of the impacts of parental involvement on the academic performance of students. A total of 4,750 students and their guardians from 60 primary schools and 37 middle schools from Kunshan, Jiangsu Province filled out the questionnaires. The findings show that: (1) parental involvement positively predict students' academic performance; (2) cognitive ability and locus of control play significant mediating roles between parental involvement and students' academic performance, and there is no significant difference in their mediating roles; (3) family SES significantly moderate the impacts of the involvement of parents on students' cognitive ability and locus of control. These findings suggest that in addition to paying heed to the important role of parental involvement on students' development, we should also give attention to developing students' cognitive and non-cognitive abilities. This study can enlighten future researchers and advance the field of parental involvement research.

Keywords Parental involvement · Cognitive ability · Locus of control · Academic performance

Introduction

Academic performance refers to the degree of students' mastery of course content, which can be reflected in their test scores in reading, mathematics, and other subjects, or by their comprehensive educational outcomes in school (Cortés Pascual et al., 2019). Academic performance is an important predictor of individual development, including friendship networks (Palacios et al., 2019) and mental well-being (Roeser et al., 1998) in childhood, as well as educational success (Benner et al., 2016), career adaptability (Datu & Buenconsejo, 2021), and social status (Behrman et al., 2017) in adulthood. Compared to the school-related factors, researches on the impact of family-related determinants on students' academic performance began relatively late. The relevant studies were inspired by the Coleman Report, which was published in 1966 and discussed equity in educational opportunities. The Coleman Report explored factors affecting school achievements of students from different ethnic groups, based on students' sample in the United States. The report showed that parents' occupation and education level, family educational resources and economic income, and other family background factors could account for more variations in students' academic performance than school-related factors (Coleman, 1966). This statement prompted further discussion on the factors affecting students' academic performance—from school education to family background (Bradley & Corwyn, 2002; Milne & Plourde, 2006).

Inspired by the Coleman Report, there are two trends in the research on students' academic performance. Some scholars used different research methods to verify the actual effect of school-related factors on academic performance in

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an effort to prove that these factors are impactful (Hedges et al., 1994; Monk, 1992), while other investigations focused on the influence of family background on academic performance (Caldas & Bankston, 1997; Davis-Kean, 2005). Family socioeconomic status (SES) was the most widely used variable to capture family background in the relevant studies, and "common-sense" indicated that high family SES was likely to lead to better academic performance. However, the correlation among academic performance and SES were not entirely consistent with White's (1982) meta-analyses. Subsequent studies also supported this viewpoint (Heyneman & Loxley, 1983; Zhao, 2015). The inconsistency of the results may be attributed to parental involvement (Hango, 2007), as Coleman (1988) considered that participation of parents has a prerequisite part in the influence of family human capital on academic performance. To fully understand the role of family-related factors, researchers have shifted their focus to more micro-level family interaction processes in recent decades and used an integrated analysis to examine the joint impact of these interactions on students' academic performance (e.g., Ogg & Anthony, 2020).

Parental involvement is also an important factor used to explore the influence of family background on the academic performance of students except for family socioeconomic status (SES) (e.g., Wong et al., 2018; Wang et al., 2023). Parental involvement denotes the interest level of parents in their children's daily activities (Wong, 2008). Parental involvement can positively predict their performance in academics (Wong et al., 2018). Influenced by the traditional human capital theory, previous research has usually supposed that parental involvement could promote students' academic performance by improving their cognitive abilities, for instance, attention, reasoning, and problem solving (Li et al., 2019). However, this notion gradually fell apart as researchers found that non-cognitive abilities (such as the positive attributional style, Big Five, hope) played a highly significant part in predicting their performance in academics (Leeson et al., 2008). Thus, they proposed the extended theoretical model of human capital, and believed that non-cognitive abilities should be incorporated into theoretical models explaining students' academic performance (Heckman et al., 2006; Zhou, 2015).

Non-cognitive ability refers to the comparatively stable behaviors, thoughts, and feelings patterns that individuals exhibit when dealing with certain situations (Brunello & Schlotter, 2011) which cannot simply be measured through achievement tests or IQ (Kautz et al., 2014). In existing studies, locus of control, which is a person's belief regarding the degree of control over the consequences of events in their lives (Rotter, 1966), is considered to be the representative and most widely used variable by researchers to characterize non-cognitive abilities. Existing studies have suggested that students' locus of control is influenced by parental involvement (Galvin et al., 2018) and can promote students' performance in academics (Chisholm-Burns et al., 2021). However, existing studies mainly emphasized the mediating role of cognitive abilities (Li et al., 2019), thereby ignoring the fact that non-cognitive abilities could also be employed as mediating variables among parental involvement and students' academic performance. Although Wu and Zhang (2017) demonstrated that parental absence affects students' development through both cognitive and non-cognitive abilities, no study has integrated these abilities to examine the influence of parental involvement on academic performance, especially under the premise that non-cognitive abilities have a greater effect on academic performance. The limitation of such study is that it gives more importance to academic performance in mathematics (which is highly correlated with cognitive ability), and academic performance in other subjects such as English (which is less predicted by cognitive ability) is weakened (Deary et al., 2007). Moreover, non-cognitive abilities such as hope, positive attributional style, and learning motivation, which also have a significant influence on the academic performance of students, are neglected when the function of non-cognitive abilities is excluded from study (Li et al., 2019). Based on these shortcomings, Tan (2018) called for further investigation into how parental involvement affects the growth of students' non-cognitive abilities to enable a better comprehension of the significance of parental involvement in students' academic development. Although Wu and Zhang (2017) demonstrated that parental absence affects students' development through both cognitive and non-cognitive abilities, they neglected an extremely important factor that reflects family background—family SES. Furthermore, existing studies are mainly based on samples and surveys performed in Western nations. In fact, it is meaningful to verify the impact of parental involvement on student development in Eastern cultures. As a cross-cultural study showed that compared with American parents, Chinese parents are more demanding and devote more time to their children's education (Chen & Uttal, 1988).

