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NEWSLETTER

Explore the Relationship between the Duration of Using Internet Learning Environment and Physical Health of Elementary and Middle School Students

By Jing Gao, Jing Liu, Hong Feng, Zhixin Zhang

IN order to explore the effects of the duration of using internet learning environment each week on the physical health of elementary and middle school students, a study published in *Modern Educational Technology* selects 783 elementary and middle school students in Beijing and Shandong Province for a one-year follow-up investigation. The students are divided into 21 experimental groups using the online learning environment for more than one semester and a control group that does not use the online learning environment, and the health status of the students is measured from four aspects of sight, respiratory rate, body mass index, and sit and reach. Through covariance analysis, the following conclusions are drawn:

- On the whole, the duration of using Internet learning environment each week has a significant effect on elementary and middle school students' sight, while it has no significant effect on respiratory rate, body mass index, and sit and reach. According to the detailed analysis of the duration of using Internet learning environment, we can know that elementary and middle school students should limit the time spent using the online learning environment to less than 1.5 hours each day.
- In terms of genders, the duration of using Internet learning environment each week significantly affects the sight of girls' right and left eyes, but only significantly affects the sight of boys' left eye. It can be seen that girls' sight is more sensitive than boys'. There are no significant differences in respiratory rate, body mass index and sit and reach.
- In terms of grades, the duration of using Internet learning environment each week has a significant effect on the sight of the right and left eyes of elementary school students, but only has a significant effect on the sight of the left eye of junior high school students, indicating that the sight of elementary school students is more sensitive than that of junior high school students. And the body mass index of junior high school students is more affected by the duration of using Internet learning environment each week than that of elementary

school students. There is no significant difference between respiratory rate and sit and reach.

Based on the research conclusions, the study suggests that schools, teachers and parents should cooperate to create a good online learning environment for students, and it proposes that the duration of using Internet learning environment each day by elementary and middle school students should be controlled at less than 1.5 hours.

Source: Modern Educational Technology, 2019; 29 (3): 59-64.

NEWSLETTER

Sexual Abuse Prevention Education for Preschoolers: Still Terrified at the Topic of Sex?

By Wenjing Zhang, Lifang Deng

A STUDY published in *Studies in Preschool Education* focuses on sexual assault in early childhood, seeking to explore the importance and effectiveness of preventive education in early childhood. The study uses the quasi-experimental design, and What If Situations Test and Personal Safety Questionnaire are taken to experiment. The Body Safe Training is selected and revised as the course material. After obtaining the consent and cooperation of the two kindergartens, 291 parents are issued with informed consent. In the end, a total of 92 children complete five educational intervention lessons and participate in the pre-test, post-test and follow-up tests. The study uses multivariate covariance analysis and repeated measures covariance analysis to explore the necessity of Chinese children to receive preventive sexual assault education.

The main conclusions are as follows:

- Children in the education group learn some important knowledge about sexual assault prevention. A higher proportion of children can identify sexual assault situations and know how to use a series of self-protection functions. These effects are maintained for three to five months.
- As long as the content and methods of education conform to the characteristics of children's physical and mental development, children can also learn simple knowledge and skills of preventive assault. The Body Safe Training adapted from Chinese culture and tradition adopted in this study is lively, specific and filled with games.
- Good anti-sexual assault education for children can increase children's perception of potential sexual assault situations, improve the level of anti-sexual assault skills, develop the habit of self-protection, and reduce the rate of abuse and recurrence. At the same time, the concept of "children are not wrong" in education can help children get out of the shadow of sexual assault faster and restore physical and mental health.

In order to help children get better anti-sexual education, the researchers put forward suggestions for parents, teachers and related education fields as such four aspects: identify and circumvent existing misunderstandings about

child sexual abuse; master relevant knowledge and skills; provide teacher training and courses on the prevention of child sexual abuse; improve the knowledge and methods needed for family prevention education.

Source: Studies in Preschool Education, 2019; 292(4): 45-56.

NEWSLETTER

ICT and Students' Sense of Well-Being: Characteristics and Inspiration

By Guiling Liu, Haiyan Zheng, Jieyan Zhang

ICT is short for Information and Communication Technology. A study published in *Guang Dong Education*, based on the data of PISA2015 student questionnaire, analyzes the characteristics of ICT use among middle school students and the relationship between ICT and students' sense of well-being. The provinces and cities that represent China are Beijing, Shanghai, Jiangsu and Guangdong. The data involves ICT resources, online time and online attitude of 15-year-old students. The results are as follows:

- The data of PISA2015 on students' attitudes towards using the Internet shows that more than 50% of students think it would be hard to live without the Internet and more than 70% of students regard the Internet as a tool to obtain information. ICT is becoming an indispensable tool for middle school students. Male and female students have different attitudes towards the Internet, and so do advantaged and disadvantaged students.
- In terms of duration of Internet use, descriptive statistics show that students from China, South Korea and Japan spend less time online than those in OECD countries. Students in Brazil and Britain spend the most time online at school and on weekends respectively, while higher proportion of students in China and South Korea never use the Internet.
- In terms of using ICT for entertainment and learning, boys and girls have different choices in entertainment activities. Taking China as an example, boys account for a higher proportion than girls in all kinds of entertainment activities.

The results of the analysis of relationship between students' sense of well-being and ICT are as follows:

- Among the countries and regions compared, except the United States, Brazil and Russia whose students' life satisfaction is higher than the average level of OECD, students' life satisfaction in other countries is lower. South Korean students are the most dissatisfied with their lives.

- Descriptive statistics show that the overuse of the Internet will have a negative impact on students' life satisfaction, but this effect is not obvious in China.
- In terms of scientific performance, the overuse of the Internet will affect students' scientific performance, which is most obvious in Chinese students.
- In addition, the data shows that students who spend too much time on the Internet are more likely to have a lower sense of belonging in school and a lower expectation for further study.

The study points out the advantages and disadvantages of the use of ICT in students in several aspects, although the cause-effect relation between the related performance like students' sense of well-being and ICT couldn't be proven, this data research is enough to reflect the correlation between the use of ICT and students' development. It also provides a certain reference for the current ICT resources distribution, information technology education and curriculum reform.

Source: Guangdong Education, 2019; 5: 34-37.

NEWSLETTER

Research on the Influence Mechanism of In-depth Learning Thinking in Internet Vision-Based on Information Literacy Mediating Effect Test

By Xing Wei, Jinjie Zhu

DOMINATED by active inquiry, meaning construction and critical reflection, in-depth learning is a kind of learning way which pays attention to understanding and meaning, emphasizing active learning and innovation. This method of learning has gradually become an essential ability of students qualified for contemporary life.

A recent report published in *Open Education Research* conducted an empirical study on the in-depth learning of 626 graduate students in a university in Beijing in the Internet environment through interviews and questionnaires. Research team explores whether learning styles in the traditional teaching environment can influence learning thinking in the Internet environment. They focus on the impact of information literacy (the ability to retrieve, evaluate, and effectively use information) on learning thinking in the Internet environment and its role in the learning transfer of traditional teaching models and the Internet environment. Results are as follows.

- The learning style in the traditional teaching environment has a significant positive impact on the learning thinking in the Internet environment. That is to say, the in-depth learning of the traditional teaching environment can more clearly predict the in-depth learning thinking of the Internet environment, and the shallow learning of the traditional teaching environment can also predict the surface learning thinking of the Internet environment more clearly.
- Information literacy can significantly affect the learning thinking of the Internet environment. The speed, breadth, accuracy, and ability to select, judge, and link information for students have an important impact on learners' knowledge networks and levels of thinking.
- Information literacy can play a mediating role between the traditional environment and the in-depth learning thinking of the Internet environment. A series of actions, such as screening, judging and linking information, connect learners and the environment throughout the traditional teaching environment and the Internet environment.

The theoretical contribution of the research is to expand the applicable context of the in-depth learning influence mechanism, and introduce the the-

ory of learning transfer, relevance and information processing theory to add theoretical explanation for the empirical study of in-depth learning thinking. At the same time, the study also enlightens teachers to focus on cultivating students' information literacy in the process of education to enhance their in-depth learning ability in the network.

Source: Open Education Research, 2019; 25(1): 73-81.

NEWSLETTER

The Impact of Health on Children's Cognitive Ability- A Comparative Analysis of Family and Urban and Rural Areas Based on a National Survey

By Ji Shen

AN article recently published in *Youth Research* explores the reward effect of health cognition and the effect regarding the influence of family resources on cognition between urban areas and rural areas. The study raises two questions: First, as for children's health cognitive rewards, resource-substitution theory or resource-reinforcement theory which can better explain the reality of Chinese society? Next, regarding the differences in health cognitive rewards between urban and rural children, in addition to the impact of urban and rural areas, is there any impact of other family resources in the process of cognitive acquisition? And, do these family resources "replace" or "strengthen" the role of health in cognition? And for each question the author proposes a pair of competitive hypotheses. Based on the data from "China Urbanization and Children Development Survey" conducted by Tsinghua University in 2012, the paper uses the propensity weighting method to deal with selective bias, and then makes analysis, and comes to the following conclusions:

- Regarding the cognitive ability in Chinese, the rural children's health cognition rewards are significantly greater than the urban children, but no matter in urban or rural areas, the influence of health on children's cognitive ability in Chinese could be replaced by other family resources.
- Regarding the cognitive ability in mathematics, there is no significant difference in health cognition rewards between rural and urban children; but regarding the children in rural areas, the influence of health on cognition could not be replaced by other family resources, while regarding the children in urban areas, this kind of influence could be only replaced by family socioeconomic capital.

Based on the research findings, the author suggests that in order to improve the development of rural children's cognitive development, one hand we should enlarge the investment in rural public health and preschool education, on the other hand we should also pay attention to cultivate family parenting strategies so that reduce the urban-rural differences in health and family resources.

Source: Youth Research, 2019; 42(2): 14-26+94.

NEWSLETTER

The Influence of Parental Psychological Control on Adolescent Depression: A Multiple Mediation Model

By Ling Sun, Yulan Li, Xuexiang Ma, Zhongfang Fu

A STUDY published in *Studies in Chinese Journal of Special Education* examines the influence of parental psychological control on adolescent depression, as well as the multiple mediating effects of negative cognitive emotion regulation strategies and self-esteem between paternal psychological control and adolescent depression. It has innovatively realized the development from single mediating model to multiple mediating model, which is more instructive for solving practical problems.

In this study, 798 students from a high school in Tianjin are tested by using cluster sampling method, with Chinese-version scale for parental psychological control, the questionnaire for cognitive emotion regulation, the Rosenberg Self-Esteem Scale, and the Center for Epidemiologic Studies Depression Scale.

In this research, the common method bias test is performed by using the Harman single factor test. The Pearson correlation analysis is carried out for each variable. The variance maximum likelihood method and the Bootstrap test were used to verify that the multiple mediation model can better explain the influence of parental psychological control on adolescent depression. The research also further uses the Process procedure for the Bootstrap test to clarify the direct and indirect effects of parental psychological control on depression.

The research findings are as follows:

- Parental psychological control has a direct predictive effect on adolescent depression. The stronger the parental psychological control, the more severe the depressive symptoms of adolescents.
- Negative cognitive emotion regulation strategies and self-esteem play a chained multiple intermediary role in the relationship between parental psychological control and depression. Negative cognitive emotion regulation strategy is the first intermediary, and self-esteem is the second intermediary.

Based on these, the researchers suggest:

- Adolescent mental health education needs to focus on adolescent emotional regulation strategies.

- Individual intervention should be considered in combination with family intervention to effectively reduce parental psychological control.
- Parents should give psychological education about depression to their children and try to understand more positive cognitive and emotional regulation strategies, so as to improve the family's view of depression and form a healthy family environment.

Source: Chinese Journal of Special Education, 2019; 225(3): 76-82.

NEWSLETTER

Victimization Patterns of School Bullying Among Adolescents in China

By Jiashu Xie, Yumin Wei, Zhuorong Zhu

A STUDY published in *Psychological Development and Education* explores the different victimization patterns of bullying and their demographic characteristics among Chinese adolescents by studying the common characteristics of four common types of bullying (verbal bullying, physical bullying, relationship bullying and cyber bullying). Based on the characteristics of the internal heterogeneity of the victims of bullying, the paper further explores the introversion (depression, anxiety) and differences of different bullying victims.

The research team used the Delaware Bullying Victimization Scale, Patient Health Questionnaire Depression Scale and Co-occurrence Anxiety Scale to investigate 3,761 middle school students in 20 middle schools in Hunan. The following conclusions are drawn from the analysis of the data:

- Among the victimization of school bullying, four common types of bullying are co-occurrence, and there are four typical victimization patterns of school bullying: an all-types (traditional and cyber) bullying victimization class (1.5%), a traditional victimization class (3.9%), and a mild traditional victimization class (14.9%) and non-victimization class (79.6%). Traditional bullying victimization refers to the case where an individual subject to verbal bullying, physical bullying, relationship bullying or the combo.
- Verbal bullying is the most common form of bullying, and most victims of cyber bullying are also victims of traditional bullying. Different demographic characteristics such as gender, grade level, school location, and academic achievement will affect the bullying mode. Among them, male students, students from junior high school, lower grade, or rural school, and students with poor self-assessment are more likely to be bullied.
- The more types and frequency of bullying suffered by bullying victims, the higher the level of depression and anxiety. Even the mild traditional bullying will have a more serious negative impact on the individual's mental health.

Combating bullying in schools requires not only policy support, but also teachers and parents preventing it in daily life. All we should maintain a “zero tolerance” attitude towards bullying.

Source: Psychological Development and Education, 2019; 35(1): 95-102.

NEWSLETTER

The Effect of Maternal Depression on Preschooler's Problem Behaviors: Mediating Effects of Maternal and Paternal Parenting Stress

By Xinyu Ma, Fumei Chen, Xin Xuan, Yun Wang, Yanfang Li

A STUDY published in *Psychological Development and Education* explores the role of parental stress in maternal depression and internal and external problem behaviors in preschoolers. 2,222 preschool children aged 3-5 and their parents from 75 kindergartens in a district of Beijing are selected as subjects in this study. The Center for Epidemiologic Studies Depression Scale, Parental Stress Scale and Behavior Questions for Preschoolers are used to investigate the depression of mothers, parental stress and children's problematic behavior. The results show that:

- Mother's depression indirectly affects father's parenting stress by affecting mother's parenting stress, that is, mother's parenting stress is a mediating variable between mother's depression and father's parenting stress.
- Parental stress partially mediates the role of maternal depression in children's internal problem behaviors. The mediating role is realized through two paths: maternal depression → maternal parenting stress → children's internal problem behaviors and maternal depression → maternal parenting stress → father parenting stress → children's internal problem behaviors.
- Parental stress completely mediates the effect of maternal depression on children's external problem behavior. The mediating effect is realized through two paths: maternal depression → maternal parenting stress → children's external problem behavior and maternal depression → maternal parenting stress → father parenting stress → children's external problem behavior.

The author finds that parental stress is an important factor for mother depression to play a role in children, which provides a new perspective for the future intervention of the negative role of mother depression and the promotion of children's development. In addition, the author also pays attention to the parental stress of mothers and fathers, and finds that the parental stress of fathers not only directly affects the development of children, but also mediates the effects of mothers' depression and parental stress on children, which reveals the importance of fathers' parenting stress. It is hoped that through this study, researchers will pay more attention to the role of fathers.

Source: Psychological Development and Education, 2019; 35:103-111.

NEWSLETTER

Can Augmented Reality Promote Learning? – A Meta-analysis Based on 35 Studies Published in International English Journals from 2010 to 2018

By Huiwen Ni, Yongbin Hu

AN article published in *Open Education Research* explores the influence of Augmented Reality (AR) on academic performance and the differences in adjusting variables such as learning period, class size, discipline, learning situation, duration of experimental intervention, etc. By adopting the meta-analysis method, 35 English literatures published in international journals from 2010 to 2018 are quantitatively analyzed to explore the influence of AR on academic performance. The study finds that:

- AR has a moderate positive impact on the overall academic performance.
- From the perspective of learning period, AR has a relatively high impact on the academic performance of high school students.
- From the perspective of class size, AR improves the academic performance of both large and small classes at a medium level.
- From the perspective of disciplines, AR exerts a moderate influence on most disciplines, such as science, physics, astronomy, architecture and biomedicine, however, its application effect in mathematics is poor.
- From the perspective of learning situation, AR has a moderate influence on indoor learning and outdoor learning.
- From the perspective of the duration of experimental intervention, AR has the most significant effect on the improvement of academic performance when the duration of experimental intervention is controlled within one day.

