

Socio-economic status and mathematics achievement in China: a review

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Abstract Mathematics education is a cultural-specific social activity. China, as a developing country with a long history and a unique culture, has the largest number of teachers and students in the world. Hence, it is of significance to explore the issue of the impact of socio-economic status (SES) on mathematics education within the Chinese context. However, investigations aiming to address this issue are relatively rare. This study was designed to examine the relationship between Chinese students' SES and their mathematics achievements. Results reveal that Chinese students' SES exerts significant influence on their mathematics achievements, and several important constituents of SES, such as parents' education and family income, stand out among others. In this paper, the cultural causes of the influence are discussed, together with a general introduction to the social and educational context. These could partly explain the empirical results, along with factors such as the values of education in traditional Chinese culture and the current important status of mathematics in modern society as well as Chinese school curriculum materials' effect on students' mathematics achievements. The economic and social situation in China, especially the imbalanced distribution of educational

resources between and within the urban and rural areas, could magnify the role of SES in mathematics achievements. Finally, the future direction of measuring and interpreting the SES's influence on mathematics achievement in the Chinese context is also discussed.

Keywords Socio-economic status · Mathematics achievement · Chinese culture

1 Introduction

It is commonly acknowledged that socio-economic status (SES) factors affect students' school mathematics achievement. However, the process by which these factors are interwoven to produce their effects is complex. In order to enact educational policy or guide instructional practice, more investigations are needed, such as which SES indicator, for example parents' education or family income, is the most dominant, whether the results are consistent across different cultural settings (i.e., West and East), how the mechanisms of these influences operate, and why the influences exist.

Why culture issues are central in this paper: Culturally based values might well be significant variables that complement cognitive and affective variables in regulating the extent to which students learn and perform in school mathematics, as well as in education more generally (Seah and Wong 2012); thus results from one cultural context should not be directly applied to another, especially when talking about transferring results between Western and Eastern cultures (Clarke et al. 2006). Different cultural settings provide somewhat different contexts for exploring the relationship between SES and achievement. The cultures of China and other East Asian countries are deeply

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rooted in Chinese culture, which is commonly referred to as the Confucian Heritage Culture Learning Phenomenon (Law et al. 2012; Wong 2004). Generally speaking, this includes China, Japan, Korea, and some other regions in Southeastern Asia that are believed to have been influenced by Confucianism (see Wong 2004). The international mathematics education community has a research tradition of connecting mathematics education with culture and this was illuminated in Bishop's (1988) work on analyzing mathematical visualization and cognition in Papua New Guinean culture. Culture as well as other background information could have great and direct effects on the quantitative results in empirical research and tracing the cultural cause of certain phenomena.

Why China is a country attracting attention: China is at a particular stage of development. In 2013, its gross domestic product (GDP) reached about 56.88 trillion Chinese yuan (9.17 trillion US dollars) with annual growth rate of 7.7%.¹ However, some social problems have emerged alongside such a fast growth of GDP, to be explored later.

In recent decades, the academic success of Asian students, especially in mathematics, has attracted the interests of sociologists, educationalists, and psychologists (Wong 2008). Scholars have investigated the relationship between their success and cultural factors (Leung 2008). Despite the impression that CHC (Confucian Heritage Culture) learners are brought up in an environment seemingly not conducive to learning, their academic performances have excelled in comparison to their Western counterparts (Fan and Zhu 2004). Considering the special cultural and social settings, it is worth discussing the relationship between SES and school mathematics achievement within the context of China.

What will be included in the paper: In the following sections, some research methodologies and statistical results for measuring the relationship between SES and mathematics achievement will be reviewed. In order to help the readers to make better sense of these studies, the Chinese cultural, social, and educational settings will first be introduced.

2 Chinese cultural, social, and (mathematics) educational settings

Several dilemmas need to be addressed when different cultural settings are selected to be considered in certain research (Clarke et al. 2012). As stated above, the context of China is essential in cross-cultural research. Therefore, in the following sections, culture, society, and mathematics education in China will be outlined.