Chinese culture has always emphasized that "All the other occupations are base, only book-reading is exalted," which makes Chinese parents regard education a key element to promote social mobility (Betthäuser, 2017). In addition, Chinese parents look forward to the success of their children, and invest a considerable amount of efforts and time on their children's education. It is therefore of particular significance to explore the link among parental involvement and students' academic performance and whether there are differences in the functions of cognitive and non-cognitive abilities (locus of control) in this relationship in the context of Chinese education.

Literature review and hypotheses development

Parental involvement and student's academic performance

Home-based and school-based are the two dimensions of parental involvement (Epstein, 1987). School-based parental involvement involves parents communicating with teachers, volunteering for school activities, attending parent-teacher conferences, and participating in school committees. Home-based parental involvement consists of parents monitoring their learning progress, checking their homework, discussing school life, and expressing educational expectations of them (Li et al., 2019). For "school-based parental involvement", regular communication between parents and teachers can increase teachers' attention to students, which can further improve students' academic performance, promote parents' understanding of students' performance at school, and help them master effective learning strategies (Young, 2020; Zhang et al., 2021). For "home-based parental involvement", Wong et al. (2018) found that it could promote the engagement of primary school students in school activities and improve their academic performance. Gonida et al. (2014) suggested that parental help with homework could significantly affect student's achievement goals and academic efficacy. The parents' educational expectations could also positively predict academic achievement (Jeynes, 2022). Although most meta-analysis studies have proven the positive link between parental involvement and students' academic performance (Castro et al., 2015; Ma et al., 2016). However, there are some studies with inconsistent conclusions. For example, Mattingly et al. (2002) and Perkins et al. (2016) found that there was no substantial correlation exists between parental involvement and students' academic performance, whereas other researchers have reported a negative relationship between them (Jeynes, 2005, 2007). In the light of these non-significant or negative relationships, Boonk et al. (2018) considered it important to have a widely accepted theoretical framework that could accommodate more mediating variables to explain the association. Thus, based on the extended human capital theory, this study incorporated the mediating effects of cognitive ability and locus of control into the hypothesis model, thereby synthesizing the findings of existing studies. **hypothesis 1 is proposed: Parental involvement can positively predict students' academic performance.**

Mediating role of cognitive ability

Cognitive ability is described as the "ability to comprehend complicated ideas, to learn from experience, to adjust efficiently to the surrounding, to reason in different ways, and to overcome difficulties through thinking" (Neisser et al., 1996). In the teaching environment, the specific manifestation of students' cognitive ability involves verbal (Kumpulainen et al., 2017), spatial (Toomey & Heo, 2019), logical reasoning (Tiihonen et al., 2005), problem-solving (Tong et al., 2019), and creative abilities (Sternberg, 2015). Cognitive ability can effectively organize and consolidate academic knowledge (Demetriou et al., 2020) and help students choose strategies and solutions flexibly to solve academic problems (Hacatrjana, 2022), which can promote academic performance. According to Information Processing Theory, students with high cognitive ability can quickly and accurately pay attention to key information, encode it in memory, and produce effective information, which contributes to higher school achievement (Vock et al., 2011).

Both human capital theory and cultural reproduction theory support that parental involvement can significantly improve students' cognitive ability (Wang & Lin, 2021). For example, Liang et al. (2018) and Li (2017) found that there is a positive and lasting influence on students' cognitive abilities when parents communicate with their children often, take them to museums, attend parent-teacher conferences, and contact teachers actively. Some scholars also found that parents can cultivate students' cognitive abilities by providing a cognitively stimulating environment, supervising and tutoring children while they do their homework, or expressing educational expectations to their children (Biedinger, 2010; Li et al., 2019). Nevertheless, when the level of parental involvement is low, that is, the parents have low educational expectations or low educational investment, their children's cognitive ability will also be low (Li et al., 2021). Based on these evidences, **hypothesis 2 is proposed: Cognitive ability have a mediating role among parental involvement and students' academic performance.**

Mediating role of locus of control

Locus of control (LOC) denotes "the extent to which the individual perceives that the reward follows from, or is contingent upon, his own behavior or attributes versus the extent to which he feels the reward is controlled by forces outside of himself and may occur independently of his own actions". Meta-analysis investigations have revealed that locus of control has a significant predictive impact on students' academic performance (Findley & Cooper, 1983; Galvin et al., 2018). When the individual believes that the outcome of an event is determined by his/her own behavior or stable traits, it means that the individual holds a belief in internal control. When the individual interprets the outcome of an event in terms of fate, luck, or chance or as being the result of the control of someone powerful, he/she holds a

belief in external control (Rotter, 1966). Internal locus of control is significantly positively associated with strong task motivation, self-efficacy, and positive self-evaluation (Galvin et al., 2018), whereas external locus of control is significantly positively correlated with task avoidance coping, psychological strain, and negative self-evaluation (Reknes et al., 2019). Students with internal locus of control are more likely to have greater achievement in academics, and more positive emotional experiences about their own learning (You et al., 2011; Karaman et al., 2017).

Individuals' locus of control can be changed by one's living environment or individual experiences in their growth (Kautz et al., 2014). It can be strengthened by frequent parental interaction with school teachers—which provides students with high-quality school and family support—and can improve their confidence in their own learning abilities and sense of control over their academic performance (Elkins & Schurer, 2020). Parent-child reading and communication at home can foster students' sense of security and encourage them to actively explore the surrounding environment. It can also help them enhance understanding of the connection between their own behavior and outcomes, thus strengthening their internal locus of control (Shifrer, 2019). Given the effect of parental involvement on students' locus of control and the predictive role of locus of control on the academic performance of students, **hypothesis 3 is proposed: Locus of control have a mediating role among parental involvement and students' academic performance.**

Moderating role of family SES

The effect of parental involvement on students' cognitive ability and locus of control may vary among families with diverse conditions. Family SES is used to measure a family's social class and its ability to access social resources (Bradley & Corwyn, 2002). Existing studies have proved that under the condition of higher family SES, students can receive more cognitive stimulation from infancy to middle childhood, which leads to better cognitive ability development (Bradley et al., 1996). Parents in high SES families have greater opportunities to access and learn scientific educational theories and methods, and can more effectively master educational instruction (Conger & Donnellan, 2007; Benner et al., 2016). In contrast, low family SES will significantly limit the improvement of students' cognitive ability (Liu et al., 2020a, b). Parents in families with low SES often suffer from greater economic and mental pressure. They are prone to expressing negative emotions and generating parent-child conflicts, which does not generate ideal outcomes of parental involvement (Neppl et al., 2016). Accordingly, **hypothesis 4 is proposed: Family SES plays a moderating role among parental involvement and students' cognitive ability.**