Therefore, the author puts forward some suggestions: accelerate the application of AR technology in education and teaching; make full use of AR to connect indoor learning and outdoor learning; develop and apply the knowledge-centered AR resources at the same time; promote the integration of AR and disciplinary development on the base of disciplines characteristics.

Source: Open Education Research, 2019; 25(1): 62-72.

NEWSLETTER

Paths of Teacher's Growth Behavior of Knowledge Discovery Based on Big Data

By Lu Wang, Le Peng, Ruxia Ma, Jiachen Yang

A STUDY published in journal of *E-Education Research* focuses on the growth behavior of teachers, trying to explore the shortcut of teacher professional development.

Based on the experiential learning circle theory proposed by Kolb as well as the three key points of online learning, knowledge construction and reflective practice, researchers construct a multi-path triple cycle model of teacher growth behavior path, and explore the path using structural equation model according to the big data from 95 teachers from seven schools in Xiamen, Fujian (classroom teaching behavior big data, practical knowledge big data and online Learning behavior big data).

The main conclusions are as follows:

- There are indeed shortcuts to teacher professional development, namely the seven typical teacher growth behavior paths found in this study. The model includes three cognitive orientations, which reflect that teachers' teaching behavior is directly influenced by their practical knowledge and indirectly influenced by online learning behavior. The four practice-oriented teacher growth path models reflect that teachers' online learning behavior is directly influenced by their practical knowledge and indirectly influenced by classroom teaching behavior.
- Practical knowledge is an important mediating variable in teachers' growth behavior path, among which teachers' educational belief, strategic knowledge, situational knowledge and reflective knowledge are the most important mediating variables.

Based on this, the researcher proposes that: the network study designer should focus on three types of informal learning activities based on cognitive telepresence, including design inquiry, induction and summary and application, in order to promote the improvement of teachers' practical knowledge level and classroom teaching behavior. Front-line teachers should improve classroom teaching behavior from the four aspects of question design, rational answer mode, response mode and teaching intervention, in order to promote the improvement of teachers' practical knowledge level and improve

the sense of presence in network research activities and improve the quality of online learning.

Source: E-Education Research, 2019; 40(1): 95-103.

Can Information Technology Promote Academic Performance of School-aged Children? An Empirical Study Based on CEPS

Chao Fang, Bin Huang

Nanjing University of Finance and Economics, Nanjing, China

Abstract. It is inconclusive whether the information technology can promote academic performance of school-aged children. Based on the China Education Panel Survey data provided by the NSRC, we used the method of quasi-experimental of propensity score matching to discuss the net effect of information technology on academic achievements. We found that: i) A significant difference existed in the academic performance between urban and rural school-aged children. The urban students were superior to those from the rural areas, whereas no positive correlation was found between the educational level and family economic condition; ii) Family human capital stock and family size (single child families) were positively correlated with internet usage, but the academic pressure reduced the probability of family Internet usage; iii) PSM revealed the negative impact of information technology on students' achievements when stratified into urban versus rural, and poverty versus non-poverty. The improvement of Chinese and English was realized indirectly by changing reading habits, while mathematics was directly by taking effective learning time. Our findings implied that a three-party linkage among the government, the school, and the family is required to emphasize the instrumental rationality of the information technology, promote the formation of the Internet learning preference, and support the development of the information technology hardware.

Best Evid Chin Edu 2019; 2(2):209-227.

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Keywords: *Information Technology; Academic Achievement; Propensity Score Matching; Internet Preference*

Introduction

THE popularization of information technology at the elementary and middle schools in China has been on the fast track after entering the 21st century. The launch of “XiaoXiaoTong” program in 2001 ushered in a new era of comprehensive connection between elementary and middle schools and the internet. In that year, there were 3.67 million computers in elementary and middle schools nationwide, and the “student-computer ratio” was as high as 51:1. A total of 10,687 elementary and middle schools had internet access, which account for only 1.8% of the whole schools (Gu, et al., 2017). Until 2016, according to the data provided by the Ministry of Education of China, the internet access rate by elementary and middle schools nationwide reached 87.45%, and the coverage rate of multimedia classrooms reached 64.29%. Education informatization objectively resulted in the unbalanced distribution geographically of the supporting information technology (Liu, et al., 2018). From the data of the Special Supervision Report on National Education Informatization Work in 2016, there was a big regional gap in the internet access rate of elementary and middle schools between the eastern, central and western areas, as well as the rate of multimedia distribution. The internet access rate in the eastern was 94.61%, which was 10% and 10.49% higher than the central and western regions, respectively. The rate of multimedia equipment in the eastern was 76.95%, which was 11.69% and 24.83% higher than the central and western regions, respectively.

The polarization of information technology has caused both “information rich” and “information poor”. Rich of information means the internet can be used to invest human capital in education, improve children’s achievement, form a closed loop between information capital and the reproduction of human capital, causing use of Internet aggravates the unfair of educational results, these were called “digital divide” (Yang, et al., 2017). Furthermore, the popularity of information technology makes children from low-resource families get preferred access to information resources, i.e., entertainment versus learning. Children from the low-resources families may have higher preference of entertainment (OECD, 2015), which makes the information technology be an inhibitor for children’s achievements. As a result, educational inequality has been further widened.

In view of the “digital divide”, educational inequality and the uncertainty between information technology and academic achievements, we hereby designed this study to focus on the following three questions: First, if information technology could improve academic achievements of school-age children? Second, whether the using of computer and internet has different effect on students’ academic achievements between urban and rural families? Third, if children from different economical backgrounds (poverty versus non-poverty family) could use information technology equally to

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improve their academic abilities. In addition, our study helped to reach a consensus on the topic whether information technology can help children improve their academic achievements to get theoretical and practical implications (Chan, et al., 2017; Cheng, et al., 2016; Xin, et al., 2010).

Research Design

Research Methods

Model Setting

In order to test the causal relationship between information technology and school-age children's academic achievements, linear model is set up as below:

$$Educ_{it} = \alpha + \beta_1 Internet_{it} + C_{it} + \mu_{it} \quad (1)$$

In formula (1), i and t indicate the individual (child) and family, respectively. The explained variable ($Educ_{it}$) represents the academic achievements of the child i in family t . C_{it} represents the set of control variables that will affect the use of information technology by child i , containing family background variables and individual characteristic variables, μ_{it} represents the residuals.

Measurement Process

Ordinary Least Square (OLS), the traditional research method, was generally used for observing the influence of information technology on the academic outcomes of school-age children. This works through observing values in the treatment group as the “net effect” of the changes in children's academic achievements from the influence of information technology. This method can lead to self-selection bias and counterfactual-selection bias. Because family providing children with a computer or internet is not a random selection process, but a factor is influenced by both characteristics of family (such as parents' economic capital, cultural capital, education decision preference) and individual child (such as gender and grade). This will produce a big difference between the treatment in which children were provided with computer/internet and the control in which no computer/internet was provided. Therefore, it is unavoidable for both self-selection and counterfactual estimation biases if we use OLS in such a situation. In order to accurately identify the “net effect” of computer and internet on the academic outcomes, Propensity Score Matching (PSM) - a method presented by Rosenbaum and Rubin (1985), will be used in this study to reduce the estimation bias.

PSM was used to find control group with similar individual and family characteristics as well as education decision for the treatment group. Meanwhile, the control group also was the counterfactual choice of the treatment group. Technically, PSM treats factors that affect family ownership of computers and internet as co-variables, and then estimates the probability of using the internet; therefore, the process of allocation can be regarded as approximately random. On the one hand, it can improve the preci-

sion of data matching; on the other hand, children in different groups can be compared horizontally. The influence of information technology on the academic achievements of school-age children was marked as Average Treatment Effect (ATT).

$$ATT = E\{E[Educ_{1i} - Educ_{0i}|D_i = 1, p = (X_i)]\} \quad (2)$$

In formula (2), $Educ_{1i}$ and $Educ_{0i}$ indicate children's academic achievements in those who had and did not have computer/internet, respectively. D_i is the indicator function, expressed in dummy variable. If family t has a computer or internet then $D_i = 1$, otherwise $D_i = 0$. $p(X_i)$ indicates the probability of child i using internet for study. The selection of factors that affect children's use of internet - represented by X - is the key of PSM.

Data

Sample

We used the Chinese Educational Panel Survey (CEPS) data, which was conducted by the National Survey Research Center at Renmin University of China. Data collecting procedures were in multi-stage stratified probability proportional to size (PPS), including the 7th and 9th graders. Four stages were included, and a total of 438 classes in 112 schools from 28 national level units were sampled in probability proportionally, and approximately 20,000 students were involved. The primary analysis was based on the baseline of this survey, which was collected during the 2013-2014 academic year.

Variable Processing and Summary Statistics

According to the educational production function from Hanushek (1992), school, government, family, and peers were the four major factors that influence educational output. Academic achievement can be seen as a proxy indicator of education output, but it was interfered by the education level and location of the school. This means it does not have horizontal comparability. However, this survey has provided standardized scores of Chinese, Math, and English, facilitated our study. Children's academic achievements were measured by the standardized scores of the three subjects, which were set as the dependent variable. As shown in **Table 1**, the mean standardized scores of Chinese, Math, and English were 70.458, 70.380 and 70.450, respectively. The mean score of Chinese was higher than the Math and English by 0.078 and 0.008 points, respectively, which indicated that children's academic achievement in Chinese was slightly better than both Math and English.

The provision of computer and internet was an important identifying variable as well as the key to explore if information technology can improve the academic achievement of school-age children. Both sets of variables in equation (2) were composed of dummy variables with values of 0 or 1 (0=no computer or internet, 1=have computer or internet). The families with computers but no internet accounted for 8.5%, whereas the families with both computers and internet accounted for 60.8%. Overall,

Table 1. Basic Statistical Information of Variables.

Variable Name	Mean	SD	Min	Max
Chinese Score	70.458	9.641	6.164	98.475
Math Score	70.380	9.733	8.422	145.115
English Score	70.450	9.707	11.349	104.833
Computer or Not	0.085	0.279	0	1
Internet or Not	0.608	0.488	0	1
Mother's Educational Level	3.828	1.977	1	9
Father's Educational Level	4.205	1.994	1	9
Educational Expectation	6.740	1.656	1	10
Economic Conditions	0.879	0.326	0	1
Family Size	0.438	0.496	0	1
Gender	0.504	0.50	0	1
Age	14.559	1.240	12	18
Grade	0.498	0.50	0	1
Household Register	0.540	0.498	0	1
Minority	0.915	0.288	0	1
Academic Pressure	0.362	0.480	0	1
Preschool Education or Not	0.80	0.40	0	1

over half families provided information technology assistant tools for their children's learning or entertainment. Parents' education level, family education expectation, economic status, and family size were family characteristic variables. Among them, the level of parents' education was used to control the human and cultural capital in different families by measuring as an ordinal variable with value 1 to 9, which represented as illiterate, elementary school, middle school, secondary school (technical school), vocational high school, high school, junior college, undergraduate, and postgraduate. The higher the level was, the higher the family human capital had. The average educational levels of mother and father were 3.828 and 4.205, respectively, which indicated that mother's education level ranged from middle school to secondary school (technical school), and father's ranged from secondary school (technical school) to vocational high school. The expectation of family education was composed of ordinal variables with value 1 to 10. The mean value was 6.740, indicating that parents expected their children to have a degree between junior college and undergraduate.

The family economic condition was represented by a dummy variable with a value of 0 or 1, which was used to control the economic capital of different families. Value 1 indicates poverty, namely the school-aged children thought their families were very poor, poor or general, whereas value 0 indicates non-poverty, i.e., the school-aged children thought their families were rich or very rich. In our study, the mean value was 0.879 that indicated that 87.9% of school-aged children thought their families were poor (poverty), but only 12.1% of school-aged children thought their families were rich (non-poverty).

Family size was also represented by a dummy variable with a value of 0 or 1 and it was used to control the resource dilution or sibling competition effect in the use of information technology. Value 0 indicates non-one-child family and value 1 indicates

one-child family. The mean value was 0.438 indicated that one-child families account for 43.8% of the whole sample and non-one-child families account for 56.2%. Theoretically, children were more likely to use information technology tools to learn if their parents had higher education level, higher education expectation and better family conditions (Fang & Huang, 2018).

Gender, age, grade, household registration, ethnicity, academic pressure, and preschool education were individual characteristic variables of school-aged children. Male and female children accounted for 50.4% and 49.6% respectively. The age ranged from 12 to 18 with an average of 14.6 years. Children in the grades 7 and 9 accounted for 50.2% and 49.8%, respectively. About 91.5% were from the ethnicity of Han, and 8.5% were minorities. After eliminating invalid samples without household registration, we defined agricultural household registration as rural household, non-agricultural household registration (including resident household registration) as urban household, the children with either rural or urban household registration accounted for 54% or 46%, respectively.

The perception of academic pressure was represented by a dummy variable with a value of 0 or 1, which indicated children's response level to parents' education expectation. Value 0 indicated children under no pressure or a little pressure, and value 1 indicated children under pressure or a lot of pressure. About 36.2% children mentioned that their parents' education expectation caused pressure during their learning, but 63.8% children said no. Finally, 80% of the children have received preschool education and 20% have not.

Additionally, in order to solve problems mentioned above - if information technology affecting academic achievements varied with household registration and family economic conditions, we took household registration and family economic conditions as the base of stratification. And then the differences of Chinese, Math, and English scores between urban and rural, poverty and non-poverty samples were shown. In **Table 2**, the mean scores of Chinese, Math, and English in those with urban household were 70.563, 70.432, and 70.799, respectively, which were higher than children with rural household (70.367, 70.439, and 70.152, respectively) by 0.196, 0.096 and 0.647, respectively. The overall academic achievements of urban students were better than that of rural students, and they had obvious advantages in English. The scores of these three subjects in children from poverty families were 70.496, 70.439, and 70.471, respectively, which were higher than those from rich family (70.181, 69.591 and 70.229, respectively), showed that there was a difference in scores between children who came from the poverty and non-poverty families, but the evidence was not solid enough to prove a positive correlation between family economic conditions and academic outcomes.

Results and Analysis

Factors That Influence the Information Technology Use

Following the research design of quasi-experimental, the net effect of information technology on school-aged children's academic performance could be estimated based on

Table 2. Sub-sample of Academic Achievement.

Score	Urban Household		Rural Household		Poor Family		Non-poor Family	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Chinese	70.563	9.651	70.367	9.631	70.496	9.672	70.181	9.407
Math	70.432	9.743	70.336	9.725	70.439	9.707	69.951	9.912
English	70.799	9.523	70.152	9.853	70.471	9.695	70.299	9.795
Obs.	7,437		8,674		14,172		1,944	

PSM, which were divided into two steps: Step 1, Logit model was used to estimate the influence of the covariates between the treatment and control groups on the utilization of information technology, namely the analysis of the relevant factors that affect the utilization of information technology; Step 2, on the basis of data balance, the above-matching strategies were used to identify the average treatment effect (ATE) of information technology on academic performance of different disciplines. Therefore, the Logit model was used first to estimate the factors that affect the usage of computers and internet. Then internet including computers was regarded as the identification variable. The estimation results are showed in **Table 3**.

Since the dependent variable of the Logit model was a dummy variable with value 0 or 1, we only got the direction of effect of the explanatory variable on the explained variables according to the results. In order to get the probability value, we calculated the average marginal effect (dy/dx) of each variable on the basis of Logit estimation. It should be noted that all variables in **Table 3** are average marginal effects except the intercept.