2.1 Chinese culture

China is a country with an ancient history and continuous civilization (from about 2000 BC), and is very different from most other cultures in the world, especially from Western cultures.

Most social values in China can be derived from Confucianism, Taoism, Buddhism, etc. (Wong 2004). Confucianism valued the element of Ren (Humaneness), Yi (Righteousness or Justice), Li (Propriety or Etiquette), Zhi (Knowledge), and Xin (Honest integrity), as well as Zhong (Loyalty), Xiao (Filial piety), and Jie (Moral integrity) (Runes 1983), which also influenced other East Asian countries, such as Japan and Korea. Moreover, it was the official philosophy for about 2,000 years throughout most of imperial China's history. Meanwhile, a complete mastery of Confucian texts (the four books, the five classics, etc.) was required to succeed in Imperial Examinations (Keju). The national examination system dating back to the seventh century in Imperial China was designed to select the best potential candidates (especially important for the populace) to serve as administrative officials in the imperial bureaucracy (Liu 2007).

Chinese education has been traditionally influenced by Confucian values, which contribute to a specific belief system (Li 2004), hold education and learning in high regard, and value parental involvement in and commitment to the education of children (Wong et al. 2012). As a result, the traditional career system values education as appropriate preparation for promising jobs and happy lives, which also work as an external motivation for education (Leung 2001; Wong et al. 2012). The notion of "the examination culture" (Wong et al. 2012) reflects the important status of high-stakes examinations in China, such as the role of Keju policy in the change of social status, which implies a practical and even utilitarian purpose of education.

Chinese parents and students tend to attribute high achievement to hard work, rather than talent; they typically think that study is a serious endeavor and expect children to put in hard work and perseverance in their study (Leung 2001). Chinese students are likely to agree with their parents' high expectations. From a Confucian perspective, the major reason for the learner not achieving a desired learning outcome is his/her lack of effort (Wong 2004). Thus, for example, in the US context, American children might view mathematics as a relatively easy subject and believe that they have already met their parents' expectations, while Chinese American parents might respond by providing more formal learning support (Wang and Lin 2005).

Furthermore, Crystal and Stevenson (1991) found that Chinese parents tend to be more critical of and dissatisfied with their children's mathematics performance than American parents.

¹ http://www.stats.gov.cn/tjsj/zxfb/201401/t20140121_502731.html.

However, some scholars have mentioned that one should not ‘over-Confucianize’ (i.e., over-focus on Confucianism) the Chinese educational background, which turned to the identification of good practices (or even just practices) in other cultural origins (e.g., Daoism, Buddhism) (Wong 2004).

The research undertaken by Wang and Zhu (2009) indicated that Chinese urban families spend a high proportion of family income on their children’s education. However, in rural areas this has become a social problem as Chinese parents try their best to support their children in pursuing school study. For example, some poor families spend the majority of their income, or even get in debt, to make sure their children receive good education. Many families, especially those from a low socio-economic background, believe that “school education” is the only way to improve their current living conditions. They believe that if their children have education which leads to qualifications or professional status, they will have many more chances of getting good jobs and will have a high social status. Middle- and upper-class families share the same belief, while they enjoy the benefits from this education.

However, an alternative perspective, that of uselessness of study, has appeared recently, especially in rural areas (Hao 2009). Since the policy of increasing university enrolment was enacted in 1999, more and more students have had chance to enter university with the result that, in 2013, more than 7 million graduates swarmed into the job market. However, the number of jobs available is far from that needed to meet the employment needs. Consequently, the competition is very fierce and some graduates cannot even find a job, which means that for poor families their huge “investment” in education is lost (Hao 2009). As a result, more and more rural families do not support their children to continue their study, because of low family income and possible low economic return after their children’s graduation. This view does not conflict with traditional Chinese culture, because of the “practical and even utilitarian purpose of education.” It is obvious that Chinese people tend to choose to learn what will help them to get success in the society.