In the case of high family SES, parents can offer abundant educational resources and more learning opportunities to their children (Park & Holloway, 2018). They can afford to place greater emphasis on children's self-reliance, personal responsibility, and development, as well as adopt supportive parenting styles (Moilanen & Shen, 2014)—all of which can increase children's sense of control over learning targets and enable them to form a higher level of internal locus of control. Shifrer's (2019) study found that parents in families with high SES who discuss school life with their children often, purchase more books, and provide other cognitive resources, can reinforce their children's internal locus of control. Parents in low SES families are more likely to demand obedience from their children. This may lead to the children's lack a sense of control over their environments, and their attribution of learning outcomes to external elements, including luck, environment, and powerful others (Wickline et al., 2011). Accordingly, **hypothesis 5 is proposed: Family SES plays a moderating role among parental involvement and students' cognitive ability.**

Previous studies have suggested that parental involvement could improve students' academic performance based on Western data. They have also proposed possible mediating roles for cognitive ability and locus of control in this relationship and have showed that low family SES undermine students' academic performance (Liu et al., 2020a, b). Nevertheless, there are some investigations with divergent conclusions and a lack of research integrating these relationships. The gaps that remain unaddressed are as follows: (1) previous studies did not agree on the effects of the association among parental involvement and academic performance of students; (2) previous researches emphasized the mediating effects of cognitive abilities (Li et al., 2019) but ignored the mediating effects of non-cognitive abilities. In addition, the difference between the mediating impacts of non-cognitive and cognitive abilities was not clear; (3) previous studies have regarded family SES as the primary family-related factor affecting students' academic performance, neglecting the prerequisite value of parental involvement and the moderating role of family SES in it. Furthermore, considering that Eastern culture requires parents to attach significance to their children's education, using Chinese students and their parents as respondents will help to supplement existing findings.

Based on extended human capital theory, we address these gaps by examining Chinese students and their parents through a questionnaire survey. The questions to be tested are as below: (1) Will parental involvement be positively related to students' academic performance? (2) Do cognitive abilities and locus of control significantly mediate the

association among parental involvement and students' academic performance? If so, what is the difference between the two mediating effects? (3) Does family SES moderate the impact of parent's involvement on students' cognitive abilities and locus of control? By answering the above questions, we integrate students' cognitive and non-cognitive abilities to investigate the mechanisms of parental involvement on students' academic performance in China. This will not only support the positive impact of parental involvement, but also provide internal and external pathways to strengthen it. This exercise can validate extended human capital theory at the theoretical level and verify relevant findings in the context of Eastern culture. At the same time, it can provide guidance for parental involvement within disadvantaged families and address educational equity issues at the practical level.

Method

Participants and procedure

All primary and secondary schools in Kunshan, Jiangsu Province of China (a total of 97 schools, including 60 primary schools and 37 middle schools) participated in this study. We invited students and their guardians from two random classes in each school to fill out the questionnaires. The questionnaires are Chinese versions of existing English questionnaires, obtained through the standard "translation-back translation" procedure. This is proven to be reliable and valid in the study of primary and secondary school students. To avoid differences in language comprehension, peers were invited to evaluate the content of the questionnaire before it was formally distributed, and it was determined that primary and secondary school students could understand the meaning of all the questionnaire items. The survey program was reviewed by the academic committee of the author's workplace, and approved by local education departments as well as principal of each school. The paper questionnaires were distributed in the fall semester of 2019. Before distributing the questionnaires, it was ensured that all students and parents gave informed consent to participate. The student questionnaires covered variables such as, students' basic information, cognitive ability, locus of control, and academic performance. The parent questionnaires covered variables such as, family socioeconomic state and parental involvement. The school arranged for the students to fill out the questionnaires in a quiet classroom during special extracurricular time. The teachers read the questionnaire guidelines to them. Students took the parent questionnaires home to be filled out by one of their guardians, then brought them back to school the next day. To ensure that the guardians understood the context of the study, instructions for filling the questionnaire were attached to the parent questionnaires.

A total of 4,750 students and their guardians from 117 elementary school classes, 55 junior high school classes, and 14 senior high school classes filled out the questionnaires. The final number of valid samples was 4,050, and the effective rate of questionnaires recovery was 85.26%. Among the 4,050 students, 54% were boys (n = 2,185) and 46% were girls (n = 1,865). There were 63.4% primary school students (n = 2,569), 26.9% junior high school students (n = 1,090) and 9.7% senior high school students (n = 391). In the sample, 43.2% of students were the only child in the family (n = 1,751), while 56.8% were not (n = 2,299). According to the 4,050 parent questionnaires, 96.7% of students were in intact families (n = 3,917) and 3.3% were in non-intact families (n = 133).