In terms of the whole sample, the human capital in the family characteristic variables was positively correlated with internet use. The probability value of internet use increased by 3.1% and 3% for mothers' and father's education, respectively. In terms of family capital, poverty exerted a negative effect on the computer use. For each unit value of the school-aged children's perception regarding whether their family were poor or not, the probability value of internet use reduced by 22.2%. Internet use was negatively correlated with family size. The probability value of internet use of one-child families was 9.7% higher than that of non-one-child families. Regarding children's characteristics, the estimated value of grade variable was significantly positive, indicating that the probability value of internet use of children in the grade 9 was 12.7% higher than that of children in the grade 7; Compared with ethnic minorities, the probability value of internet use in Han children was 14.3 percentage points higher. The registration of rural household had a negative effect on internet use, which was significant at the level of 1%. Academic pressure was also negatively correlated with internet use. When the perceived academic pressure increased by one unit, the probability value of internet use decreased by 2.4%.

In terms of the urban and rural sub-samples, the estimated values of mothers' and fathers' education in rural samples were 1.1 and 1.9 percentage points higher than that in urban samples. The negative impact of family poverty on internet use of rural children was greater than that of urban children, whereas the positive impact of family

Table 3. Results of Logit's Estimation.

Variable	Full Sample	Urban Sample	Rural Sample	Poverty Sample	Non-poverty Sample
Mother's Educational Level	0.031*** (0.003)	0.021*** (0.003)	0.040*** (0.004)	0.033*** (0.003)	0.016*** (0.005)
Father's Educational Level	0.030*** (0.002)	0.024*** (0.003)	0.035*** (0.004)	0.033*** (0.003)	0.013*** (0.005)
Educational Expectation	0.003 (0.002)	0.003 (0.003)	0.002 (0.003)	0.003 (0.002)	-0.00006 (0.005)
Economic Conditions	-0.222*** (0.014)	-0.138*** (0.016)	-0.314*** (0.023)	—	—
Family Size	0.097*** (0.007)	0.093*** (0.009)	0.099*** (0.011)	0.109*** (0.008)	0.007 (0.015)
Gender	-0.010 (0.007)	-0.014 (0.009)	-0.006 (0.010)	-0.012 (0.007)	0.004 (0.014)
Age	-0.060*** (0.005)	-0.043*** (0.007)	-0.073*** (0.007)	-0.064*** (0.005)	-0.029** (0.011)
Grade	0.127*** (0.012)	0.089*** (0.016)	0.157*** (0.017)	0.136*** (0.013)	0.049* (0.028)
Household Register	-0.124*** (0.007)	—	—	-0.136*** (0.008)	-0.030** (0.015)
Minority	0.143*** (0.012)	0.107*** (0.013)	0.174*** (0.021)	0.157*** (0.013)	0.024 (0.028)
Academic Pressure	-0.024*** (0.007)	-0.016* (0.009)	-0.032*** (0.010)	-0.026*** (0.008)	-0.011 (0.015)
Preschool Education or Not	0.064*** (0.008)	0.040*** (0.011)	0.082*** (0.012)	0.066*** (0.009)	0.045*** (0.017)
Cons.	3.937*** (0.406)	3.327*** (0.693)	3.585*** (0.508)	2.656*** (0.413)	4.250** (1.751)
Log Likelihood	-8,914.02	-3,413.82	-5,489.58	-8,251.25	-648.29
Pesudo R ²	0.1939	0.1529	0.1083	0.1686	0.0797
Obs.	16,516	7,601	8,915	14,525	1,991

*Notes: 1. Robust standard errors are in parentheses. 2. *P<0.1, **P<0.05, ***p<0.01.*

size on internet use was higher than that of urban children. These results indicated that there may be a binary division between urban and rural families in the information technology usage. The higher parents' educational expectation for their children, the higher the probability value of internet use, which is consistent with the theoretical hypothesis of this study, but the estimated value failed to find the significance. The possible reason is that the effect of educational expectation on internet use is not linear and direct, but indirectly moderates through some intervening co-founding variables.

In terms of poverty and non-poverty sub-samples, the average marginal effect of each variable was roughly the same in the value and direction of the parameter estimation. The difference only lied in the absolute value of the estimation. For example, the effect of parents' education on internet use was 3.3% and 3.3% in the poverty sam-

ples, but 1.3% and 1.6% in the non-poverty samples. It was indicated that children from poverty families had a higher probability to use internet especially when their parents had higher education level compared with those from rich family. In terms of academic pressure perception, the estimate of the children from poor families was 0.026, which was 0.011 higher than children from the rich families. It was indicated that when academic pressure was perceived, children from poverty families were more likely to give up internet to study hard, which also showed that students' use of internet was more likely to meet their own entertainment preferences rather than learning. Due to the small sample size, the estimate of non-poverty samples was slightly less significant than that of poverty samples.

The Impact of Information Technology on Academic Achievement

Balance Test of Covariates

Based on the factor analysis of Logit model on the information technology usage, we further used PSM to estimate the “net effect” of computer and internet use on the academic achievements of school-aged children. In terms of technical processing, individuals in the treatment group and the control group were first paired. The propensity score of school-ages children who participated in the pairing was then calculated, therefore, the difference between the paired groups was the “net effect” of the treatment group, namely the ATE. In order to ensure the robustness of the estimation, we selected k-nearest Neighbor Matching, Radius (Caliper) Matching, Kernel Matching and Mahalanobis Matching as our matching strategies.

Before using the above-mentioned strategies to estimate the ATE, each covariable was ensured to be balanced. Therefore, the balance of each covariable was tested. In **Table 4**, columns 3 and 4 show the sample mean size (including before and after matching) in both groups. Column 5 shows standard errors of data before and after matching, which was the ratio of the sample mean difference of the two groups to the square root of the sample size. Columns 6 and 7 show the absolute value of the percentage deviation reduction and the t value. According to **Table 4**, except for the increase of 94.4% in the standard error coefficient of gender variable, the standard error of other covariables all showed a decline trend at various degrees. The family size decreased most in standard error, which reached 99.2%, but the grade variable had the smallest decline, decreased by 49.1%. There were significant differences in each covariable before matching, while with a few variables statistically rejected the null hypothesis after matching. The t values of majority variables are not significant in statistics, i.e., the null hypothesis - treatment group and control group had no significant differences - cannot be refused. It indicated that the data matching eliminated significant differences of individual and family characteristics from different groups, which verified the rationality of matching method and covariate selection in this paper. This is also confirmed by the common value range of propensity score depicted in **Figure 1**.

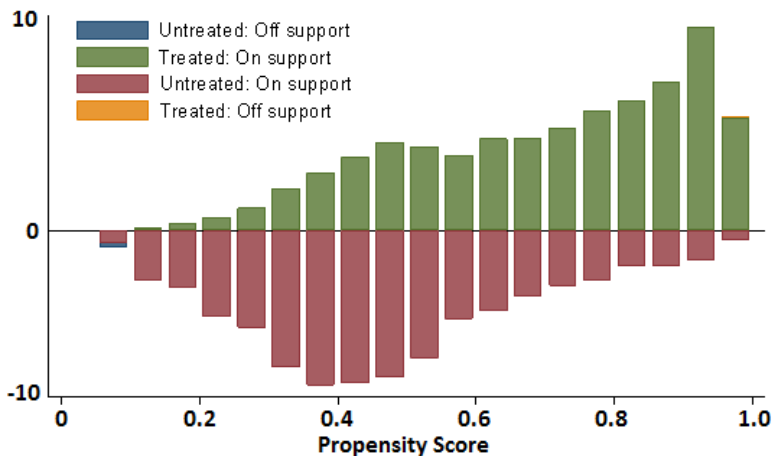
The Effect of Computer on Academic Achievement

Table 4. Covariate Equilibrium Test.

Variable	Type	Treated	Control	%Bias	Reduct Bias	t
Mother's Educational Level	Before	4.396	2.970	79.7	97.7	47.72***
	After	4.392	4.359	1.9		1.13
Father's Educational Level	Before	4.760	3.359	77.3	98.7	46.30***
	After	4.756	4.738	1.0		0.60
Educational Expectation	Before	6.913	6.495	25.1	86.4	15.81***
	After	6.912	6.969	-3.4		-2.59***
Economic Conditions	Before	0.825	0.965	-47.1	78.8	-27.36***
	After	0.825	855	-10.0		-5.71***
Family Size	Before	0.557	0.259	63.6	99.2	38.87***
	After	0.556	0.558	-0.5		-0.32
Gender	Before	0.498	0.507	-1.7	-94.4	-1.08
	After	0.499	0.482	3.4		2.37**
Age	Before	14.394	14.791	-32.0	91.6	-20.08***
	After	14.395	14.361	2.7		2.00**
Grade	Before	0.487	0.508	-4.1	49.1	-2.55**
	After	0.487	0.498	-2.1		-1.47
Household Register	Before	0.411	0.738	-70.1	96.6	-42.93***
	After	0.411	0.400	2.4		1.57
Minority	Before	0.950	0.868	28.7	82.9	18.64***
	After	0.949	0.964	-4.9		-4.82***
Academic Pressure	Before	0.333	0.403	-14.4	92.9	-8.98***
	After	0.333	0.338	-1.0		-0.73
Preschool Education or Not	Before	0.853	0.720	32.8	87.3	20.87***
	After	0.852	0.869	-4.2		-3.43

Notes: 1. *P<0.1, **P<0.05, ***p<0.01.

Figure 1. Common Range of Tendency Score.



In order to ensure the robustness of the estimation results, we used k-nearest Neighbor Matching, Radius (Caliper) Matching, Kernel Matching, and Mahalanobis Matching on the basis of the covariate balance test, to accurately identify the “net effect” of computer usage on Chinese, Math, and English scores. In the k-nearest Neighbor Matching, set $k = 4$, which used one-to-four matching; Radius was less than 0.01 in Radius (Caliper) Matching; Kernel function and bandwidth were defaulted in Kernel Matching. A method of handling heteroscedasticity robust standard error has been used in Mahalanobis Matching, which was indicated by Adadie and Imbens (2006).

According to the **Table 5**, the results of the k-nearest neighbor matching showed that the Chinese, Math, and English scores of the treatment group were 69.748, 70.20, and 70.015, respectively, before the matching, but were 70.524, 79.397, and 70.491, respectively for the control group. The differences between the two groups were 0.776, 0.197, and 0.476, respectively, of which the differences in Chinese and English scores were negatively significant at levels of 1% and 10%. After the matching, the differences were 0.734, 0.131, and 0.241, respectively, which reduced by 0.042, 0.066, and 0.235, respectively, compared with prior-matching ones. The results showed that after adjusting the self-selection and counterfactual bias of family and individual characteristics by PSM, the negative effect of computer use on academic achievements was significantly reduced, indicating that ignoring the self-selection and counterfactual bias would overestimate the negative effect of computer use on academic achievements.

According to the estimation results of k-nearest neighbor matching, internet use had a negative effect on children’s academic achievements. That is to say, compared with families without computers, the use of computers cannot help school-aged children improve but inhibit their academic level. Our results suggested that school-aged children may have two preferences for computer use - learning and entertainment. Given the sample was only from the 7th and 9th graders, and children in grade 7 and 9 were still in the formation and development period of cognitive and non-cognitive abilities, and their self-control ability was weak. In this case they are more likely to use computer for entertaining rather than for learning, which may be the major cause for the computer/internet use for negative academic achievements. In addition, when computers were used to meet their entertainment needs, it definitely caused a lack of effective learning time, which was another reason for the formation of negative causal relationship.

In terms of the estimation results of different disciplines, the negative effect of computer use on Chinese performance was higher than that on Math and English, and the negative effect on English performance was higher than that on Math. This partially showed that information technology had an exogenous impact on traditional reading methods and habits. Since the cultivation of students’ understanding, the ability relies more on paper reading habits in Chinese teaching. The dependence of school-aged children on computer and paperless reading habits was not conducive to enhancing their understanding. This is the reason why the computer use has the most significant negative effect on Chinese performance.

Compared with Chinese, Math learning relies more on the construction of logic and deduction ability, computer use itself does not affect the development of logic,

Table 5. The Impact of Computer on Academic Performance.

Strategy	Score	Type	Treated	Control	ATT	T-stat
k-nearest Neighbor	Chinese	Before	69.748	70.524	-0.776***	-2.85
		After	69.748	70.481	-0.734**	-2.40
	Math	Before	70.20	70.397	-0.197	-0.72
		After	70.20	70.331	-0.131	-0.43
	English	Before	70.015	70.491	-0.476*	-1.74
		After	70.015	70.255	-0.241	-0.77
Radius	Chinese	Before	69.748	70.524	-0.776***	-2.85
		After	69.748	70.380	-0.633**	-2.27
	Math	Before	70.20	70.397	-0.197	-0.72
		After	70.20	70.299	-0.099	-0.35
	English	Before	70.015	70.491	-0.476*	-1.74
		After	70.015	70.307	-0.293	-1.03
Kernel	Chinese	Before	69.748	70.524	-0.776***	-2.85
		After	69.748	70.531	-0.783***	-2.81
	Math	Before	70.20	70.397	-0.197	-0.72
		After	70.20	70.410	-0.210	-0.75
	English	Before	70.015	70.491	-0.476*	-1.74
		After	70.015	70.482	-0.467*	-1.65
Mahalanobis	Chinese	Before	69.748	70.524	-0.776***	-2.85
		After	69.748	70.895	-1.147***	-4.05
	Math	Before	70.20	70.397	-0.197	-0.72
		After	70.20	70.598	-0.398	-1.36
	English	Before	70.015	70.491	-0.476*	-1.74
		After	70.015	70.705	-0.690**	-2.48

Notes: 1.* $P < 0.1$, ** $P < 0.05$, *** $p < 0.01$.

deduction, and other cognitive abilities of school-aged children. Therefore, the negative effect of computer use on Math performance was not from technology itself, but from the occupation of effective learning time. Finally, it should be noted that the results of Radius (Caliper) Matching, Kernel Matching and Mahalanobis Matching estimations were similar to k-nearest neighbor matching, which verified the robustness of the estimation of the study. But the ATT of Math and English were not significant in statistics, the possible reason for this may be due to the small sample size of the control group, i.e., the families with computers only account for 8.5% in the total sample, which reduced the significance of the estimation results.

The Effect of the Internet on Academic Achievement

Based on the effect of computer on academic achievement, we adopted the four matching strategies mentioned above to explore the effect of internet (including computer) on children's academic achievements, so as to clarify whether there was a differentiated effect of computer and internet use on academic achievements. As the families that with internet account for 60.8% of the total sample, which was much higher than those with computers only (8.5%). In order to ensure both groups have equated sample size after

Table 6. The Impact of Internet on Academic Performance.

Strategy	Score	Type	Treated	Control	ATT	T-stat
k-nearest Neighbor	Chinese	After	70.572	70.279	0.293*	1.89
		Before	70.567	70.883	-0.316	-1.22
	Math	Before	70.359	70.413	-0.055	-0.35
		After	70.356	71.392	-1.036***	-3.92
	English	Before	70.570	70.263	0.307*	1.96
		After	70.565	71.391	-0.826***	-3.10
Radius	Chinese	Before	70.572	70.279	0.293*	1.89
		After	70.567	70.796	-0.229	-0.95
	Math	Before	70.359	70.413	-0.055	-0.35
		After	70.356	71.327	-0.971***	-3.98
	English	Before	70.570	70.263	0.307*	1.96
		After	70.565	71.141	-0.577**	-2.37
Kernel	Chinese	Before	70.572	70.279	0.293*	1.89
		After	70.567	70.731	-0.164	-0.70
	Math	Before	70.359	70.413	-0.055	-0.35
		After	70.356	71.248	-0.892***	-3.77
	English	Before	70.570	70.263	0.307*	1.96
		After	70.565	71.071	-0.506**	-2.14
Mahalanobis	Chinese	Before	70.572	70.279	0.293*	1.89
		After	70.572	70.841	-0.269	-1.13
	Math	Before	70.359	70.413	-0.055	-0.37
		After	70.359	71.275	-0.917***	-3.79
	English	Before	70.570	70.263	0.307*	1.96
		After	70.570	71.151	-0.581**	-2.32

Notes: 1.* $P < 0.1$, ** $P < 0.05$, *** $p < 0.01$.

matching, we used the four matching strategies mentioned above to improve the significance of the ATT. The estimated results were reported in **Table 6**.