In terms of mathematics teaching and learning in China, there are differences between the past and the present. In ancient China, mathematics (even sciences) officially was not considered important and mathematicians (scientists) did not have a high social status. Chinese learners were engaged in Imperial Examinations (Keju) to become officials, which greatly influenced the East Asian world (Liu 2007). Though mathematics was not included in this examination system, there were numerous mathematical products contributed by folk mathematicians, such as *The Nine Chapters on the Mathematical Art*. Some achievements shown in that book were hundreds of years ahead of mathematical development elsewhere in the world. The

characteristics of Chinese mathematics valued the construction of knowledge of application (Liu 1997) and did not care about axioms, logic, and induction (Leung 2001). The role of mathematics in present Chinese school education will be introduced in the following subsection.

2.2 Chinese society, education, and mathematics education

The traditional cultural background shows that Chinese families would like to be involved in the education of their children, which implies a close relationship between SES and students’ achievement (including mathematics).

Mainland China is at a particular stage of development as the data indicated at the beginning of the paper showed. China is the world’s fastest growing economy. In 2013, its urban per capita disposable income and rural per capita disposable income reached 26,955 Chinese yuan and 8,896 Chinese yuan² respectively (six Chinese yuan roughly equal to one US dollar). This indicates that a large gap between urban and rural economic development still remains.

With unbalanced economic development of different areas of China (eastern versus western), some areas, especially rural areas, can only provide very poor educational possibilities for students (Ma 2006). Rural schools tend to lose their good teachers,³ and even do not have enough teachers to facilitate the teaching tasks. The two pictures taken by the first author in a western Chinese province are illustrative of the poor environment experienced by students when they go to school (Figs. 1, 2).

As is seen in Fig. 1, some students have to walk on a country road to school every day. In such a harsh environment, students need to get up as early as 4:00 a.m. to ensure that they arrive at school on time. Figure 2 shows the harsh living conditions of the students in Fig. 1. Moreover, there are usually insufficient qualified teachers in these schools. For example, some teachers have weak subject knowledge in mathematics and cannot use information technology, let alone gain access to the latest teaching materials and methods.

It should be noted that the unbalanced development of the economy might magnify the role of SES in educational activity. The unbalanced distribution of educational resources exists not only between the rural and the urban areas, but also within them. The issue of equity has been recently discussed frequently not only in academia but also in the media. In spring admissions, the problem of “school-selection” has been a headline of most mainstream media in recent years. The distribution of schools is not equivalent, even in well-

² http://www.stats.gov.cn/tjsj/zxfb/201401/t20140120_502082.html.

³ http://paper.jyb.cn/zgjyb/html/2013-09/08/content_172658.htm?div=-1.



Fig. 1 A long way to school



Fig. 2 The students' dormitory

developed big cities. It can be seen that students and parents choose a primary school and middle school not following the national educational policy stating that children should put the school located near their home as the first choice. Especially those parents who are rich or have a high social status prefer to spend extra money in order to choose schools for their children which have a good reputation (Wen 2005). Many schools (at compulsory education level, especially the middle schools) recruit students based on the results of some special examinations such as the Mathematical Olympiad, the content of which is usually not included in the public school curriculum. Since the children of more well-off parents receive much more tutoring or outside-school education (including private tutors), their chances of having a high social status are much greater than those of poor children. Social authority and class should not be ignored in considering the factors of SES (Wen 2005). Here we have a mechanism which explains the relation between SES and

mathematics achievement (at compulsory education level): “powerful parents” help children receive better education (primary education and outside-school education), get higher scores (especially better Mathematical Olympiad results), and receive public middle school education resource of high quality. All these help students to get a good mathematics achievement, which in turn helps them to get enrolled in high quality middle schools and then get a better mathematics achievement there.

Thus this unbalanced distribution of educational resource means that SES plays an important role in obtaining high quality education and then in high students' learning achievement (including in mathematics).