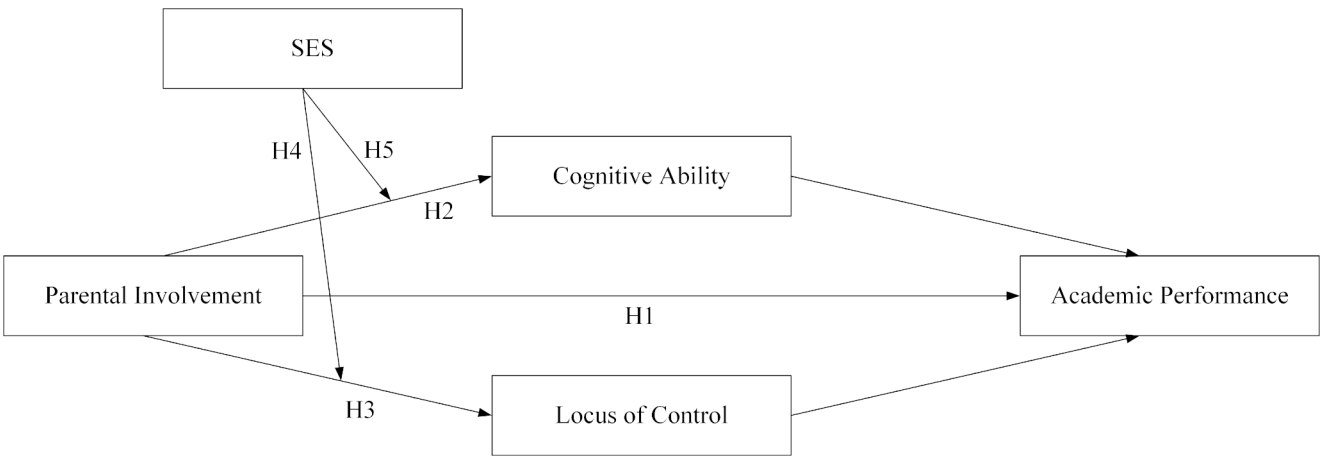

Fig. 1 The hypothesis model for the current study

Measures

Parental involvement

Tan's (2022) parental involvement scale was adopted in this research. This questionnaire was originally developed by Tan in 2018 based on Epstein's definition of parental involvement and was used to determine the level of parental involvement among Chinese middle school students. Later, based on the original version, the questionnaire was adapted by Tan to measure the level of parental involvement among elementary school students in grades 3–6 and secondary school students in grades 7–12, which yielded reliable and valid results (Tan et al., 2022). It included four dimensions: parental support of their child's learning at home, parent-child discussions, parental participation in school-organized activities, and parent-teacher discussions Among them, parent-teacher discussions and parental participation in school-organized activities were included in the dimension of school-based parental involvement. Parental support and parent-child discussions of their child's learning at home were included in the home-based dimension of parental involvement. Parents rated 17 items on a four-point Likert-type scale (1 = never, 2 = rarely, 3 = sometimes, 4 = often). The following are examples of the items on the questionnaires: "Discuss how well my child is doing in school", "Help my child with his/her homework", "Discuss my child's behavior with a teacher through my own initiative", "Attend a scheduled meeting or conferences for parents". Higher scores reflect higher levels of parental involvement. The Cronbach's alpha coefficient of the scale was 0.929 in this research.

Cognitive ability

The students' cognitive ability questionnaire was adapted from the Self-Report Measure of Cognitive Abilities (SRMCA) developed by Jacobs & Roodenburg (2014). Existing mature instruments of cognitive ability such as the Cognitive Reflection Task (CRT), Raven Progressive Matrix (RPM), and Working Memory Capacity Test (WMC) have shortcomings such as being time-consuming and difficult to operate (Lilleholt, 2019). It has also been found that cognitive ability assessments based on self-reports are more reliable and valid than those based on traditional cognitive ability tests (Jacobs & Roodenburg, 2014). According to the dimensions of SRMCA, this study measures students' cognitive ability based on three aspects: logical reasoning, problem-solving, and creativity, which are measured through self-reports. The questionnaire consisted of eight items and the expressions of the existing questionnaire were adjusted on the basis of the language habits of primary and secondary school students. The final questionnaire items were as follows: "I can make out the correct name of an object" (logical reasoning), "I can figure out a way to solve a difficult problem" (problem-solving), and "I can do mental rotations of three-dimensional images" (creativity). Using a five-point Likert-type scale (1 = strongly disagree, 2 = disagree, 3 = not sure, 4 = somewhat agree, 5 = strongly agree). Higher scores indicate higher levels of cognitive ability. The Cronbach's alpha coefficient of the questionnaires was 0.908.

Locus of control

Students' locus of control was measured by the Pearlin Mastery scale developed by Pearlin et al. (1981). The earliest instrument of locus of control was the 23-item Internal-External Control scale (I-E scale), which was created by Rotter (1966). Later, Pearlin et al. (1981) developed the Pearlin Mastery scale taking into account the degree to which people believe the source of reinforcement (e.g., own behavior, fate, or chance). The Pearlin Mastery scale has been extensively employed for measuring the locus of control among elementary and secondary school students and has consistently presented good reliability and validity (e.g., You et al., 2011). There were seven items (one was a reverse item) in the locus of control section of the scale, which uses a five-point Likert-type scale (1 = strongly disagree, 2 = disagree, 3 = not sure, 4 = somewhat agree, 5 = strongly agree). The scale was self-reported by students. Examples of the questionnaire items are as follows: "When I make plans, I can make them work". Higher scores represent greater levels of internal locus of control. The Cronbach's alpha coefficient of the scale was 0.859 in this study.

Academic performance

Students' academic performance is usually measured by ability tests for instance the Program for International Student Assessment, students' scores on academic tests or their GPA (Poropat, 2009), or by students' self-reported academic ranking (Li & Qiu, 2016). Previous investigations have revealed that the cost of ability assessment or academic examination is too high, and the results are easily affected by accidental factors such as the assessment environment and students' status (Mayston, 2003; Zhu et al., 2020), whereas students' self-reported academic ranking is a simple and high quality assessment method (Dang, 2007; Li & Qiu, 2016). In the Chinese educational system, students' academic performance is usually measured by their academic ranking and is uniformly understood by students and parents. This study used the student's academic ranking in the class through self-reporting to measure academic

performance, a method whose effectiveness has been proven in previous research (Fu et al., 2016; Zhang et al., 2019). Students' academic ranking was scored as: 1 = below average; 2 = average; 3 = above average. The more the score, the better the academic performance of students.