In overall, the ATT of internet use on all subjects were negative after matching, and with exception of Chinese score, both math and English scores were statistically significant, which means that internet use inhibits children's academic achievements. Specific to different disciplines, the negative effect of internet on Chinese performance fell within to the range of [-0.164, -0.316.], Math [-0.892, -1.036] and English [-0.506, -0.826]. These indicated that internet use had the most significant negative effect on the improvement of Math performance, followed with English and then Chinese. Meanwhile, in contrast to the estimation results given in **Table 5**, the negative effect of internet use on academic achievements was somewhat eliminated in Chinese and English, but expanded in Math than computer use only. The estimated results confirmed the hypothesis - the negative effects of information technology usage on different disciplines were different in mechanism. Specifically, for liberal arts (Chinese and English), it indirectly changes the way of reading and habits by means of technological change. But for science (Math), it further strengthens the computer/internet entertainment preference, directly changing the time distribution of effective learning.

Table 7. The Impact of Internet on School-age Children's Academic Performance in Urban and Rural Areas (Intra-Group Differences).

Score	Urban					Rural				
	Type	Trtd.	Ctrl.	ATT	t	Type	Trtd.	Ctrl.	ATT	t
Chinese	Before	70.75	69.91	0.834***	3.10	Before	70.32	70.41	-0.089	-0.43
	After	70.74	70.82	-0.078	-0.20	After	70.32	70.82	-0.502*	-1.82
Math	Before	70.59	69.89	0.691**	2.54	Before	70.03	70.59	-0.565***	-2.70
	After	70.58	71.15	-0.571	-1.40	After	70.03	71.36	-1.332***	-4.72
English	Before	70.99	70.13	0.858***	3.23	Before	69.97	70.31	-0.341	-1.61
	After	70.98	71.24	-0.263	-0.66	After	69.96	71.18	-1.223***	-4.31

Notes: 1. * $P < 0.1$, ** $P < 0.05$, *** $p < 0.01$. Trtd: Treated; Ctrl: Control.

For the estimated value of ATT, internet highlighted students' entertainment preference in the process of information technology usage, so it had a higher negative effect on Math scores than computer did. On the contrary, internet use objectively broadened the channels for children to obtain effective information, improved their knowledge level such as reading and understanding abilities. That was the reason why the Internet had a weaker negative effect on Chinese and English performance than sole computer. Finally, the estimation results of computer and internet were integrated to answer the first question raised in this study: With the rapid development of information technology, the popularization of computer and the continuous increasing of internet access rate, the use of information technology by families failed to improve their children's academic achievements. In contrast, the computer and internet use caused a decline in Chinese, Math, and English scores. Our results were similar to that reported by Chen et al. (2017).

Urban and Rural Sub-Sample Regression

For the total sample, we estimated the effect of internet on the academic achievements of urban and rural children by using the k-nearest neighbor matching strategy. **Table 7** presents the estimated results of the differences between the urban and rural subgroups. In terms of urban sub-samples, the estimated value of the ATT was negative indicating that compared with the control group, internet use inhibited the academic achievements of urban children, and the inhibitory effect on Chinese, math, and English scores were -0.078, -0.571, and -0.263, respectively. Among them, the math performance was the most obviously affected. For the rural sub-samples, the effect of internet on students' academic achievements was also negative, and the inhibitory effect on Chinese, math, and English performance were -0.502, -1.332, and -1.223, respectively, and this negative impact of internet use on math was greater than Chinese and English.

The estimated results of rural-urban sample regression answered the second hypothesis of this study. To a certain extent, the information technology usage has

Table 8. The Impact of Internet on School-Age Children's Academic Performance in Poor and Non-Poor Families (Intra-Group Differences).

Score	Poor Sample					Non-poor Sample				
	Type	Trtd.	Ctrl.	ATT	t	Type	Trtd.	Ctrl.	ATT	t
Chinese	Before	70.66	70.28	0.372**	2.27	Before	70.18	70.17	0.009	0.01
	After	70.63	70.99	-0.361	-1.45	After	70.18	71.03	-0.849	-0.96
Math	Before	70.48	70.39	0.084	0.51	Before	69.81	71.03	-1.215*	-1.71
	After	70.45	71.32	-0.866***	-3.42	After	69.81	72.31	-2.505***	-2.79
English	Before	70.62	70.27	0.358**	2.18	Before	70.31	70.19	0.128	0.18
	After	70.60	71.25	-0.652***	-2.59	After	70.30	71.45	-1.143	-1.23

Notes: 1. * $P < 0.1$, ** $P < 0.05$, *** $p < 0.01$. Trtd: Treated; Ctrl: Control.

caused decline in academic achievements in both urban and rural school-aged children, but no significant statistical difference was observed. For the absolute value, the negative impact of internet use on rural children was greater than the urban peers. Possible reason for this phenomenon was that the education level of urban parents was generally higher than rural parents. The average education level of father and mother from urban area were 5.138 and 4.749, respectively, which showed that fathers' average education level were senior high school (vocational high school) and mothers' were secondary school/technical school. The average education level of father and mother from rural area were 5.138 and 4.749, respectively, which showed that fathers' average education level was in the range of junior high school to secondary school/technical school and mothers' was in the range of primary school to junior high school. Higher education level helps parents control their children's entertainment preference when they use internet as well as guide their learning preference in time. This is the reason why the absolute value of negative impact of internet use on academic achievements of children from urban families was lower than that of rural families.

Poverty and Non-Poverty Sub-Sample Regression

We used family economic status to distinguish poverty and non-poverty families, and adopted the k-nearest neighbor matching strategy to estimate the impact of internet use on the academic achievements of school-aged children with different family economic conditions (**Table 8**). For the estimated value of ATT, no significant difference was found between internet users and non-users in both poverty and non-poverty families. The academic achievements of the treatment group were significantly lower than the control group indicating that internet use inhibits children's academic achievements, and the inhibitory effect on the math performance was higher than on Chinese and English. This was similar to that obtained by full-sample regression that verified the robustness of our study. For the absolute value of the estimate, the negative impact of internet on children who came from the better family economic status was higher than the comparisons. Taking math scores as an example, the inhibitory effect of internet on its per-

formance was -0.866 in the poverty children, but was 0.866 in the non-poverty children. One possible reason was that children from poverty families were more sensitive to academic pressure and family economic conditions than those from non-poverty families. In the poverty group, 36% children felt academic pressure, but about 31.5% in non-poverty children. Children from poverty families could convert the academic pressures and the perception of family economic conditions into learning motivation. Consequently, they actively suppress the entertainment preference and use internet as a learning assistant. As the proverb says, "Poverty children are more independent". Therefore, the negative impact of internet use on poverty children was less significant than the non-poverty comparison.

Conclusions and Discussion

Conclusions

Our study was based on the China Education Panel Survey data provided by the NSRC. In the context of the continuous popularity of computers and internet, we used the method of quasi-experimental of PSM to find the net effect of information technology on academic achievements.

It was indicated that:

- There is difference in Chinese, math, and English. Chinese scores in the two grades (7 versus 9) were slightly better than Math and English. The academic achievements of urban students were better than the rural peers, especially in English. It illustrated that the unbalanced distribution of urban and rural education resources in quantity and quality is the major reason leading to significant difference in the quality of education between urban and rural areas. However, there was no positive correlation between the education achievements and the family economic status.
- Based on the Logit conditional probability model, we found that there was a positive correlation between the family's human capital stock and the information technology use. The probability of internet use increased by 3% and 3.1%, respectively, for each education level of the parents. Each one-unit increase in children's perception of family's poverty status reduced the probability of internet use by 22.2%. The probability value of internet use of one-child family was higher than non-one-child family by 9.7%.
- We found that the use of information technology inhibited children's academic achievements, but the underlying mechanisms were different in different subjects based on the PSM. For liberal arts (Chinese and English), it works indirectly by changing the way of children's reading and habits, but for science (Math), it works by taking away effective learning time. The entertainment preference was the basic cause of the negative impact. At the same time, ignoring the differences in family and individual characteristics led to selective bias and counterfactual bias, which resulted in overestimation of the negative impact of internet on the academic achievements.

- Sub-sample regressions showed a negative impact of information technology on school-aged children's academic achievements in both urban and rural, poverty and non-poverty samples. Guidance, moderation and regulation of parents' education to entertainment preference as well as children's perception of both academic pressure and family economic status were the leading causes of the differences between urban and rural, poverty and non-poverty children.

Discussion

This empirical study on the influence of information technology on school-age children's academic performance has essential implications for policy makers. As a means of teaching assistance, the application and popularization of computer and internet, theoretically, should help to improve students' academic outcomes. However, our empirical study found that the information technology has not effectively promoted the academic achievements, no matter in urban or rural areas, or from poor or non-poor families. This conclusion obviously contrasted to the initial intention of education informatization, i.e. the information technology had a negative impact on school-age children's academic achievements. The reason is majorly due to students' two preferences for the computer and internet use - either learning or entertainment. Given children in grades 7 and 9 are still in the formation and development period of cognitive and non-cognitive abilities, which means their self-control ability is weak (Li, et al., 2017; Li, et al., 2017; Wang, et al., 2017; Yang, 2018). When they use internet, they are more likely to be dominated by the preference of entertainment, which weakens and restrains their learning preference.

In response to the reasons mentioned above, we suggest following three aspects below to make a full use of information technology to improve the quality of school education and narrow the "digital divide" in the context of education informatization. First, as a micro-field of educational activities, parents should not only provide the hardware of computer and internet for their school-aged children, but also devote themselves to cultivating the ability to distinguish their preference to entertainment and learning in the application of information technology. In addition, parents should re-plan and rationally allocate children's entertainment time during their working day, and help their children to form good learning habits and point of view on information technology. Second, as a medium of education activities, innovation of teaching model (such as the combination of "online" and "offline learning") should be encouraged to stimulate children's learning interest. Meanwhile, school and teachers should manage the network teaching in a reasonable way by providing a civilized and ordered network teaching environment as well as preventing the negative phenomena, such as network violence, network uncivilization, and addiction. Third, as a macro field, education activities should give priority to rural area to reduce the unbalanced distribution of educational resources between urban and rural areas, and pay more on the construction of education information system in rural schools, so as to eliminate the "digital gap". Moreover, corresponding administrative measures should be introduced at the policy aspect to ensure a reasonable advancement of information teaching.

It should be pointed out that the marginal contribution of this study is that we estimated the “net effect” of the information technology on the academic achievements in school-aged children by using PSM to reduce the selective bias. However, there are additional two points need to be expanded further in this field. First, guide children to prefer to learn when they use computers and internet and restrain the entertainment preference using reasonable time planning. The next focus should set on the causal relationship between the rational use of information technology and academic performance. It is also the profound requirement that improves educational quality, as the education informatization going forward to the next new era. Second, are there any other effects of information technology on the academic achievements in school-age children? For example, information technology functions as an intermediary variable, either positively intervening or negatively inhibiting the development of cognitive and non-cognitive abilities of school-aged children to affect their academic achievements. Therefore, it would be another beneficial effect to discuss further the mediating role of information technology in promoting the cognitive/non-cognitive ability and academic performance, and clearly depict the differentiated effect of computer and internet on students’ development, and provide information support and decision-making basis for the input of national, school and family education resources.

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An Investigation into the Impact of Mindfulness Education on Children Development – Based on the Mindfulness Experiment on 5th Graders of D primary School in W City

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Abstract. This study selected fifth graders from D Primary School as subjects and conducted a 12-week mindfulness education experiment using a pre- and post-test control experiment design. The results can be used to demonstrate that mindfulness education has a significant impact on children's attention development, emotional balance and development, psychological development and happiness enhancement. These aspects interact with each other to jointly improve the overall development level of children. Therefore, activities of mindfulness education are necessary and should be carried out moderately at school, thus giving full play to the positive role of mindfulness education in child development.

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IN the past ten years, with the rise of the mindfulness movement, training that appeals to the improvement of attention, mental health development and emotional regulation has been increasingly discovered and valued by scholars at home and abroad. Mindfulness education is not a fixed course or teaching mode, but refers to various educational activities carried out using mindfulness methods, such as mindfulness reading, mindfulness awareness, mindfulness writing, mindfulness lectures, and mindfulness eating, etc. The United States has implanted mindfulness training into the “K-12” education system. The UK’s mindfulness campus program has benefited more than 7,000 children. The Dutch mindfulness upbringing program has had a positive impact on the communication between children and parents. The study of mindfulness in China has just started. Researchers have realized that mindfulness training has important values in school education to improve children’s attention, shape children’s moral quality, promote children’s self-regulation, and enhance subjective well-being of teachers and students. In this study, students of grade five in an elementary school were selected to conduct a 12-week mindfulness education experiment using a pre- & post-test control experiment design, attempting to reveal the specific effects of mindfulness education on development of children.

Research Methodology

The theoretical hypothesis of this study is that experimental interventions through the mindfulness education curriculum adapted from cognitive therapy can effectively promote the development of children’s psychological, social, emotional and cognitive aspects, thus improving the overall development level of children. The research mainly incorporates the combined method of educational experiment and measurement. The educational experiment adopts the pre- and post-test control experiment design of equal groups. The measurement tools include the “Attention Stability Questionnaire,” the “Psychological Health Scale for Primary School Students,” the “Positive and Negative Emotion Scales,” and the “Index of Well-being.”

Subjects

D Elementary School in W city is a small-scale school with no more than 35 students in each class. The number of students is conducive to the control and implementation of the experiment. In addition to the changes in body growth, children of the fifth grade begin to have more various feelings and emotions than before. Compared with children in the early period of primary school, older students can analyze and integrate external affairs in a more detailed manner and regulate their behavior (Zhang, 2004). In summary, after a careful discussion between the researcher and the principal of the experimental school and the head teachers, Class 1, Grade 5 was selected as the experimental group, and Class 2, Grade 5 was used as the control group. The two classes were equal in number and the two classes included typical students, head teachers and classroom teachers. Under the existing manpower and material resources, such class size and class level are just in line with the number and standards of subjects expected by the researcher.

There were 20 male students and 11 female students in the experimental group, and one of them is an exceptional child. During the experiment, 4 students either took time off at different times or had events affecting their body and mind within one week to two weeks before the test. After excluding the influence of irrelevant variables, a total of 26 valid samples were obtained. In the control group, there were 19 male students and 12 female students. The subjects who did not meet the requirements were deleted, and a total of 29 valid samples were obtained. The quantity of final samples obtained is shown in **Table 1**. There are 32 boys and 23 girls in the valid sample.

Research Design

The experiment used two types of designs. One is the experimental design of the experimental group and the control group between the subjects; the other is the experimental design of the experimental group before and after the test. Using the mindfulness education course as the intervention method, and the fifth grade students of D Primary School as subjects of the study, quasi-experimental design was adopted as the research design. The researchers conducted pre- and post-intervention and pre- and post-intervention tests in the class with both the experimental group and the control group. The dependent variable was the total score of each scale before and after the pre- & post-tests of experimental group and the control group.

In order to control the interference of irrelevant and additional variables and reduce the experimental error as much as possible, this study adopted a variety of technical treatment methods: (i) The number of students, the sex ratio, and the family background of the experimental group and the control group were roughly balanced. (ii) During the experiment period, the teaching methods of the teachers in the experimental group and the control group were the same as before, and they were consistent with the school teaching arrangements. (iii) Subjects were excluded who did not meet the experimental requirements by questionnaire. For example, those who have had a major impact on their own development because of family or other factors, as well as those who did not complete the experiment due to taking time off. (iv) The experimental assessor was separated from the researcher. In order to reduce the influence of subjective factors, the researcher only conducted 12 weeks of mindfulness training for the students throughout the experiment. The effect evaluation was supported by the class teacher and third party personnel (doctoral students) to conduct measurement and interview work before and after the experiment.