Mathematics is in a different situation currently compared with its situation in ancient China (Leung 2001), with the modernization of society impacted by Western culture. It is now one of the most important subjects in school (a compulsory subject for grades 1–12), which is typical in Western mathematics education systems. This situation can be traced back to the importation of the former Soviet Union educational system when the People's Republic of China was founded in the 1950s. Mathematics teachers often have a high status compared with their colleagues.⁴ Nowadays, the academic selection function of mathematics (in school recruitment) plays a very important role in high-stakes examinations. The mathematics curriculum was the first to be reformed at the beginning of the twenty-first century in mainland China (Liu et al. 2014). Under pressure, Chinese families spend large human and economic resources on children's mathematics learning, such as buying learning materials, hiring private tutors, and supporting outside-school learning. Thus the important status of mathematics and the families' attention on mathematics contributes to a close link between SES and mathematics achievement. However, the significant change compared with the situation of mathematics in ancient China may not come from the view of mathematics in Chinese parents and teachers, but rather from the Keju policy to present school recruitment policies (in which mathematics is essential for nearly all the different schools' recruitment) which follow the “practical and even utilitarian purpose of education” mentioned above.

2.3 Summary

This overview of Chinese culture and social situation shows how different these are from other cultures. Education has been emphasized by society and individuals (for its “practical and even utilitarian purpose”), both in ancient and current times, and mathematics has become one of the most important subjects valued by families and schools. An unbalanced distribution of educational resource usually

⁴ Teachers teach a single subject in mainland China.

appears at a certain stage of development in a country, with the family factor significantly influencing the possession of educational resource for learning mathematics in both rural and urban areas. Families have both internal and external motivation to “win” the education resource of learning mathematics for their children, and help their children to reach a high achievement in mathematics.

It can be concluded that SES plays an important and special role in students’ mathematics learning. Meanwhile, the cultural background helps to explain the empirical research results. The following paragraphs will review the existing studies on the issues of socio-economic background and mathematics achievement and then discuss these results within Chinese culture.

3 Review of results from empirical research

The aim of this review is to answer the question: What are the characteristics of socio-economic status and students’ mathematics achievement in China? The review draws on data from key journals published both in China and overseas. The intention was to analyze a number of measurements that derived from the research aiming to examine what, why, how, and under what conditions socio-

economic status has affected students’ mathematical achievements. Surprisingly little research has been published in the field of mathematical education specifically, though much relevant work has been published in the area of psychology and some in general education areas (educational and economic policies).

Why these papers were included: To be included in this review, a study had to satisfy the following criteria: (i) applying a measure of SES and mathematics achievement; (ii) reporting quantitative data based on sufficient statistical details for calculation of correlations between SES and mathematics achievement; (iii) choosing articles from professional journals or reports; (iv) including sample students in mainland China. Papers explaining the statistical results within Chinese culture were also valued. Based on these criteria, 19 studies were selected. These show that, although the number of the published papers on this issue in China is not abundant, there is an increasing amount of empirical research in education and psychology that suggests that SES plays a key role in students’ academic development in general and mathematics achievement in particular (e.g., Hu and Du 2009; Shi and Shen 2007; Sun et al. 2009; Xue and Min 2008). The effect of this relationship can be seen on students from infancy to adolescence, and on different constituents of SES. More details can be seen in Table 1.

Table 1 Summary of the independent samples

References	Grade/school level	SES measure	Findings
Xiao et al. (2009)	Grade 1	Mother’s educational level, father’s occupation, family income	High SES > low SES
Huang and Cheng (2011)	Kindergarten (age 4–6 years)	Parental education	Significant
Zhang et al. (2005)	Age 4 years	Mother’s education level, and family income	Significant
Li et al. (2011)	Grade 5	Parental education, occupation, and family income	Significant
Li (2011)	Grade 5	Parental education, occupation, and family income	Significant
Ren and Xin (2013)	Grades 4–6	Family resources	Significant
Pang et al. (2013)	Grade 9	Parental education, learning materials, book storage	Significant
Ren (2010)	Grade 4	Parental education, occupation, family income	Significant
Cheng et al. (2012)	Grades 4 and 8	Mother’s educational level	Significant
Sun et al. (2009)	Age 9–12 years, primary school	Parental education, family income	Significant
Xue and Min (2008)	Junior high school	Parental education, family income	Significant
Xie and Du (2009)	Junior high school	Parental education, family income	Significant
Hu and Du (2009)	Grade 6	Parental education, family income	Significant
Yu and Wen (2005)	NA	Parental education	Significant
Wen (2005)	Undergraduate	Father’s occupation and educational level	Significant
Wu (2007)	Age 6–18 years	Father’s education and occupation	Significant
Ding and Xue (2009)	Grade 12	Father’s education, family income, reading materials	Not significant
Tao and Yang (2007)	Grade 11	Father’s occupation and educational level, family income	Not significant
Pan and Du (2008)	Grade 9	Parental education and occupation	Not significant