Family SES

Family SES is a comprehensive index composed of parents' educational level, occupation, and personal annual income level. In the past, family SES has been measured using a single indicator (Witter et al., 1984; Diener et al., 1993; Mueller & Parcel, 1981). However, in recent years, researchers believe that using a combination of these indicators to measure SES is more objective, comprehensive, and reliable (Tan et al., 2020); this method has since become the standard form of measurement (Sackett et al., 2009; Korous et al., 2020). In this investigation, all indicators of family SES were filled in by the guardians with their own and their spouses' information, and each indicator was assigned scores based on the existing measurement methods. The educational level is the highest educational degree, and was scored as follows: 1 = elementary school; 2 = junior high school; 3 = technical secondary school; 4 = junior college; 5 = senior high school; 6 = bachelor's degree; 7 = master's degree; and 8 = doctor's degree." Occupation was scored according to the classification standards for parents' occupation (Qiao et al., 2013): 1 = unemployed; 2 = production personnel in agriculture, forestry, animal husbandry, fishery, and water conservancy; production and transportation equipment operators and related personnel; 3 = clerical, commercial or garment workers; 4 = all kinds of professional and technical personnel; and 5 = staff of state organizations, party organizations, managers of enterprises and institutions. Higher scores indicated higher occupational status. Personal annual income level was scored as follows: 1 = 50,000 and below; 2 = 50,000 to 120,000; and 3 = 120,000 and above.

Principal component analysis was performed on the standardized z-scores of the above six indicators to get the factor loading of each variable. The SES indicator was fitted in accordance with the following formula adapted from Yuan et al. (2022): $SES=(\beta 1*Z_{\text{father's education level}}+\beta 2*Z_{\text{mother's education level}}+\beta 3*Z_{\text{father's occupation}}+\beta 4*Z_{\text{mother's occupation}}+\beta 5*Z_{\text{father's annual income level}}+\beta 6*Z_{\text{mother's annual income level}})/\varepsilon f$. $\beta 1 \sim \beta 6$ were the corresponding factor loadings, and εf was the eigenvalue of the first factor. The scores of SES in this study ranged from − 16.84 to 16.62. The more the score, the greater the level of the family's SES.

Control variables

In existing studies, control variables such as the gender, grade level, whether or not the student is an only child, and parents' marital status were generally considered in the association among parental involvement and academic performance (Ogg & Anthony, 2020; Wang et al., 2020; Anthony et al., 2014). We therefore selected students' gender, whether he/she is an only child, grade level, and their parents' marital status as control variables for students' academic performance. Students' gender scored as: 1 = male; 2 = female. Whether or not the student is an only child was scored as: 1 = only child in the family; 2 = not the only child in the family. Grade level was scored as: 1 = elementary school; 2 = junior high school; 3 = high school. Parents' marital status was scored as: 1 = non-intact family; 2 = intact family.

Data analysis

SPSS 26.0 and the SPSS PROCESS 3.5 macro of Hayes (2013) were used for data analysis. First, the common method bias was analyzed utilizing Harman's single factor test. Second, correlation analysis and descriptive statistics were employed to clarify the characteristics and relationships of each variable. Third, the mediation model of Process (Model 4) was employed to assess the mediating effect of cognitive ability and locus of control between parental involvement and academic performance. The moderated mediation model of Process (Model 7) was then utilized for testing the moderating role of family SES. Fourth, the bootstrapping method was utilized to obtain robust standard errors and 95% confidence intervals for parameter estimates. When the interaction item was significant and the 1,000 bootstrapped 95% confidence interval did not include zero, the moderated mediation model was considered effective. Fifth, when the moderating impact was considerable, a simple slope analysis was performed.

Result

Preliminary analyses

To avoid common method bias, the Harman single-factor test was utilized. The results showed that the accumulated amount of explanatory variance was 62.117%, and the largest factor was 27.303%, which was lower than the 40% criterion proposed by Podsakoff et al. (2003). Furthermore, a series of confirmatory factor analyses was carried out to examine the construct distinctiveness of the five main variables (parental involvement, cognitive ability, locus of

Table 1 Means, standard deviation, and correlations scores of each research variable

Variables	M	SD	1	2	3	4	5	6	7	8	9
1. Students' gender	1.46	0.50	1								
2. Grade level	1.46	0.66	0.05**	1							
3. Only child status	1.57	0.50	0.12***	-0.12**	1						
4. Parent marital status	1.97	0.18	-0.00	-0.01	-0.10**	1					
5. Parental involvement	3.07	0.54	-0.01*	-0.03	-0.04*	0.04*	1				
6. Cognitive ability	4.09	0.65	-0.04*	-0.06**	0.01	0.03	0.30**	1			
7. Locus of control	4.33	0.58	0.03	-0.09**	-0.01	0.03	0.25**	0.63**	1		
8. Academic performance	2.32	0.71	0.05**	-0.03	-0.07**	0.02	0.13**	0.19**	0.21**	1	
9. Family socioeconomic status	0	6.00	-0.00	-0.08**	-0.10**	0.04**	0.27**	0.10**	0.08**	0.19**	1

Note. N = 4050. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 2 Coefficients of the multiple mediation model

Predictors	Mediator: Cognitive ability		Mediator: Locus of control		Outcome: Academic performance	
	β	*t*	*β*	*t*	*β*	*t*
Students' gender	-0.05*	-2.30	0.04*	2.34	0.08***	3.72
Grade level	-0.05**	-3.40	-0.08***	-5.63	-0.02	-1.30
Only child status	0.03	1.38	-0.02	-1.17	-0.11***	-4.91
Parent marital status	0.05	0.94	0.06	1.16	-0.08	1.34
Parental involvement	0.37***	20.17	0.27***	16.08	0.92***	4.34
Cognitive ability					0.09***	4.53
Locus of control					0.16***	6.63
R^2	0.10		0.07		0.06	
F	$86.85_{(5)}$***		$60.75_{(5)}$***		$38.68_{(7)}$***	

Note. *N* = 4050. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$

Table 3 The pathways of the multiple mediation model

Effect	Path	Effect	Boot *SE*	95% Boot *CI*	Proportion
Total effect		0.08	0.01	[0.06,0.10]	-
Direct effect	PI—>AP	0.09	0.02	[0.05,0.13]	54.07%
Indirect effect 1	PI—>CG—>AP	0.04	0.01	[0.02,0.05]	21.16%
Indirect effect 2	PI—>LC—>AP	0.04	0.01	[0.03,0.06]	24.77%
C1		-0.006	0.01	[-0.02,0.03]	-

Note. *N* = 4050. PI = Parental involvement. AP = Academic performance. CG = Cognitive ability. LC = Locus of control. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$. C1 means "Indirect effect 1" minus "Indirect effect 2"

control, academic performance, family SES). Compared to other models, the five-factor model indicated an adequate fit ($\chi 2/df = 3.158$, RMSEA = 0.023, SRMR = 0.0361, TLI = 0.982, CFI = 0.986), preventing the common method bias problem.