Research Scenario

The children's mindfulness education in this study is a self-regulation method that teaches children to be physically and mentally active. It is based on the adult mindfulness decompression method or the mindfulness cognitive therapy, and includes a series of courses based on the righteousness intervention program modified by the child's age teaching method. Because children's mindfulness cognitive therapy is for children with special needs, the course intervention of this study is aimed at the educational effectiveness of ordinary students. It should not be called therapy, but adapted to a kind of

Table 1. Sample Statistics.

	Total #	Boys	Girls	Valid #	Boys	Girls
Experimental Group	31	20	11	26	15	11
Control Group	31	19	12	29	17	12

suitable mindfulness education program for the learning and education of general students. Therefore, in the design of the mindfulness education curriculum, we developed a 12-week course of mindfulness education based on the curriculum structure of foreign children's mindfulness cognitive therapy and children's mindfulness decompression therapy (**Table 2**). The experimental group received a 40-minute mindfulness education course once a week, had related homework, and the control group remained the same as they were before this experiment.

Research Instruments

Measurement Scale

The research instruments of this study include the Attention Stability Test Questionnaire, the Mental Health Rate Scale for Pupil (MHRSP), the Positive and Negative Affective Scale (PANAS), and the Index of Well-being (IWB).

(1) *Attention Stability Test Questionnaire*: The Attention Stability Test includes two parts, A and B, which consisting of multiple curves starting from the left side and ending on the right side, requiring participants to trace a curve from the left with eyes, and filling the number at the beginning of the curve into the square at the end of the curve on the right. Pens or fingers cannot be used as assistance in the whole test, and the correct response number is used as an evaluation index for attention stability. A study by Yin Hengchan in 2003 showed that the test had good validity (Yin, 2003).

(2) *Mental Health Rate Scale for Pupil (MHRSP)*: This scale is a psychological test questionnaire consisting of 80 items. Every 10 items constitute a subscale, which in turn includes 8 subscales such as learning disabilities, emotional disorders, personality defects, social adaptation disorders, moral defects, behavior disorder and special disorders. The project adopts a three-level scoring system. Each project has three levels of "no", "occasionally" and "frequently", with 0 point, 1 point and 2 points in turn. The whole scale is the sum of the scores of each subscale. The higher the score is, the more the mental health problems there are, the lower the psychological level is.

(3) *Positive and Negative Affective Scales*: This scale is compiled by Watson (1988) and is currently the most widely used positive emotion measurement tool. It consists of 20 words that describe different sentiment and emotion. It is divided into Positive Affect (PA) and Negative Affect (NA). Two dimensions, each with 10 words. Chinese scholars have studied the applicability of the Chinese version of the scale in China and the cross-cultural consistency between China and the United States. The results show that the scale is suitable for the Chinese population, with cross-cultural con-

Table 2. Children's Mindfulness Education Course.			
Time	Course Theme	Course Content	Homework
Week 1	What is righteous thought: a gift to accompany a lifetime	Self-introduction; establishing norms; consciously aware of non-judgment	Mindfulness exercise
Week 2	Breathing righteous thoughts: experience breathing as an anchor point, come back after each distraction, and observe breathing as a way to cope with difficulties	Lie, stand, sit and breathe	Number breath 10 times before going to bed
Week 3	Mindfulness diet: the automatic guidance of the thinking in the process of eating	Mindfulness eating raisins; mindfulness eating	Mindfulness diet record; Number of breaths 20 times before going to bed
Week4	Mindfulness Awareness: discovering and breaking through inertia thinking	The attributes of the five senses as the object of awareness	Number of breaths 20 before going to bed
Week 5	Body scan: awareness exercises of static body	Consciously aware of various parts of the body successively	Mindful awareness exercise; Number of breaths 20 times before going to bed
Week 6	Mindfulness sit-in: awareness exercise from the inside out	Mindfulness, breathing, body, thinking, emotions, behavior, etc.	Number of breaths 20 times before going to bed
Week 7	Mindfulness stretching: dynamic body awareness exercises	Learn to be aware of the body through action; mindfulness yoga	Animal and plant posture
Week 8	Mindfulness walking: dynamic exercises from the outside to the inside, keeping awareness during walking	Walking indoors and outdoors, experience the feeling of your feet	Number of breaths 20 times before going to bed
Week 9	Mindfulness Listening: exploring the interpersonal communication of mindfulness	Harmonious relationship; Listening to the sound: no choice to detect	Learn to listen and express; friendly wish list
Week10	Mindfulness life: my thoughts, feelings, physical feelings, behavior	20 minutes of meditation practice; explore the implementation of mindfulness life	Daily practice such as brushing, bathing, etc.; Number of breaths 20 times before going to bed
Week 11	The Road to Mindfulness: introspect and review personal growth	Introspective meditation; share the process through narrative	Write a letter to yourself
Week 12	Love: thanksgiving practice	Blessing	Self-practice

sistency and good reliability and validity (Zhang & Yan, 2004).

(4) *Index of Well-being (IWB)*: This scale was compiled by Campbell et al. in 1976. The scale includes two subscales: the Life Satisfaction Questionnaire and the Overall Affective Index. IWB has 9 questions; Overall Affective Index has 8 questions; the life Satisfaction Questionnaire has 1 question; the project uses 7 points; the total score is the sum of the scores of the life satisfaction questionnaire and the average score of the Overall Affective Index. Li Jing et al. revised the scale. After research, it was found that the correlation between the Overall Affective Index and the Happiness Survey was 0.53, and the consistency between the Overall Affective Index and Life Satisfaction was 0.56, which could be used as a tool to measure the happiness index (Li et al., 2000).

The measurement process is strictly carried out in accordance with the procedures of psychological measurement. The main test is to issue and collect questionnaires on site one week before and one week after the experiment, and to unify the instructions. Students are required to carefully fill out the questionnaire according to their actual situation, in order to ensure the recovery rate and efficiency of the questionnaire, the whole process of the questionnaire test is carried out under the joint supervision of the researcher and the class teacher to ensure the authenticity and scientificity of the data.

Qualitative Research Instruments

The qualitative research instruments we developed of this study include the Mindfulness Experience Log Sheet, the Homework Log Sheet, the Open Questionnaire, and the Interview Outline.

The Mindfulness Experience Log Sheet is made by children to record their experiences and feelings during the implementation of the course. For example, what do you think about? What physical feelings are you concerned about? What emotions and feelings have you experienced? The content is designed to match the weekly teaching activities. At the end of each course, the children fill in the forms themselves to understand their learning state, as a reference for correcting teaching, and also as a source of research for researchers.

The Homework Log Sheet: After the course, the children go home to complete the Homework Log Sheet. The content design is also matched with the weekly teaching activities. The ideas, feelings, thoughts, affects, words and deeds, etc. perceived in each exercise are recorded. The researcher conduct family work every week. Reviewing the assignments and give appropriate guidance and encouragement to form a quality of mindfulness and better integrate mindfulness into life.

The Open Questionnaire: In addition, the researcher compiled a questionnaire and presented the interview questions in the form of a questionnaire to gain a more comprehensive understanding of the experiment results.

Finally, the researcher conducted formal interviews or random interviews on children during the experiment. The formal interview was based on the interview outline prepared in advance to obtain the overall perception of children in the teaching of

mindfulness courses. Random interviews paid more attention to the real feelings during class, through the perspective of individual differences, to obtain children's different views on mindfulness education curriculum.

Data Processing

Using SPSS 20.0, the researcher analyzed the results of attention stability test questionnaire, mental health scale, positive and negative emotion scale, happiness scale, etc. in this study. The statistical analysis method used in this study can meet the research needs.

Results and Analysis

Through the comparative analysis of the difference results of pre-test and post-test between the experimental group and the control group and the results of pre-test and post-test of experimental group, we found that mindfulness education has extremely significant effects in promoting children's attention development, mental health development, emotional balance, and happiness.

Analysis of Homogeneity Test Results between the Experimental Group and the Control Group

In order to test whether the two groups were homogeneous, the independent sample T test was used to examine the difference of pre-test. The results showed that there was no statistically significant difference between the experimental group and the control group in the Attention Stability Test, Mental Health Rate Scale for Pupil, Positive and Negative Emotion Scales, and the Index of Well-being (**Table 3**). Therefore, students in these two classes can be used as an experimental group and a control group.

Analysis of the Difference between the Results of the Experimental Group and the Control Group Before and After the Experiment

According to the independent sample T test, it can be seen from **Table 4** that there is a statistically significant difference in the scores of the Attention Stability Test between the experimental group and the control group before and after the experiment ($p = 0.003$); the mean value of the difference of the experimental group before and after the Attention Stability Test ($M = 4.31$) was significantly higher than that of the control group ($M = 0.03$), indicating that the stability of the attention of the experimental group was better than that of the control group.

The mental health problems of the students in the mindfulness experimental group were significantly improved compared with the control group. There was a statistically significant difference in the total score of the Mental Health Rate Scale for Pupil ($p = 0.000$), and the mean difference of the total score of the Mental Health Rate Scale for Pupil of the experimental group (post-test score minus pre-test score) ($M = -9.27$) was significantly larger than that of the control group ($M = -1.48$). It shows that the psychological improvement of the students in the experimental group, whether it is the

Table 3. Homogeneity Test Results.

	<i>t</i>	<i>p</i>
Attention Stability Test	-0.325	0.746
Mental Health Rate Scale for Pupil	-0.019	0.985
Positive Emotion Scale	0.296	0.768
Negative Emotion Scale	-0.088	0.930
Index of Well-being	-0.228	0.821

Table 4. Comparison of the Difference.

Subscale	Exp. (n = 26)		Ctrl. (n = 29)		<i>t</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
AST A Test	0.46	0.905	-0.07	0.842	-2.252	0.028*
AST B Test	3.85	7.103	0.10	0.724	-2.824	0.007**
AST Total Test	4.31	7.287	0.03	1.085	-3.123	0.003**
MHRSP Learning Disability	-0.96	2.690	-0.10	0.939	1.613	0.113
Emotional Disorder	-1.62	2.174	-0.17	0.759	3.356	0.001***
Personality Defect	-1.81	3.124	-0.24	0.830	2.602	0.012*
Social Adaptation Disorder	-1.69	2.526	-0.21	0.774	3.016	0.004**
Moral Defect	-0.12	2.123	-0.28	0.797	-0.379	0.706
Bad Habit	-1.08	2.911	-0.10	0.772	1.736	0.088
Behavior Disorder	-1.85	2.694	-0.21	0.819	3.123	0.003**
Special Obstacle	-0.15	1.736	-0.17	0.658	-0.053	0.958
MHRSP Total Score	-9.27	8.263	-1.48	2.278	4.877	0.000***
Positive Emotion	4.54	8.353	0.17	0.928	-2.798	0.007**
Negative Emotion	-2.65	6.066	-0.31	0.850	2.060	0.044*
Overall Emotion Scale	4.58	8.941	0.17	1.256	-2.627	0.011*
Life Satisfaction Questionnaire	0.73	0.919	0.03	0.944	-2.765	0.008**
Overall Affective Index	5.31	8.749	0.21	1.656	-3.082	0.003**

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; the higher the mental health score, the more negative psychological state; the higher the negative emotion score, the worse the mood. The same below. Exp.: Experimental group; Ctrl.: Control group.

overall level or mental health, personality defects, adaptation disorders and behavioral disorders, is significantly ahead of the control group after the mindfulness training. The results of the mindfulness education experiment are very significant. There are no statistical differences in mental health, including learning disabilities, moral defects, bad behavior, and mental disorders.

Before and after the experiment, the difference between the Positive and Negative Emotion Scales of the experimental group and the control group was statistically significant ($p = 0.007$; $p = 0.044$). The mean value of the difference before and after the Positive Emotion Scale test of the experimental group ($M = 4.54$) was significantly

larger than that of the control group ($M = 0.17$); the mean value of the difference before and after the Negative Emotion Scale of the experimental group ($M = -2.65$) was significantly smaller than that of the control group ($M = -0.31$). It shows that the mindfulness education experiment can effectively promote children's emotional development.

The Index of Well-being indicates that mindfulness education is effective for improving student well-being. There was a significant difference in the scores of happiness before and after the test between the experimental group and the control group ($p = 0.003$). The mean difference of pre-test and post-test of happiness in the experimental group ($M = 5.31$) was significantly higher than that of the control group ($M = 0.21$).

Comparison between Pre-Test and Post-Test Results of the Experimental Group

After performing the paired sample T test for the data of rating scale of attention (AST) in the experimental group before and after the test, the results showed (as shown in **Table 5**): there was a significant difference between the overall data of attention between pre-test and post-test ($p = 0.006$), and the total average score of post-test of attention ($M = 32.65$) was significantly higher than the total average score of the pretest of attention ($M = 28.35$); the A and B subtests also obtained the same result.

The average score of the experimental group's post-test on mental health (MHRSP) is significantly different from that of pre-test ($p = 0.000$), and the average score of mental health in post-test was nearly 10 points less than that of the pre-test, indicating that the mindfulness education largely promotes students' development of mental health. Specifically, the mindfulness education has different degrees of influence on the various dimensions of students' mental health. According to the extent of effects by the mindfulness education, those dimensions can be successively arranged from top to the bottom in such order as behavioral disorders, personality defects, social adaptation disorders, emotional disorders, bad habits, and learning disabilities.

After analyzing the data of the Positive and Negative Emotion Scales of the experimental group after the experiment, it can be seen that there are significant differences between the positive and negative emotions ($p = 0.010$), and the total average score of post-test of the Positive Emotion Scale are 4.53 points higher than that of the pretest. The total average score of the Negative Emotion Scale of post-test is 2.65 points lower than that of the pretest. It shows that mindfulness education can enable students to gain more positive emotions and to promote the transformation from negative emotions to positive emotions.

The students in the experimental group have got better emotions. The scores of the Overall Affective Index were statistically significant ($p = 0.015$), and the total average scores of the overall emotional index of post-test ($M = 43.31$) were significantly higher than the total average scores of the Overall Affective Index of pretest; the scores of the Life Satisfaction Questionnaire of pretest and post-test were significantly different ($p = 0.000$), and the total average score of post-test ($M = 5.42$) was higher than that of the pretest ($M = 4.69$); the total scores of the Index of Well-being of pretest and post-test were statistically significant ($p = 0.005$), and the average score of the post-test of

Table 5. Descriptive Statistics of Pretest Results of the Experimental Group (n = 26).

Subscale	Pre-test		Post-test		t	p
	M	SD	M	SD		
AST A Test	9.46	0.859	9.92	0.392	-2.601	0.015*
AST B Test	18.88	8.788	22.73	3.915	-2.761	0.011*
AST Total Test	28.35	9.082	32.65	4.009	-3.014	0.006**
MHRSP Learning Disabilities	4.85	3.283	3.88	2.422	1.822	0.080
Emotional Disorders	6.15	1.515	4.54	1.392	3.789	0.001***
Personality Defects	6.54	3.455	4.73	3.471	2.950	0.007**
Social Adaptation Disorders	5.35	1.573	3.65	2.591	3.416	0.002*
Moral Defect	2.65	1.788	2.54	1.944	0.277	0.784
Bad Habits	4.27	4.035	3.19	2.698	1.886	0.071
Behavioral Disorders	6.15	2.444	4.31	2.363	3.495	0.002*
Special Obstacle	3.19	2.713	3.04	2.615	0.452	0.655
MHRSP Total Score	39.15	11.471	29.89	13.382	5.720	0.000***
Positive Emotion	30.12	9.905	34.65	8.275	-2.770	0.010**
Negative Emotion	22.92	8.275	20.27	7.102	2.231	0.035*
Overall Emotion Scale	38.73	8.586	43.31	6.078	-2.610	0.015*
Life Satisfaction Questionnaire	4.69	0.970	5.42	0.987	-4.055	0.000***
Overall Affective Index	43.42	8.650	48.73	6.472	-3.093	0.005**

Table 6. Correlation Analysis of Total Scores of Attention, Mental Health, Positive and Negative Emotions, and Happiness (Pearson).