NA information not available

It can be seen that although SES has been the research topic of these reviewed papers, there still is an inconsistency concerning its empirical measurement. Many researchers defined SES using three main indicators: parental income, parental education, and parental occupation (e.g., Li et al. 2011). Family resources, as another indicator, were also used in some of the studies (e.g., Ren and Xin 2013). These variables were so important that they also attracted attention from the international community (Valero et al. 2012), indicating that these researchers tend to use internationally universal structures of SES to analyze Chinese data, meaning that some important variables in Chinese culture are not included, such as parents' social authority (whether the father was an official or not).

Generalization: Family SES is significant in determining students' academic development. According to Li (2003) and Wu (2007), over the last decades the effect of family SES on students' school enrolment has increased. This is not a surprising finding in the Chinese context as discussed in Sect. 2. Children of rural household registration (*hukou*⁵) status become more disadvantaged compared with their urban counterparts. Moreover, SES also appears to affect the quality of students' schools. It is possible that children with high socio-economic status could receive high quality education through entering into a better kindergarten, primary school, even high school (Pang et al. 2013; Xiao et al. 2009).

For the concrete constituents of SES: Based on a national survey, Wen (2005) also found a positive correlation between fathers' SES (including education, career, etc.) and their children's results in the national college entrance exam as well as the levels and types of higher education institution in which they finally studied. It can be explained that fathers' SES determines the family's SES to a great extent, not only because fathers earn more money for the family, but also because fathers' social relationships (e.g. friend, kindred) or social authority determine the whole family's status in a community. These factors are vital in benefiting from the unbalanced distributed educational resource in China. Also, Cheng et al. (2012) reported that students had higher participation in and more positive attitudes towards private mathematics tutoring if their mothers had a better educational background, which was considered to further positively affect students' mathematics achievement. In some (rural) families, grandparents might take the responsibility to care for children's education, while parents tend to undertake tasks (called peasant-worker) in major cities to earn more money.

For students of different ages: The influence of SES in these studies affected achievement at different ages, but especially for primary school students. The impact of SES seemed to affect even preschool children's achievement. The

studies showed that family SES affects children's mathematics learning, through variables such as home experience of learning mathematics, mathematics for school readiness, and cognitive development in mathematics. Specifically, parents of high income and educational background engage more in mathematics activities with their children, and they are more inclined to use scaffolding dialogue, demonstration, and games to support their children's mathematics learning (Huang and Cheng 2011). Xiao and her colleagues investigated 143 children (mean age = 6.63 years) and found that the performance of children from a high-SES family was much better on the concepts of category, number and operation, time and space, as well as statistics, than their peers from low-SES families (Xiao et al. 2009). Likewise, employing "The Child Math Assessment" (Klein et al. 1998), Zhang et al. (2005) reported significant correlation between children's SES and mathematical development in terms of number and operation, geometry, measurement, and algebra. A longitudinal study, by Ni et al. (2009), investigated 3,415 fifth grade students of two districts in a central city in mainland China. The results showed that family SES measured through the family's income, parental education, and occupational status had a positive correlation with not only the development of students' cognitive ability, such as skills in mathematics calculation, mathematical explanation, and communication, but also the development of the students' affect and interest in and dispositions towards learning mathematics (Li 2011). Students from high socio-economic status families showed more interest in learning mathematics, and they were more likely to participate in classroom discourse. These results support the findings that students' attitude towards learning mathematics was associated positively with parental occupation and family income in Ren's (2010) study. Another longitudinal study was carried out by Ren and Xin (2013). In their study, 1,234 grade 4 students were involved and the measurement of students' mathematics achievement was conducted on six occasions from grade 4 to grade 6, over a period of 3 years. They found that SES, measured by the index of family capital such as learning and living facilities, significantly predicted students' mathematics performance in their final examination at the end of the semester. What is more, with an increase in age, the association between SES and students' academic achievement demonstrated a stable pattern. Besides, it was found that the variance of the performance was the greatest in the group of students who came from low socio-economic families from the beginning to the end. Variance was relatively smaller among moderate and high-SES students. As discussed in Sect. 2, one partial explanation could be that family SES could help students to enter into high quality primary schools in China. Based on a sample of 5,066 students of grade 9 (middle school level) from 5 cities across China, Ren and his colleagues examined the impact of family