The means, standard deviations, and correlations between the variables are presented in Table 1. The data showed that there are significant positive correlations between parental involvement and cognitive ability ($r = 0.30$, $p < 0.01$), locus of control ($r = 0.25$, $p < 0.01$), academic performance ($r = 0.13$, $p < 0.01$), and family SES ($r = 0.27$, $p < 0.01$). Cognitive ability and locus of control were both positively associated with academic performance ($r = 0.19$, $p < 0.01$; $r = 0.21$, $p < 0.01$).

Main effects and mediation effects

Controlling for students' gender, only child status, grade level, and parents' marital status, the mediating effect test model (Model 4) in SPSS macro developed by Hayes (2013) has been used to test the mediating effect of cognitive ability and locus of control among parental involvement and students' academic performance. As shown in Tables 2 and 3, parental involvement had a considerable positive predictive influence on cognitive ability and locus of control ($\beta = 0.37$, $t = 20.17$, $p < 0.001$; $\beta = 0.27$, $t = 16.08$, $p < 0.001$), as well as on academic performance ($\beta = 0.13$, $t = 8.33$, $p < 0.001$). Following the addition of locus of control and cognitive ability as mediating variables to the model, the direct predictive impact of parental involvement on academic performance remained positively significant ($\beta = 0.92$, $t = 4.36$, $p < 0.001$), and so did that of cognitive ability and locus of control ($\beta = 0.09$, $t = 4.34$, $p < 0.001$; $\beta = 0.16$, $t = 6.63$, $p < 0.001$).

The bootstrap 95% confidence intervals for the direct impact of parental involvement on predicting academic performance and the mediating effect of cognitive ability and

Table 4 Coefficients of the moderation model

Predictors	Mediator: Cognitive ability		Mediator: Locus of control	
	β	*t*	*β*	*t*
Students' gender	-0.05*	-2.55	0.04*	2.17
Grade level	-0.05***	-3.38	-0.08***	-5.72
Only child status	0.03	1.47	-0.02	-1.19
Marital status of parents	0.04	0.68	0.05	0.92
Parental involvement	0.37***	19.58	0.27***	15.81
Family SES	-0.10***	-10.29	-0.10***	-11.10
Parental involvement x Family SES	0.03***	10.70	0.03***	11.38
R^2	0.12		0.10	
F	$80.44_{(7)}$***		$63.35_{(7)}$***	

Note. $N = 4050$. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$

Table 5 Regression results of moderated mediation test for conditional effect at SES = mean and +/− 1 SD on CG.

SES on CG	Effect	SE	t	BootLLCI	BootULCI
-1.0002(M-1SD)	0.17	0.03	6.34***	0.12	0.22
0(M)	0.37	0.02	19.60***	0.33	0.40
1.0002(M + 1SD)	0.57	0.03	21.14***	0.52	0.62

Note. $N = 4050$. SES = Family socioeconomic status. CG = Cognitive ability. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$

locus of control did not contain 0 (see Table 3), indicating that parental involvement not only positively significantly predicted academic performance directly, but also indirectly predicted it through cognitive ability and locus of control. The direct and mediating effects accounted for 54.07% and 45.93% of the total effect, respectively.

Comparing the two mediating effects in Table 3, the results showed that locus of control played a similar mediating role with cognitive ability between parental involvement and academic performance (Cognitive ability: indirect effect = 0.04, $SE = 0.01$, 95% CI = [0.02, 0.05]; Locus of control: indirect effect = 0.04, $SE = 0.01$, 95%CI = [0.03, 0.06]). Although the mediation effect of cognitive ability accounts for 24.77% of the total impact of parental involvement on academic performance—higher than that of locus of control (21.16%)—the 95% confidence interval contains 0 (95% CI = [-0.02,0.03]). This indicates that the difference between the two mediating effects does not meet the criteria for statistical significance.

Moderation effect of family SES

Controlling for variables including students' gender, only child status, grade level, and parents' marital status, the moderated mediation model (Model 7) in the SPSS macro created by Hayes (2013) was employed for measuring the moderating impact of family SES on the relationship between parental involvement and academic performance. As shown in Table 4, the product term of parental involvement and family SES was significant in predicting both cognitive ability and locus of control ($\beta = 0.03$, $t = 10.70$, $p < 0.001$; $\beta = 0.03$, $t = 11.38$, $p < 0.001$), highlighting that family SES can significantly moderate the positive predictive influence of parental involvement on students' cognitive ability and locus of control.

Table 6 Regression results of moderated mediation test for conditional effect at SES = mean and +/− 1 SD on LC.

SES on LC	Effect	SE	t	BootLLCI	BootULCI
-1.0002(M-1SD)	0.07	0.02	3.14***	0.03	0.12
0(M)	0.27	0.02	15.82***	0.23	0.30
1.0002(M + 1SD)	0.46	0.02	19.01***	0.41	0.51

Note. $N = 4050$. SES = Family socioeconomic status. LC = Locus of control. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$

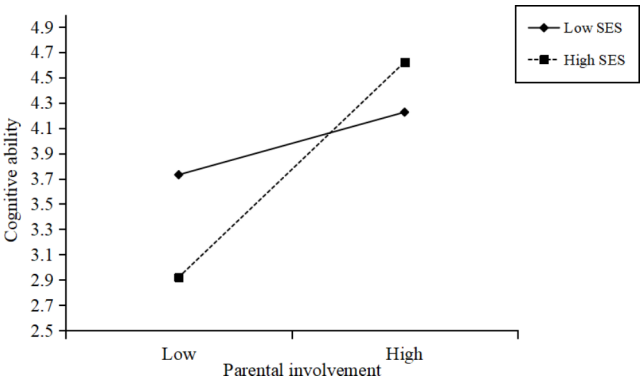

Fig. 2 SES moderates the relation between parental involvement and students' cognitive ability