	1	2	3	4	5
1 Attention	-				
2 Mental Health	-0.777**	-			
3 Positive Emotion	0.690**	-0.727**	-		
4 Negative Emotion	-0.658**	0.687**	-0.867**	-	
5 Happiness	0.767**	-0.818**	0.727**	-0.781**	-

Note: ** significantly correlated at .01 level (two-tailed)

the Index of Well-being was 5.31 points higher than that of the pretest.

Correlation Analysis Results

Pearson Product-moment correlation was used to analyze the difference between attention, mental health, positive emotion and negative emotion, and happiness. The correlation between each variable is shown in **Table 6**. It can be seen that there is a significant positive correlation between attention and happiness ($r = 0.767$), positive emotions ($r = 0.690$); there is a significant negative correlation between attention and negative emotions, mental health. There is a significant negative correlation between mental health

and attention, positive emotions, and happiness; there is a significant positive correlation between mental health and negative emotions. There is a significant positive correlation between happiness and positive emotions; there is a significant negative correlation between happiness and negative emotions. There is a significant negative correlation between positive emotion and negative emotion. It shows that when children's attention is developed, their psychological barriers decrease, positive emotions increase, and happiness increases. Once children's psychological disorders and negative emotion decrease, then their attention, positive emotions, and sentiment will develop. As children's emotional index and happiness increase, their negative emotions decrease, positive emotions increase, and their psychology tends to develop well.

Conclusions and Implications

According to the above analysis, the mindfulness education experiment promotes the children's attention development, mental health development, social development, emotional balance and development, happiness improvement, and also has an interactive effect, thereby promoting the overall development of children.

In this study, mindfulness education can improve children's attention stability and significantly improve their attention development. In the questionnaire, student S wrote, "When I am distracted, I can accept it and turn my attention back." Student L said, "I copied the text from the first row to the third row before, but I don't do this now." Undoubtedly, mindfulness education can significantly reduce students' learning pressure and improve their mental health. However, this study only found that the effects on emotional disorders, personality defects, social adaptation disorders and behavior disorders in mental health were significant; the effects on learning disabilities, moral defects, bad habits and mental disorders were not obvious, but according to interviews and questionnaires, mindfulness education has an effect on children's learning disabilities, morality and bad habits to some extent. For example, student G said, "When I write homework, I can write it more quietly. I made many mistakes before, but now I can get an A for many times." student D said frankly, "When I do homework or write words, I can write with mindfulness. When I can't solve the problem, I can calculate it with a pen seriously." It explains that through mindfulness education children can develop good habits.

This experimental study also proves that cultivating students to master the method of mindfulness through mindfulness education can make them control and evade negative emotions, gradually observe and feel the novelty and beauty of the present life, understand thoroughly the happiness contained in the depths of the soul, and thereby, the experience of positive emotions can be strengthened and gathered. In addition, the study also finds that the improvement of the level of mindfulness plays a significant mediating role in improving the effect of happiness, which is consistent with the research results of the researchers (Xu et al., 2015; Liu et al., 2013) and also with the qualitative findings of this study. For example, student W said, "I changed a lot after taking the mindfulness class, from fear to calm, from impatient to tolerant. I am more

patient with things.” “When I am angry and unhappy, I can breathe and calm down. When I take the mindfulness class, I feel very happy. Mindfulness adds color to my life.”

According to the above analysis, this experiment has achieved certain results and can provide some guidance for the practice of mindfulness education. However, if we want to ensure that mindfulness education plays a positively leading role in the children development, we need to do the following work.

(1) Raising Awareness, Actively Creating Conditions, and Appropriately Carrying Out Mindfulness Education

Children are in a critical period of physical and mental development, with physical and psychological development and changes in study habits and school environment, they will face psychological problems affecting, interpersonal communication, personality development, self-awareness and the pressure of study and life. Through the findings, as a new form of school education, mindfulness education plays a unique role in promoting children's development and it is an effective way to achieve children's all-round development and healthy growth. This study has shown that children mindfulness education plays a significant role in regulating children's negative emotions and promoting children's happiness. In the state of mindfulness, the student's parasympathetic (relaxation) nervous system is maximally activated, and can experience a state of joy, peace, calmness, and happiness. In mindfulness education, techniques such as body scans, mindfulness sensory awareness, mindfulness movement, mindfulness breathing, etc. are guiding students to consciously think, pay attention to and extend the awareness of the present. Mindfulness emphasizes non-judgment and acceptance; it promotes children's cognitive reassessment, and creates the conditions in order to accept the current situation. All these attributes can cultivate deeper empathy and good qualities in children. Therefore, it is necessary to add more mindfulness education and training for children, improve the quality of mindfulness, and then can promote the all-round development and healthy growth of children.

(2) Strengthening the Mindfulness Teaching Ability of Educators and Improving the Overall Development Level of Children

When educators conduct mindfulness training for children, they should pay attention to guiding children to observe their physical or psychological feelings, so that children can learn to observe and accept their current state as much as possible without any evaluation, so as to guide the emotions and ideas to be expressed. The purpose of mindfulness education is not only to achieve the goals of the established educational activities, but more importantly, how to integrate the attitudes and methods of focusing on and understanding the mind and body experience, open acceptance, and non-judgment in the whole process of education and teaching. Therefore, the words and deeds of educators are the most direct demonstration of mindfulness to students. This requires educators to have mindfulness learning experiences and continuous mindfulness practices and further education. The most important thing is to be able to practice in daily life. Only when educators are aware of themselves can they constantly feel the needs of children

to be in the “being mode,” which in turn helps to accomplish improved educational achievement and the overall development level of children.

(3) Drawing Nourishment from Related Mindfulness Projects and Localizing Western Mindfulness Education

Many countries in the West have established social institutions such as the “Mindfulness Education Association,” “Mindfulness Education Network,” and “School of Mindfulness” to actively apply mindfulness education within schools. For example, Nan Tien Institute (Australia) provides a special course for mindfulness, education transforming teachers’ in-service training to enhance mindfulness teaching helping teachers better integrate “mindfulness” into specific teaching practices. In China’s Taiwan region, the “Mindfulness Development Association” and the “Chinese Mindfulness Decompression Center” have also been established, where the positive mindfulness training practice has been actively carried out in the primary school life curriculum action research, and has achieved certain results. The development of mindfulness education projects such as these provides abundant nutrients for the orderly implementation of mindfulness education in mainland China.

However, any kind of educational theory is not a universally applicable truth, but has its relevance or cultural constraints. If the practice of mindfulness education is to be carried out in an orderly manner and achieve the expected results, it is necessary to construct a “localized” mindfulness education theory that is locally compatible, so as to provide theoretical support. To this end, we need to combine the Chinese national conditions, based on local situations and reality, to localize the Western mindfulness education theory This will encourage educators to actively carry out the exploration and practice of mindfulness education, to accomplish experiences and achievements, and construct a mindfulness education model with Chinese characteristics, thus creating conditions for laying the foundation to improve the development of children in China.■

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What Role Does School Play in Helping Socioeconomically Disadvantaged Students Succeed against the Odds?

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Abstract. Based on the data of a large scale survey conducted by Collaborative Innovation Center of Assessment Toward Basic Education Quality at Beijing Normal University, this study examined the role of school in reducing education inequality. The results showed that schools concentrated with resilient students had higher mean socioeconomic status (SES) and SES heterogeneity, more education resources, higher teaching quality, and more positive school climate, and these factors also functioned as significant predictors of academic resilience. Providing socioeconomically disadvantaged students with access to both high SES schools and enriched school resources can even the education inequality related to family background. In order to promote education equality, policymakers and education practitioners should take measures to reduce the degree of stratification and encourage student integration, promote equal distribution of high quality education resources among schools, enhance teachers' ability to effectively use individualized, cooperative and inquiry teaching methods, and build a supportive climate.

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Introduction

SINCE the release of Coleman Report in 1966, the impact of schools on students' achievement and education inequality has been a hot topic in educational sociology and educational economics. It has been widely studied regarding the role of schools in students' academic development and in education inequality, and formed distinct views such as schools can reproduce and expand education inequality, or schools can compensate for the cognitive gap between students with different family backgrounds (Raudenbush & Eschmann, 2015).

Regarding school's role in promoting education inequality has been dominating contemporary sociology of education, because it was recognized that schools enlarge the learning outcome inequality, which consequently expands social inequality. However, accumulating empirical studies revealed that educational inequality, in some other aspects such as the gap between students' academic achievement, cognitive and non-cognitive skills is strongly related to family socioeconomic status (SES), in which schools had much larger compensation effect than expected (Alexander, et al., 2001; Downey, et al., 2004; Downey & Condrón, 2016; Ready, 2010). As the resource substitution theory indicated that the existence of multiple resources makes the outcomes less dependent on any particular resource, i.e., in an individual's development, one type of resource can compensate the other that was absent (Ross & Mirowsky, 2006). For students from low SES families, they are at a prominent disadvantage in the possession of family economic, cultural and social capital, their academic performances would largely depend on the accessible school resources, so they would benefit more from schools where the quality improved. In other words, access to high-quality school will make up the negative impact resulted from the lack of family resources. Accordingly, the chance for individuals with disadvantaged family background to become academically resilient students^L will be significantly increased if the school quality improved. Based on the basic theoretical model of education effectiveness research proposed by Klieme et al. (2014), this study aimed to explore the influence of school input and process factors such as the composition of school, school resources, teaching quality, and school climate on disadvantaged students' academic resilience, and to test the applicability of "resource substitution theory" in the school education outcomes.

Literature Review

Based on the educational production function, studies analyzed the role of school factors that affect students' development under the theoretical frame as "background - input - process - output", of which the factors include school composition, school resources, teaching quality and school environment (Borman & Dowling, 2010; Du & Yang, 2012; OECD, 2005; Ren & Xin, 2011; Xie & Zhang, 2018).

School Composition and the Development of Disadvantaged Students

As a result of residential segregation and the implementation of nearby enrollment policy, there is a distinct social class division between schools. Students from disadvantaged families are more likely to be enrolled in socioeconomically disadvantaged schools. The socioeconomic composition of a school reflects the degree of social class division, which is widely considered as an important factor to explain the difference in students' performance between schools. Investigation into the relationship between school composition and students' development provides an essential reference for education policy reform and practice.

School socioeconomic composition functions as an indicator for students' achievement that shows a significant heterogeneity. Studies have shown that the link between school socioeconomic composition and academic performance was stronger in disadvantaged students. From the data of the Second International Mathematical Comparative Study, Zimmer et al. (2000) found that the peer effect was significant enough to affect students' academic achievement for those who aged 13 to 14 years and especially for students with lower mathematical ability across five participating countries. Using the data of the Trends in International Mathematics and Science Study (TIMSS) 2011, Gustafsson (2016) found that, in most countries or regions, the average school SES was the most remarkable moderating variable of the relationship between family SES and the eighth grade students' achievement, which indicated that education system can somewhat compensate the education inequality that related to family background, and the most effective education system will help disadvantaged students to achieve better results through building up a safe, orderly and achievement-oriented school environment, as well as providing higher quality instruction. As reviewed by Anjani (2016) that the expansion of heterogeneity of students' SES within a school was more conducive to their development, that is, the integration of students from various social status can be a policy used to promote academic development of disadvantaged students.

However, contrast results from different studies had not found a definite relationship between school socioeconomic composition and academic performance. Rumberger et al. (2005) conducted a multilevel analysis on the data of National Education Longitudinal Study, and no significant difference was found regarding the impact of school SES on the academic achievement between advantaged and disadvantaged students. The descriptive study conducted by Perry et al. (2010) on the Australian PISA samples also found that the achievement gap between high and low SES schools was almost the same among different individuals with various SES levels.

In sum, the school composition has a heterogeneous effect on students' achievement, and providing disadvantaged students with opportunities for entering relatively higher SES and more heterogeneous schools is one of the ways to compensate for the lack of family education resources. However, direct evidence was yet found on this relationship. Based on relevant findings and the resource substitution theory, we hypothesized that,

- H1a: The higher the average SES for schools, the higher the probability that disadvantaged students would be resilient.

- H1b: Disadvantaged students enrolled into high SES schools would significantly reduce learning outcome gap that was related to family background.
- H2a: The greater the SES heterogeneity for schools, the higher the probability that disadvantaged students would be resilient.
- H2b: Disadvantaged students enrolled into high heterogeneous SES schools would significantly reduce learning outcome gap that was related to family background.

School Educational Resources and the Development of Disadvantaged Students

Investigation into the effect of school educational resources on students' academic performance would provide a basis for the policy formulation to allocate resources and for the implementation of measures to promote a balanced development of education. In general, variables such as the average education expenditure, proportion of teachers who hold different types of degrees or qualifications, teachers' work experience, and school size were regarded as school education resources to carrying out survey and experimental studies, and then drawing certain type of relationship between these resources indicators and students' achievements.

It has showed that the heterogeneity of school education resources had substantial effect on students' achievement, and disadvantaged students who are lack of family resources would benefit more from the enriched school resources. At least three significant evidences support this relationship. First of all, the school quality has a bigger impact on students' performance in low-resourced countries. Heyneman and Loxley (1983) conducted a comparative study of 28 countries, and found that the effect of school education resources on elementary students' achievement displayed different patterns in different education systems (so-called "Heyneman–Loxley effect", HL effect), namely the lower the country's per capita income, the smaller the impact of family SES on students' achievement, the greater the impact of schools and teachers' quality on students' achievement. Baker et al. (2002) found that although HL effect has subsided somewhat, it still exists in those countries affected by extreme poverty, instability and infectious diseases. The most recent study conducted in the developing countries also verified that school resources had significant impact on students' performance (Ndlovu, 2018). Second, school education resources have significant impact on the academic performance of disadvantaged students. Based on the comparative data provided by PISA, Agasisti et al. (2014) used multilevel logit regression to find that the quality of school education resources, the proportion of qualified teachers, extra-curricular activities significantly improved the possibility of disadvantaged students to be resilient, whereas class size, computer per student were of little importance (Agasisti, et al., 2018). Based on the samples of the fourth to eighth graders, Southworth (2010) adopted multilevel linear regression to find that improving the quality of teachers and school resources reduced the influence of school ethnic composition and socio-economic composition on students' academic achievements indicating that school could compensate for disadvantaged students. Third, the influence of school educational resources on students with low SES is

relatively greater. Studies have found that school educational resources have bigger impact on disadvantaged students than the advantaged peers, such as the positive effect of small-class teaching on minority students was more significant than white students (Finn & Achilles, 1999), and teacher quality and student/teacher ratio had significant impact on the relationship between family SES and students' achievement (Hou & Shen, 2014; Nye, et al., 2004). These results suggested that school educational resources play a compensating role in helping disadvantaged students to develop. However, few studies observed the heterogeneous effect of school resources on different groups of students, and more empirical evidence is needed regarding the impact of school resources on the academic development of disadvantaged students'.

Based on previous findings and the resource substitution theory, and to examine the impact of school education resources on the academic development of disadvantaged students, we hypothesized that,

- H3a: Access of disadvantaged students to schools with more sufficient educational resources would significantly increase their chances to become resilient students.
- H3b: Access for disadvantaged students to schools with more sufficient educational resources would significantly reduce learning outcome inequality that was related to family background.

Teaching Quality and the Development of Disadvantaged Students

Observable teaching methods and teaching practices are important indicators of teaching quality, which represent middle-leveled learning opportunity and reflect a more authentic process of educational equity. Variables such as the frequency of teachers' use of cognitive activation, adaptive teaching, inquiry-based teaching methods, as well as classroom management, and classroom learning environment are used to indicate teaching quality, and correspondingly their impact on students' academic development was observed.