⁵ http://en.wikipedia.org/wiki/Hukou_system.

SES on students' mathematics achievement using PISA testing tool and found that mothers' education was more important than fathers' education (Pang et al. 2013; Ren et al. 2012).

For the mechanism of the impact: There has been relatively little research on the mechanism that produces this kind of link between SES and mathematics achievement. Huang and Cheng (2011) and Zhang et al. (2005) found that parents' education level, as the index of SES, influenced the home cultural/ecological environment and led to positive outcomes for children. Therefore, the home cultural/ecological environment not only refers to stimulating materials and experience such as toys, games, reading materials, and parent-child interaction, but also to parental cognition (e.g., belief, expectation, and judgment) of children's development and mathematics learning and teaching.

High-SES parents held beliefs and evaluations that were closer than their low-SES counterparts to the actual performance of their children. Low-SES families instead had over-high or over-low expectations and evaluations that did not correlate well with their children's actual performance. According to Alexander et al. (1994), parents' abilities to form accurate beliefs and expectations regarding their children's performance are essential in structuring the home and educational environment so that they can excel in post-schooling endeavors. Parental involvement and commitment to the education of children in Chinese traditional culture discussed above might partly explain why parents' belief correlates with students' achievement. Because parents tended to get involved in their children's education, their belief could make a difference.

Additionally, the use of a specific curriculum was observed to be a moderator of the impact of socio-economic status and the development of different aspects of students' mathematics achievement (Li et al. 2011). Specifically, results demonstrated that the gap between low- and high-SES students in terms of the measure of calculations and routine mathematics problem solving narrowed, especially for students who used the conventional curriculum. At the same time, the trend of narrowing achievement gap on the measurement of complex problem solving, which required students to show their solution processes and to provide justifications for their answers, was only found in the group of the students who used the reform-based curriculum (Li et al. 2011). Researchers explained that different emphases of the two curricula presumably account for the results. Specifically, the emphasis in the conventional curriculum is more on computation and connections within mathematical strands while the reformed curriculum attached more importance to problem solving and multiple solutions, leaving more

space for students to manipulate, discuss, and cooperate with peers in practice (Shi 2009). Through these results, the impact of SES was complex within different curriculum backgrounds and different kinds of learning tasks. Therefore, more qualitative studies are needed to explore the mechanism behind SES and students' achievement.

4 Discussion and future directions

The literature discussed above contributes to understanding the link between SES and student mathematics achievement in the context of China.

Generally speaking, as shown in Table 1, the existing empirical research reflects that SES significantly affects Chinese students' mathematics achievement. The influence was found in different school levels, with more evidence being found in primary schools and middle schools. Several internationally utilized indexes of SES were examined, such as parents' education, family income, etc. Some research discussed the mechanism of the influence, such as the role of curriculum as a mediator to reduce the impact of SES.