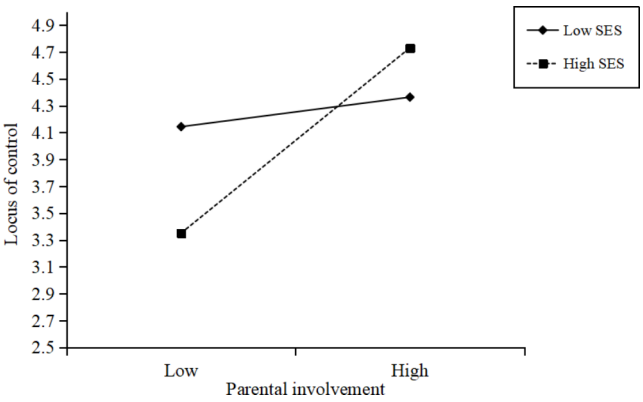

Fig. 3 SES moderates the relation between parental involvement and students' locus of control

Simple slope analysis (see Tables 5 and 6; Figs. 2 and 3) showed that parental involvement had a considerable positive predictive impact on cognitive ability for the participants with higher SES (one SD above the mean) ($\beta_{simple} = 0.57$, $t = 21.14$, $p < 0.001$), and also for those with lower SES (one SD below the mean) ($\beta_{simple} = 0.17$, $t = 6.34$, $p < 0.001$), which indicated that a higher parental involvement was related to better cognitive ability. Parental involvement had

a significant positive predictive effect on locus of control for participants with both higher SES ($\beta_{simple} = 0.46$, $t = 19.01$, $p < 0.001$) and lower SES ($\beta_{simple} = 0.07$, $t = 3.14$, $p < 0.001$), which indicated that a higher parental involvement was related to better locus of control.

Discussion

The findings demonstrated that parental involvement positively predicted students' academic performance, and cognitive ability and locus of control played significant mediating roles in this relationship. Moreover, family SES played a positive moderating role in the relationship between parental involvement and students' cognitive ability and locus of control.

Direct effect of parental involvement on student's academic performance

Our findings revealed that parental involvement positively predicted students' academic performance, thus hypothesis 1 was supported. According to the extended human capital theory model, the essence of parental involvement is the educational investment by parents or guardians, including the material, time, and affective investment they provide for their children both at home and school. The more parents are active in their children's education, in whatever capacity or setting, the better the academic performance of the children (Kloosterman et al., 2011).

In China, educational investment has a significant influence on the academic performance of children This may be because traditional education concepts push Chinese parents to attach more importance to their children's education and pay great attention to educational investment. Moreover, the Chinese government has incorporated parental involvement as an important component of compulsory education in relevant law or policy documents (e.g., Guidelines on Strengthening Family Education Work; Family Education Promotion Law of the People's Republic of China).

Mediation effects of children's cognitive ability and locus of control

The research highlighted that cognitive ability played a significant mediating role in the association among parental involvement and students' academic performance, which supports hypothesis 2. This is in line with the current researches (Li et al., 2019; Hardaway et al., 2020). Parental involvement can effectively improve children's cognitive abilities (Plomin & Rende, 1991), for instance, skills, knowledge, and self-efficacy for school success, and further promote individual academic success (Hoover-Dempsey et al., 2005). Parental involvement can provide students with more cognitive stimulation (such as extra-curricular tutoring and reading materials) and a good home learning environment, which can improve their logical thinking, reasoning, problem-solving, creativity, and other cognitive abilities (Hardaway et al., 2020). In addition, parents who are more involved are better informed about school dynamics or educational information. They can also better convey their educational expectations to their children, which can aid in improving children's self-education expectations, school engagement, and other variables highly related to cognitive abilities, thus improving their academic performance (Li et al., 2019; Liang et al., 2018).

It is also discovered that locus of control mediated the association among parental involvement and academic performance, which supports hypothesis 3. In general, highly involved parents provide warm, supportive relationships and a safe home environment (Carton & Nowicki, 1994), which can lead students to believe they have control over their future. Through participation in school activities, expressing educational expectations, and parent-child communication, parents can strengthen, support, and encourage students' autonomy. This can enable them to solve problems independently (Carton et al., 1996), which is closely related to the development of students' internal locus of control. Internal locus of control is often associated with individual adaptability, responsibility, optimism, persistence, and other excellent learning qualities (Joo et al., 2011). Individuals with an internal locus of control hold the opinion that academic performance is determined by their own abilities and efforts, and are not easily troubled by stress and anxiety in the face of difficulties. They are more likely to complete their learning plans and realize their academic goals (Joo et al., 2011), and are more motivated to learn autonomously. Since they expect to be rewarded through their own efforts, they are more likely to achieve better academic performance (Xiong & Zou, 2022). Therefore, internal locus of control is considered to be a protective factor for students to achieve higher academic performance.

Differences between children's cognitive ability and locus of control

The study found no significant differences in the mediating roles of cognitive ability and locus of control. Due to the influence of test-oriented education, studies on academic performance often focused on students' cognitive abilities, but neglected individual non-cognitive abilities. The extended human capital theory model emphasized that both cognitive and non-cognitive abilities should be incorporated into the analysis framework (Gahramanov et

al., 2019). Following this model, non-cognitive ability is at least as important as that of cognitive ability for children's academic performance. Meanwhile, parental involvement, as an important family investment, is able to develop both cognitive and non-cognitive abilities in children (Brunello & Schlotter, 2011). On the basis of data from the National Longitudinal Survey of Heckman et al. (2006) found that students' non-cognitive ability played an equally important role in their academic performance as their cognitive ability. The mediating effects of cognitive and non-cognitive abilities may not differ significantly. This is because cognitive ability reflects the general level of cognition (e.g., working memory, verbal ability) and higher level of cognition (e.g., logical reasoning, problem-solving, and creativity) students need to perform well academically (He et al., 2021), while locus of control reflects the extent to which they think their academic performance depends on their own ability and effort, and influences the amount of time and effort they devote to their studies (Chukwuorji et al., 2018). Both cognitive ability and locus of control are important for academic performance.