Studies have shown that teaching quality affects students' learning motivation and achievement, and high-quality teaching had a greater impact on students who were at risk of academic failure. Klieme et al. (2009) proposed a basic model including cognitive activation, classroom management and supportive climate, which assumed that cognitive activation influences students' mastering and understanding of knowledge through deep processing and self-reflection; structured and clearly-defined classroom management affects students' achievement through time on task; and supportive climate influences students' learning motivation through the mediation of mood and emotion. Studies based on data from the Tennessee STAR plan indicated that all four grade students can benefit from effective teaching, and evidence showed that the effect of teaching on math was more obvious in schools concentrated with minority students although the overall difference of genders, races or SES backgrounds was small (Konstantopoulos & Chung, 2011). Studies of fourth grade students in six European countries found that the teacher factors in the education effectiveness dynamic model that includes structured teaching, questioning and problem solving, higher order prob-

lem solving thinking skills, providing opportunities to practice and applicate new knowledge, quality of interaction between teachers and students, and formative learning assessment had much bigger impact on the academic achievements of students with low performance, but none of these factors had larger effect on students with good performance (Vanlaar et al., 2016). Studies of Latino students from low-income families showed that the flexibility and practicability of teaching had a positive effect on students' academic resilience (Sosa & Gomez, 2012). Studies of elementary students in South American showed that, compared with non-resilient students, resilient students were more likely to report that teachers providing more feedback and teaching arrangements were reasonable (Waxman et al., 1997). Teaching strategies, such as group learning and encouraging each other, helped promote educational resilience (Downey, 2008). These results suggested that maximizing students' meaningful participation in the class through teachers' effective teaching is an important way to enhance academic resilience.

According to previous research findings, we hypothesized that,

- H4a: Disadvantaged students entering schools with better teaching quality would significantly increase their probability to become resilient students.
- H4b: Disadvantaged students entering schools with better teaching quality would significantly reduce learning outcome inequality related to family background.

School Climate and the Development of Disadvantaged Students

School climate is a relatively persistent and stable “soft environment” characteristic that distinguishes one school from the other. It is an important aspect of the school education process. It was described that school climate is the order and discipline, teacher-student relationship, academic pressure, teachers' morale, etc., through which the correlation with students' academic development was investigated to provide reference for school-based improvement.

Studies have shown that positive school climate is protective to resilience and weakens the negative impact of family SES on students' achievements. Children exposed to risk factors would benefit from supportive school relationships and achieve sustainable academic success (Wang et al., 1998). A follow-up study of low-SES minority elementary students in the United States showed that a safe and orderly school environment and positive teacher-student relationship are contributors to distinguish resilient students from non-resilient ones (Borman & Rachuba, 2000). A multilevel logit study based on PISA 2006-2015 data indicated that, for most participating countries and regions, schools with positive class environment were more likely to produce disadvantaged resilient students (Agasisti, et al., 2018). A study of American 15-year-old students found that the correlation between SES and student achievements in an orderly classroom condition was weaker than that from a negative condition (Cheema & Kitsantas, 2014). A multilevel regression study of Israel's nationally representative sample of elementary and middle schools suggested that, school climate has a compensating and moderating effect for the relationship between school SES and students'

achievements, which could be described as the achievement gap between students with different family backgrounds is much smaller under positive school climate condition (Berkowitz, et al., 2015). In addition, a meta-analysis of 78 studies on school/classroom climate and students' academic performance from 2000 to 2015 showed that positive school and class climate reduced the negative impact of low SES on academic performance (Berkowitz, et al., 2017). These findings suggested that the positive school climate contributed to the academic development of disadvantaged students and reduced educational inequalities related to family background.

In sum, supportive school and class climate has positive impact on students' academic performance and narrows the academic gap among schools and students with different socio-economic status. Therefore, we hypothesized that,

- H5a: Disadvantaged students entering a school with positive learning climate would increase their probability to become resilient students.
- H5b: Access of disadvantaged students to schools with positive learning climate would reduce outcome inequality related to family background.

Methods

Data

The data were from the "Regional Assessment of Education Quality" project jointly carried out by Collaborative Innovation Center of Assessment toward Basic Education Quality at Beijing Normal University and an eastern province in 2014. Stratified three-stage unequal probability sampling method was adopted to select the fifth and ninth grade students, their parents, teachers and principals from 11 cities in the participating province for the academic test or survey. The project collected data of students' moral behavior, physical and mental health, academic development, interests and academic burden as well as information regarding their families and schools. A total of 30,743 grade 9 students from 610 junior high schools were enrolled in this study. Among them, 84.6% were public schools and 15.4% were private schools. Urban schools accounted for 22.5%, county-level schools were 27.9%, and rural schools were about 49.7%. Besides, 48.7% were female students, 52.8% were from one-child families, and 92.7% had received more than one year of preschool education.

Variables

The school characteristic variables (**Table 1**) include: i) mean school SES and SES heterogeneity that reflect student composition and peer group characteristics; ii) school education resources including the adequacy of various teaching materials, courses and extracurricular activities that reflect the educational input; iii) school teaching quality including the use of individualized, cooperative and inquiry teaching strategies that reflects the learning opportunities; iv) school climate that reflects the learning environment.

Table 1. Variables.	
Variable	Explanation
SES Category	The mean of parents' highest education level, parents' highest occupational status and family property score was calculated after standardization and converted into a variable of 0-10. Then, according to the criteria of top/bottom 1/3, it was divided into disadvantaged students, average students and advantaged students.
Academic Achievement	Students' standardized test scores of Chinese, mathematics and science are averaged after standardization, and then converted into variables of 0 to 100.
Academic Resilient	Firstly, the residuals of the regression of academic achievement on SES and SES square terms are regarded as academic resilience. Then, academic resilience was classified into high, medium and low performance by top/bottom 1/3 standard. Finally, the top 1/3 group was defined as resilient students, and the bottom 1/3 group was defined as non-resilient students.
Gender	Girl=1, Boy=0.
Age	Calculated according to the date of birth of the student report.
Only Child	Single child in the family=1, others=0.
Preschool Education	1 year or more preschool education=1, less than 1 year=0.
School Mean SES	Mean of students' family SES in the school.
SES Heterogeneity	Standard deviation of students' family SES in the school.
Educational Resources	The scores of the adequacy of school infrastructure and teaching materials, extracurricular activities and school-based courses are standardized and averaged, and then converted into a variable of 0-10.
Teaching Quality	The mean of students' evaluation about teachers' individualized, collaborative and inquiry teaching, which is converted into a variable of 0-10 at the school level.
School Climate	The mean of students' evaluation about teachers' behavior in respect, trust, fairness and justice, which is converted into a variable of 0-10 at the school level.
Public/Private School	Private school=1, public school=0.
School in the City	School in the city=1, others=0.
School in the County	School in the county=1, others=0.
School Size	Total school enrollment/100.

As showed in the **Table 2**, for the whole sample, the mean of students' academic performance and academic resilience were 65.156 and 59.183, respectively. The average age was 14.455. The means of school SES, SES heterogeneity, educational resources, teaching quality and school climate were 4.271, 1.344, 6.793, 5.063 and 5.111, respectively. The average enrollment of schools was 1,198. For the sub-samples, the mean academic performance of disadvantaged students was significantly higher than that of non-disadvantaged students, and the average age of disadvantaged students was significantly higher than non-disadvantaged ones. Advantaged schools had highest² score in mean SES, SES heterogeneity, educational resources, teaching quality, school

Table 2. Descriptive Statistics.

	Variable	Full Sample		Split Sample			F
		M	SD	Disadvantaged	Avg	Advantaged	
Stdt	Academic Achievement	65.16	17.37	58.39	65.15	72.11	1,823.02***
	Age	14.46	0.63	14.56	14.45	14.36	253.86***
Schl	Schl Mean SES	4.27	1.16	3.13	4.05	5.64	1,217.74***
	SES Heterogeneity	1.34	0.27	1.11	1.33	1.59	331.59***
	Edu Resources	6.79	1.90	5.75	6.89	7.73	67.37***
	Teaching Quality	5.06	1.48	4.42	5.07	5.71	44.12***
	Schl Climate	5.11	1.37	4.63	5.09	5.61	28.08***
	School Size	11.98	8.30	7.50	12.81	15.62	59.68***

Note: ***: $p < 0.001$, **: $p < 0.01$, *: $p < 0.05$. M: Mean; Avg: Average; SD: Standard Deviation; Stdt: Student Level; Schl: School; Edu: Education.

climate and school size; schools with middle-level status scored the second high; and disadvantaged schools scored the lowest in all school factors.

The overall development of disadvantaged students' was in general worse than those from the average and advantaged families, and the quality index of disadvantaged schools was significantly lower than advantaged schools reflecting the idea that family background has significant effect on children's human capital accumulation. The uneven distribution of education resources between different schools was an important mechanism of the education inequality. These differences demonstrated the problems that disadvantaged students might have, and these differences within this group provide potential key to solve the development problems. Therefore, we, in this study, explored the school factors associated with disadvantaged students with different academic development outcomes (resilient versus non-resilient), and explained how schools provide educational compensation for disadvantaged students.

Statistical Analysis

Multivariate analysis of variance (MANOVA) was used to explore the characteristic differences among schools with different proportions of resilient students; multilevel logit regression was used to explore the influence of school factors on the odds ratio (OR) of disadvantaged students becoming resilient, and multilevel linear regression was used to explore which school factors narrow the achievement gap between students with different family background. All analyses were conducted in Stata13.0.

Results

Characteristics of the Schools with Different Proportion of Resilient Students

In order to illustrate the relationship between schools and the academic resilience of disadvantaged students, we first analyzed the characteristics of schools with different ratios of resilience students. Schools were divided into three groups according to the proportion of disadvantaged resilient students, i.e., low resilient schools, medium resilient schools and high resilient schools. School grouping was the independent variable and the five characteristics were dependent variables. Through MANOVA and post hoc tests, we examined the differences among different groups of schools. The judgment rules of mean difference effect size (Cohen's d) listed by Pu (2014) ($|0.2|$, $|0.5|$, $|0.8|$ represent small, medium, and large effects, respectively) were taken as the criteria for comparisons among different school groups. The results are presented in the **Table 3**. It showed that different school groups had significant differences in all the characteristic variables ($p < 0.001$), and the score of high resilient schools was higher than that of medium and low resilient schools.

The average SES of high resilient schools was significantly higher than that of medium and low resilient schools and the effect size was 1.233 and 1.434, respectively. The SES heterogeneity of high resilient schools was significantly higher than that of medium and low resilient schools and the effect size was 0.152 and 0.214, respectively. The education resource adequacy at high resilient schools was significantly higher than that of medium and low resilient schools and the effect size was 0.449 and 0.564, respectively. The teaching quality of high resilient schools was significantly higher than that of medium and low resilient schools and the effect size was 0.346 and 0.550, respectively. The school climate of high resilient schools was significantly higher than that of medium and low resilient schools and the effect size was 0.220 and 0.247, respectively.

These results indicated that, the quality of high resilient schools was significantly higher than both medium and low resilient schools, which manifested as higher average SES, greater SES heterogeneity, more education resources, higher teaching quality and more positive school climate. This is consistent with previous studies. In terms of the socio-economic composition of school, study based on the national assessment of educational progress data in the United States found that, the school SES of high performing African-American eighth graders was much higher than that of the low achieving students (Lee, et al., 1991). Based on the PISA 2006 data, study was conducted and found that the average economic, social and cultural status of the schools attended by resilient students was slightly higher than that of the disadvantaged low-performing students (OECD, 2011). Based on the education quality assessment data in China, He et al. (2016) found that the average SES of fourth grade migrant children with high academic achievement was significantly higher than the migrant children with low academic achievement. In terms of school resources, a study of PISA 2009 Italian students found that the education resource quality of the schools with the lowest quarter of resilient students was significantly lower than other peer schools, and the difference in the extracurricular activity index was especially huge (Agasisti & Longobardi, 2014).

Table 3. Characteristics of Schools with Different Proportion of Resilient Students.

School group	Stat.	School Factors					
		Mean SES	SES Hetero.	Edu Resources	Teach Quality	Schl Climate	
Low Resilient Schools	Mean	3.787	1.233	6.273	4.634	4.953	
	SD	1.027	0.249	2.122	1.612	1.422	
Medium Resilient Schools	Mean	3.912	1.306	6.587	4.991	4.998	
	SD	0.817	0.257	1.659	1.262	1.298	
High Resilient Schools	Mean	4.875	1.483	7.340	5.454	5.285	
	SD	1.012	0.248	1.676	1.375	1.339	
Group Difference	<i>F</i>	76.313***	51.477***	17.715***	16.490***	3.499***	
	η^2	0.206	0.149	0.057	0.053	0.012	
Post-hoc Comparison	High-Low	Mean-Difference	1.088**	0.249**	1.068**	0.820**	0.333*
		<i>Cohen'd</i>	1.434	0.214	0.564	0.550	0.247
	High-Medium	Mean-Difference	0.963**	0.177**	0.753**	0.463**	0.287*
		<i>Cohen'd</i>	1.233	0.152	0.449	0.346	0.220

Note: ***: $p < 0.001$, **: $p < 0.01$, *: $p < 0.05$. Schl: School; Edu: Education; Hetero: Heterogeneity; Stat: Statistics.

Regarding teaching quality, a classroom observation study of schools concentrated with low family income Hispanic students in the US showed that, quantity and quality of the academic interaction between teachers and students in the reading and mathematics classes (teachers took student-oriented teaching strategies such as cognitive guidance, cooperative learning, and understanding student at social and interpersonal levels) were the most influential variables of the academic results of low-income Hispanic students (Waxman, et al., 2008). On school climate, a study carried out in public schools in Canada found that resilient schools (“beating the odds schools”) scored the 82nd percentile in the school climate, and the long-term underperforming schools scored in the 14th percentile; after accounting for a variety of factors such as characteristics of student organizations, school size and human resources, the climate of resilient schools was still more positive than the other schools (Voight et al., 2013), suggesting that school climate was an important distinguishing characteristic between “resilient school” and “non-resilient school”.

The Influence of School Factors on the Academic Resilience of Disadvantaged Students

We built up a series of two-level logistic regression models which included school average SES, SES heterogeneity, education resources, teaching quality and school climate as the key independent variables respectively to examine the influence of school factors on the academic resilience of disadvantaged students after accounting for the basic characteristics of students and schools. The results are shown in the **Table 4**.

Table 4. The Influence of School Factors on the Possibility of Disadvantaged Students Becoming Resilient.

Variables	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5
Gender	1.454 ^{***} (0.087)	1.464 ^{***} (0.079)	1.455 ^{***} (0.078)	1.455 ^{***} (0.078)	1.455 ^{***} (0.078)	1.455 ^{***} (0.078)
Age	0.822 ^{***} (0.035)	0.822 ^{***} (0.033)	0.825 ^{***} (0.033)	0.821 ^{***} (0.033)	0.819 ^{***} (0.033)	0.82 ^{***} (0.033)
Only Child	1.093 (0.894)	1.064 (0.058)	1.082 (0.060)	1.084 (0.060)	1.088 (0.060)	1.09 (0.060)
Preschool Education	0.894 (0.079)	0.867 (0.073)	0.879 (0.074)	0.889 (0.075)	0.89 (0.075)	0.891 (0.075)
City School	1.422 [*] (0.250)	0.485 ^{***} (0.082)	0.836 (0.139)	1.192 (0.190)	1.275 (0.203)	1.362 (0.222)
County School	1.671 ^{***} (0.249)	0.813 (0.102)	1.047 (0.138)	1.562 ^{***} (0.195)	1.515 ^{***} (0.190)	1.618 ^{***} (0.209)
Private School	0.795 (0.235)	0.807 (0.125)	0.888 (0.145)	0.894 (0.149)	0.810 (0.134)	0.793 (0.134)
School Size	1.023 [*] (0.012)	0.997 (0.006)	1.008 (0.006)	1.015 [*] (0.006)	1.02 ^{**} (0.006)	1.022 ^{***} (0.007)
School Mean SES		2.524 ^{***} (0.185)				
SES Heterogeneity			7.468 ^{***} (1.706)			
Education Resources				1.226 ^{***} (0.035)		
Teaching Quality					1.293 ^{***} (0.048)	
School Climate						1.144 ^{***} (0.045)
Constant	11.079 ^{***} (7.322)	0.581 (0.379)	1.105 (0.737)	3.348 (2.132)	3.577 [*] (2.275)	6.004 ^{**} (3.855)
N of Students	7630	7630	7630	7630	7630	7630
N of Schools	585	585	585	585	585	585

Note: 1. Exp(B) is presented in the table and standard error in parentheses.

2. ***: $p < 0.001$, **: $p < 0.01$, *: $p < 0.05$.