It is not surprising to find these significant statistical results, since similar findings are found in international research, such as research using TIMSS data (Lamb and Fullarton 2002). However, the mechanism behind quantitative results could be quite different in various cultural contexts. As discussed in Sects. 2 and 3, the cultural and social roots of these influences were traced. The tradition of valuing education in Chinese culture, and the current important status of mathematics in modern society, as well as the Chinese school curriculum, constitute the potential of the effect of SES on students' mathematics achievement. Chinese parents are eager to be involved with students' learning of mathematics. Their expectation and belief, as well as their mathematical knowledge, could act on students' mathematical learning and in turn act on students' achievement. The Chinese economic and social situation, especially the unbalanced distribution of educational resources between and within the urban and rural areas, and SES-related opportunities to gain access to these resources, could magnify the potential of the effect of SES on mathematics achievement. The families with high SES (including the rich families as well as the families with social authority) are eager to use their energy to get better educational resources for their children. The following situation is very popular in China. Some students get the "First Cause"⁶ with the help of their families' power

⁶ First Cause is term introduced by Aristotle and used in philosophy and theology. Aristotle noted that things in nature are caused and that these causes in nature exist in a chain, stretching backward.

through studying in a better primary or secondary school. At the same time, these students usually spend weekends attending private tutorials to learn some advanced mathematics knowledge (such as for the Mathematical Olympiad). The majority of the students who attend private tutoring come from relatively rich families. Thus, it appears to be common that those who have a better chance of getting better mathematics achievement are those from parents holding high social and economic power. Since they are able to spend much more time and money on studying, they have greater chance to obtain better mathematics achievement. Therefore, their chance to win in the competitiveness to enter high quality schools or universities is also greater. It can be concluded that parents' social and economic power as well as academic ability could work in favor of their children throughout the education cycle.

For the future, more research is still needed with regard to the following aspects. Firstly, it can be seen that most of the studies focused on students' cognitive learning outcomes, and the affective outcomes such as interest and dispositions towards learning are not considered. This is problematic because it is clear that both cognitive and motivational factors are relevant to successful learning and, thus, further research on SES needs to look into its effect on affective outcomes of learning as well (Brown 1992). Also, the indicator of student achievement is typically a unidimensional testing score (usually a natural number from 1 to 100), which is not enough to represent students' true achievement (especially the acquisition of powerful mathematical ideas). Shavelson et al. (1986) argued that the standard achievement data used in process-product research may have a quality problem, and they called for the application of cognitive psychology and psychometrics.

Secondly, the existing research typically explored different aspects of SES separately. Thus they used family income, parents' education, etc. as independent variables and did not identify the relationships among these aspects. These variables are likely to intersect (Valero et al. 2012); for example, there is likely to be interaction between family income and father's education or occupation.

Additionally, a variety of mechanisms linking SES to student achievement have been proposed, such as social causation and social selection (Bradley and Corwyn 2002; Conger and Donnellan 2007). Social causation arguments suggest that SES affects families and the development of children in terms of both family stress processes (a framework that links socio-economic disadvantage to a family stress process that increases parents' emotional distress and jeopardizes the development of children) and family investments in children (an explanatory framework that links parents' socio-economic advantage to children's physical, emotional, cognitive, and social well-being). The

social selection perspective proposes that the traits and dispositions of parents influence their social status and the development of their children (e.g., Mayer 1997). Currently, most of the studies, such as the ones included in this review, have been conducted from the social causation perspective. More such empirical studies of various perspectives are needed to understand the process of the impact of SES on student learning, especially in China. More attention should be paid to cultural-specific research design in future studies, for example including some Chinese-cultural-specific indicator of SES: Wen (2005) argued that since the social relationship was valued in China, the SES of families' social relations (kinsfolk or friend) should be included in relative researches. As discussed in Sect. 3, a specific SES variable schema with a Chinese background is needed, such as social authority of families for example.

Finally, it is generally acknowledged that SES operates at multiple levels to affect student learning (e.g., Caldas and Bankston 1999; Leventhal and Brooks-Gunn 2000). According to Sirin (2005), the impact of family SES varies among individuals depending on where they live and the cohort with whom they go to school. Hence, it is also important to consider the other levels of SES such as school SES in the future.

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