Moderating effect of SES

The present study revealed that family SES played a significant moderating role in the association among the influence of parental involvement on students' cognitive ability and locus of control, which supports hypotheses 4 and 5, and is consistent with previous studies (Jiang & Dong, 2020; Shifrer, 2019). High family SES parents have greater resources and opportunities to become involved in their children's education with effectiveness and high-quality (Liu et al., 2020a, b). First, they have better educational backgrounds, and more educational knowledge and learning experiences. These allow them to become more involved in their children's education in a more effective manner. Second, they can give educational resources to their children, and have more opportunities to conduct extracurricular tutoring to improve their cognitive ability (Park et al., 2011). They are also able to produce a safe and supportive growth setting for the development of children's internal locus of control (Carton et al., 2021). Third, they can actively and conveniently participate in school education and management, maintain regular communication with school teachers, become important members of the schools' parent committees, and obtain more learning opportunities and school resources for their children (Hill & Taylor, 2004). In contrast, low family SES parents may be unable to fully realize the positive value of parental involvement in school education due to living conditions, work pressure, limited time, and other reasons that cause them to be marginalized or passive in home-school cooperation (Zhao & Hong, 2012). They face greater financial and emotional distress, making it challenging to give adequate educational resources and a good growth environment to their children (Conger & Donnellan, 2007). Moreover, they have difficulty in providing knowledge or skills to their children, and lack the confidence and ability to educate them (Poon, 2020).

Implications

This study has the following theoretical implications: First, although the positive influence of parental involvement on students' academic performance has been emphasized in previous research, the possible mediating role of locus of control (non-cognitive ability) as a mechanism by which parental involvement affects students' academic performance has largely been ignored (Li et al., 2019). Following the extended human capital theory model that emphasizes that both cognitive and non-cognitive abilities should be jointly included in the research framework, this study confirmed that both cognitive and non-cognitive abilities play significant mediating roles between parental involvement and students' academic performance. There is no significant difference between the mediating roles of the two, which compensates for the neglect of non-cognitive abilities in previous studies. Second, the existing research chose Chinese participants for the survey samples, which makes up for the lack of research on locus of control in non-Western countries (Shifrer, 2019; Elkins & Schurer, 2020). The Chinese have attached great importance to family education and have emphasized students' autonomy in achieving success since the ancient times. This helps to more comprehensively verify the value of parental involvement and explain the positive influence of internal locus of control on students' academic performance. Third, this study constructed a moderated mediating effect model, which confirmed that family SES can significantly moderate the influence of parental involvement on students' cognitive abilities and locus of control (Poon, 2020). Previous studies mainly focused on the impacts of family SES on parental involvement and students' academic performance, ignoring the fact that family SES may moderate the entire process of parental involvement in the educational process. This study provides a new theoretical perspective for the continued promotion of equity in elementary education.

This study has the following practical implications: Firstly, it helps parents, educators, and policymakers understand the importance of parental involvement on students' academic performance. In the process of students' growth, we should not only encourage parents to prioritize their children's education, monitor their learning, and communicate with them more, but also invite them to participate in the daily work of schools to form a good mechanism of

family-school cooperation and educational atmosphere. Secondly, this study can reverse the inherent pattern of taking cognitive ability as the most important predictor of students' academic performance by proposing that non-cognitive ability, including locus of control, is also of great value. In the future of family education instruction, parents and teachers should prioritize developing students' internal locus of control, which can help them develop strong motivation and positive self-efficacy for learning. Thirdly, although parental involvement can improve students' academic performance, this relationship is still moderated by family SES, especially for students with low family SES. This finding reminds us that in encouraging parental involvement in education, we need to prevent educational inequities that may result from family economics. Moreover, we should emphasize protecting the educational rights of disadvantaged students with low family SES.

Limitations and future directions

The following are the limitations of this study: Firstly, in order to minimize the workload of data collection and protect student privacy, the study chose to assess students' academic performance through students' self-reports. Although considered a convenient and accurate measure (Herrenkohl et al., 2009), this approach makes it difficult to analyze specific aspects of students' academic performance in depth. Second, we obtained the parental involvement, cognitive ability, and locus of control variables through a one-time survey without a multi-time-point sampling design, which may lead to a common method bias problem. Third, we only required that one of the child's guardians complete the parent questionnaire, without asking them to indicate their gender and role (father, mother or others). While asking parents to complete the questionnaire allowed for a holistic assessment of parental involvement in their children's education, it did not consider other control variables, for instance, the guardian's age and gender. Future research can distinguish the role of guardians, gender, age, and other basic variables to discuss parental involvement, and enrich the measurement content and methods of students' academic performance, cognitive ability, and non-cognitive ability. Other non-cognitive ability variables such as personality, self-efficacy, and motivation can also be examined to propose specific educational recommendations that can promote parental involvement and students' academic performance.

Conclusion

In conclusion, this study aimed to explore the correlation among parental involvement and students' academic performance. Our outcomes show that parental involvement can positively predict students' academic performance. School children of actively involved parents tend to have greater level of students' academic performance, while the school children of less involved parents are related to lower levels of students' academic performance. In addition, our findings emphasize the significant role of cognitive ability and locus of control in these relationships. Cognitive ability and locus of control mediate the connection among parental involvement and students' academic performance, and the mediating roles have no significant difference. Furthermore, we find that family SES positively moderate the impacts of parental involvement on students' cognitive ability and locus of control. This suggest that parents who have higher-family SES tend to promote more the development of school children' cognitive ability and locus of control than parents who have lower-family SES.

These findings suggest that we should pay attention not only to the impacts of parental involvement on students' academic performance, but also examine how enhancing students' cognitive abilities and locus of control can impact the aforementioned association. At the same time, we should view the effect of parental involvement and family SES from a systematic and interactive perspective, especially their impacts on students' cognitive and non-cognitive abilities in the interaction process. It is hoped that these findings will enable a better understanding of inequality in education from the perspective of parental involvement and therefore, help put in place more targeted and effective intervention measures, which can inspire researchers of family education in the future.

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Declarations

Ethic statement The studies involving human participants were reviewed and approved by Academic Ethical Group of The Faculty of Education, Soochow University. The participants provided their written informed consent to participate in this study.

Competing Interest The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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