According to model 0 (only control variables were included), gender, age, school location and school size had significant influence on the probability of disadvantaged students to become resilient, whereas the coefficient of single child or not, pre-school education and private school were not significantly related to this probability. To be specific, the odds ratio of disadvantaged girls becoming resilient was 1.454 times higher than the disadvantaged boys; with one-year increase in age as unit, the odds ratio of disadvantaged students becoming resilient was decreased by 17.8%. The odds ratio of disadvantaged students in urban schools and county-level schools to become resilient

was 1.422 and 1.671 times higher than those from rural schools, respectively. For every additional 100 students in school size, the odds ratio of disadvantaged students becoming resilient increased by 2.3%. These results indicated that, compared with their peers, male students, older students (who enrolled in school later than usual or have had repeated grades), rural school students and small school students were more likely to face the risk of academic failure caused by low family SES, so they need more attention being paid by their parents and educators.

According to models 1 to 5, after accounting for the effect of students and school characteristics, the five factors were all significant predictors of the probability of disadvantaged students becoming resilient, which could be understood as: i) for one-unit increase in the average school SES, the odds ratio of disadvantaged students becoming resilient (OR, the same below) increases by 152.4%. ii) For one-unit increase in the SES heterogeneity of school, the OR increases by 646.8%. iii) For one-unit increase in school education resources, the OR increases by 22.6%. iv) For one-unit increase in the teaching quality of the school, the OR increases by 29.3%. v) For every unit improvement of school climate, the OR increases by 14.4%. Therefore, the hypotheses H1a, H2a, H3a, H4a and H5a were verified.

The Role of School in Reducing Achievement Gap Related to Family Background

For students in different SES groups, we set a series of multilevel linear regression models which contained the key explanatory variables at the school level including the basic characteristics of students and schools and family capital, so as to investigate the effect of each school factor on the academic performance of students. The results are shown in the **Table 5**. After accounting for the controlling variables, five school factors significantly and positively predicted each group's academic achievement indicating that junior high school students with different family SES all benefited from the improvement of school average SES, school SES heterogeneity, school education resources, teaching quality and school climate; and with the exception of school climate, the effect of the other four school factors on students' academic performance increased as family SES decreased.

In order to compare the difference between the effects of school factors on three groups of students, we used the method that was proposed by Lian (2017) that includes the interaction terms to test whether the disadvantaged or the advantaged group benefited more from school improvement. First, we introduced a dummy variable D_i ($D_i=1$ indicates disadvantaged group, and $D_i=0$ indicates advantaged group) to represent the student group. Second, we included the interaction terms of dummy variable D_i and all independent variables in the multilevel linear regression equation. For example, the academic performance was the dependent variable, the school average SES was the core independent variable, we constructed the interaction term of the D_i with all the controlling variables (gender, age, single child or not, preschool education; family economic capital, family cultural capital, family social capital; school location, private/public, school size) and school average SES in the equation. Third, we ran the re-

Table 5. The Differential Impact of School Factors on Different Group of Students.

Variable	Split-Sample Regression				Test for coefficient difference between disadvantaged and advantaged groups
	Full Sample	Disadvantaged Students	Average Students	Advantaged Students	
Student Characteristics	Included	Included	Included	Included	Included
School Characteristics	Included	Included	Included	Included	Included
School Mean SES	6.099 ^{***} (0.299)	6.539 ^{***} (0.437)	5.693 ^{***} (0.361)	4.673 ^{***} (0.326)	0.899 [*] (0.444)
SES Heterogeneity	14.21 ^{***} (1.397)	12.840 ^{***} (1.568)	12.473 ^{***} (1.402)	9.993 ^{***} (1.357)	0.033 (1.259)
Educational Resources	1.547 ^{***} (0.190)	1.536 ^{***} (0.194)	1.313 ^{***} (0.201)	1.024 ^{***} (0.194)	0.343 [*] (0.157)
Teaching Quality	1.93 ^{***} (0.224)	1.768 ^{***} (0.248)	1.708 ^{***} (0.226)	1.628 ^{***} (0.225)	-0.082 (0.207)
School Climate	1.206 ^{***} (0.238)	0.908 ^{***} (0.268)	1.038 ^{***} (0.209)	1.114 ^{***} (0.236)	-0.313 (0.212)
N of Schools	610	592	610	588	610
N of Students	30,743	10,585	9,844	10,314	20,899

Note: 1. Student characteristics include gender, age, family structure (only child of not), preschool education as well as family economic capital, cultural capital and social capital; school characteristics include school location, school size, private/public school.

2. ***: $p < 0.001$, *: $p < 0.01$, *: $p < 0.05$.

3. Standard error in parentheses.

gression model and paid attention to coefficients of the interaction of Di and the core independent variable. In the example above, the positive coefficient of the interaction term means that school average SES had a stronger effect on the academic performance in disadvantaged students; the negative coefficient of the interaction term indicates that school average SES had a stronger effect on the academic performance in advantaged student group. For the model with school SES heterogeneity, school education resources, school teaching quality and school climate as the core independent variables, the regression coefficient difference test of disadvantaged and advantaged students was also carried out according to the similar steps. The results are shown in the **Table 5**.

The coefficient of the interaction terms between schools' mean SES, school education resources and dummy variable were positively significant indicating that disadvantaged students gained more achievement benefits from the improvement of school average social status and school education resources. The coefficient of the interaction terms between SES heterogeneity, teaching quality, school climate and dummy variable were not significant, which indicated that disadvantaged students had basically the same achievement as disadvantaged students from the expansion of school SES heterogeneity,

improvement of school teaching quality and improvement of school climate. Therefore, hypotheses H1b and H3b were verified, but hypotheses H2b, H4b and H5b were not verified.

Discussion

The Role of School Composition

Based on the large scale survey data conducted by Collaborative Innovation Center of Assessment toward Basic Education Quality in China, our empirical study found that school average SES can be used to predict the probability of disadvantaged students to become resilient, as well as to narrow the education inequality related to family background, which confirmed previous findings such as “school socio-economic composition was significantly and positively related to students’ academic performance” (Palardy, 2013; Perry, 2012) and “the average school SES could predict the possibility of disadvantaged students’ academic resilience” (Agasisti, et al., 2018). Different explanations exist regarding the possible reasons why socio-economically disadvantaged students benefit from their peers who came from families with high SES. First, according to the endogenous effect of the social interaction (or social contagion effects) (Manski, 1993), peers’ learning motivation and academic performance would directly influence student’s academic achievement and to get them been more similar with their peers. Disadvantaged students who had peers with higher family SES generally developed higher self-education expectations (Wu & Huang, 2010) and experienced fewer behavioral problems (Kahlenberg, 2012). Disadvantaged students in higher-SES classes or schools might face pressure from social norms to become more like their peers, thereby spending more time on their learning and achieving better results than expected. Second, socio-economically advantaged schools have more explicit and implicit resources such as higher-quality teachers, accumulated teaching and course resources, and potential resources from the community and parents as well. Disadvantaged students who were enrolled in these advantaged schools would automatically get access to these resources that would greatly compensate for the lack of family education resources. Third, in schools with higher SES, teachers there usually have higher expectations on students’ performance, and then they would adopt higher standards for students and implement them in teaching. This kind of teaching strategy is beneficial to disadvantaged students. Fourth, disadvantaged students in higher-SES schools might receive more educational involvement from parents and more support from teachers, which would help them to develop positive psychological traits and valuable non-cognitive skills, thus achieve higher grades and narrow the achievement gap to advantaged peers.

Why does the increase of SES heterogeneity in school promote academic resilience of disadvantaged students? First of all, a significant positive correlation exists between the average school SES and SES heterogeneity. In our study, the correlation coefficient between them was 0.711. Disadvantaged students who were enrolled in heterogeneous schools have more relatively advantaged peers than those in the homogeneous schools. According to our explanations mentioned above, these students will benefit

from the positive peer effects. Second, socioeconomic diversity reduces the negative impact of poverty on the brain. Continued pressure brought by poverty and fear would pass negative impact on the prefrontal executive function, and make individual's ability to solve problems, set goals and complete task be restrained (Wang & Zhou, 2017). Relocating these disadvantaged individuals from persistent poverty pressure to schools with high integration of SES will produce positive results. Third, diversity promotes individual's cognition development. According to Piaget's cognitive development theory, children's cognition development is partially due to the imbalance of conflicts and diversity, and being in a diversified environment will promote individual's positive thinking ability, intellectual input and perspective formation, which contribute to good learning results (Conwayturner, 2016).

The Role of School Education Resources

This study found that the adequacy of school education resources positively predicted the probability of disadvantaged students for becoming resilient and reduced the educational inequality associated with family background indicating that school education resources indeed play a part in compensating for the development of disadvantaged students. This finding was consistent with the results on the effect of school curriculum and teaching resources. Using the PISA 2009 data of 15 EU countries, Agasisti et al. (2017) found that disadvantaged students who were enrolled in schools with more extracurricular activities and higher quantity and quality of resources were more likely to become academically resilient. Based on the data of Large-Scale Education Quality Assessment in China, He (2013) found that the student-teacher ratio and the number of math classes per week had a significant positive impact on the academic resilience of migrant and left-behind children. Students with low family SES gain significant benefit from adequate school education resources, probably because there may not have that much opportunity for them to participate in cultural activities at home, whereas the courses and extracurricular activities that schools provide can exactly help them to develop a sense of belonging and school identity, thus motivate them to learn more to improve academic performance and narrow the gap to the advantaged peers.

The Effect of School Teaching Quality

Our study revealed that the teaching quality of a school positively predicts the probability of disadvantaged students to become resilient, and provided new evidence that schools providing students with more meaningful learning opportunities such as differentiation, cooperation and inquiry learning could successfully cultivate academic resilience (Wang, et al., 1998). Using differentiating teaching strategy, the teachers have the opportunity to know their students more such as their difference/gaps in proficiency, ability to understand and knowledge use, learning interests and quality, and set up more appropriate teaching goals and use more reasonable teaching schedule to guide each individual student accordingly. With the help of teachers, the academic difficulties faced by disadvantaged students will be solved to a large extent, their confidence in learning and their motivation to explore new knowledge are also greatly promoted,

which are helpful to give a full play to their potential and make their academic performance more reliant on their own effort. Using cooperative teaching strategy, students have more opportunities to discuss and communicate, and establish close relationship with their peers and teachers, and then their abilities to communicate, listen and cooperate, and their initiative, creativity and sense of competence all are greatly improved. A democratic and harmonious learning climate helps students to develop a more positive emotional attitude to schools and learning, and then put more effort in learning activities. Using inquiry-based teaching strategy, students have more opportunities to participate in activities such as raising questions, making assumptions, designing plans, analyzing results and drawing conclusions, and also have more opportunities to communicate, present and reflect that not only help to deepen their understanding of knowledge, but also cultivate their interpersonal skills. Inquiry-based classes can enhance students' autonomy and have been showing to be helpful to students' learning.

The Effect of School Climate

This study found that positive school climate is a significant predictor of the academic resilience of disadvantaged students, and provided new evidence that positive school climate is significantly correlated with academic success in low SES schools, and that support from important characters are the key reasons for them to achieve good performance. Studies on the relationship between school climate and academic success in public middle schools in Canada showed that students in schools with high school climate scores (top 5%) were 10 times more likely to be resilient than those in schools with average scores (Voight, et al., 2013). In a meta-analysis of 99 articles about the correlation between teacher-student relationship and academic achievement ranging from pre-school to high school, the effect size of positive/negative teacher-student relationship and students' academic achievements was small to medium, and teacher-student relationship had more influence on low SES students' academic achievement, and negative teacher-student relationship had more destructive influence on the academic development of students with learning difficulties or school failure risks (Roorda, et al., 2011). The resilience and youth development model that derived from ecological system theory assumed that teenagers have psychological needs such as safety, love and sense of belonging, and the fulfillment of these needs largely depends on the protective factors and resources provided by school, families, society, and peer groups (including close relationship, high expectations, and meaningful participation opportunity). If external resources are able to meet their psychological needs, individuals will develop resilient traits (such as cooperation, empathy and self-efficacy), and these traits will protect children from the adverse effects of the risk factors and help to obtain good development (Li & Zhang, 2006). According to this model, positive school climate, serving as an external environment support, will help to satisfy students' basic needs such as building relationships, developing competence, and improving their psychological capital to cope with adversity, and becoming academically resilient.

Implications

From our study, we drew conclusions that showed significant differences in terms of school quality indicators between resilient and non-resilient schools, i.e., school quality indicators positively predicted the probability of disadvantaged students to become resilient, and school mean SES, school education resources significantly narrowed the achievement gap that related to family SES. Based on these, we put forward the following four suggestions to promote equal education.

First, the Government and Educational Authority Should Try to Reduce the Social Class Division of Students and Promote the Integration of School Students.

Governments and educational departments at all levels need to promote balanced development of compulsory education, strengthen the exchange and sharing of teachers, management experience, curriculum and resources between schools and different regions, narrow the gap in teachers and school conditions, even the imbalanced phenomenon of high SES student's concentration in some schools caused by school enrollment, and adjust the school social composition. In terms of school admission policy, we suggest the number of high SES students in quality schools must be strictly controlled, the access probability of disadvantaged students to quality schools must be increased to certain level to help them get more resources and supportive school environment, so that they can take advantage of these resources and environmental conditions to accelerate and narrow the achievement gap to their peers.

Second, the Government and Educational Authority Should Increase Investment in Education Resources and Pay Attention to the Fairness of High-Quality Resources Distribution.

Regarding educational resource investment, especially teachers' recruitment and supplement, governments at all levels should take into account the family background of students and give preference to schools with large number of disadvantaged students, so that making up the development gap between disadvantaged students in these schools and their advantaged peers. In addition, we also call for attention to the differences in school curriculum and extracurricular activities that potentially increase the achievement gap between schools. The local education department should try to provide after-school services and high quality teaching resources for disadvantaged schools to ensure that high quality teachers and teaching resources are balanced and allocated, and gradually minimize the quality differences between schools.

Third, Schools Should Try to Improve Teachers' Ability to Effectively Use Differentiated, Cooperative and Exploratory Teaching Methods.

All kinds of schools, especially disadvantaged schools with a large number of disadvantaged students, should further deepen the reform of class teaching, and promote differentiated, cooperative and exploratory teaching methods to give all students the same

opportunity to receive teachers' care, so that every student's learning needs can be met to a greater extent. Meanwhile, local education departments and schools should further intensify teacher's training in disadvantaged schools through establishing cross-regional teacher development community and research platform, and carrying out various kinds of teaching experience exchanges to improve teachers' ability to apply effective teaching strategies and gradually narrow the gap between teachers' professional abilities. All these measures help to promote students' achievement and narrow the gap between them resulted from the difference of family background.

Fourth, Schools Should Try to Build Supportive School Climate.

Teachers' support, especially for disadvantaged students, by paying attention to each student's development, encouraging their participation in the class, listening their needs, expressing respect, providing necessary help as well as giving high expectations, can improve students' school experience and enhance the sense of school belonging that subsequently help them to devote to learning. Besides, schools can provide appropriate feedback, recognition and rewards for teachers, motivate them to be dedicated to their jobs, and give them more opportunity of on-job training and further professional development, through which a solid foundation would be paved for improving the academic resilience of disadvantaged students.■

Note:

1. *Students who encounter risk factors for academic failure (e.g., low family SES, migrant background, and ethnic minorities, etc.) but achieve much higher academic performance are called resilient students. For example, in the reports of PISA 2009, 2012, 2015 (program for international student assessment), the regression residual of students' performance on family economics, social and cultural statuses (ESCS) and ESCS square terms are used as indicators of academic resilience, and those with low ESCS and high academic resilience are defined as resilient students. In the thematic report of "education equity: breaking barriers to social mobility" released by OECD 2018, students with ESCS at the lowest 1/4 of their country/region and scores at the highest 1/4 of their country are defined as resilient students from the domestic perspective (OECD, 2018).*
2. *Disadvantaged schools were defined as having the lowest 1/3 of the average family SES, but advantaged schools were defined as having the top 1/3 of the average family SES.*

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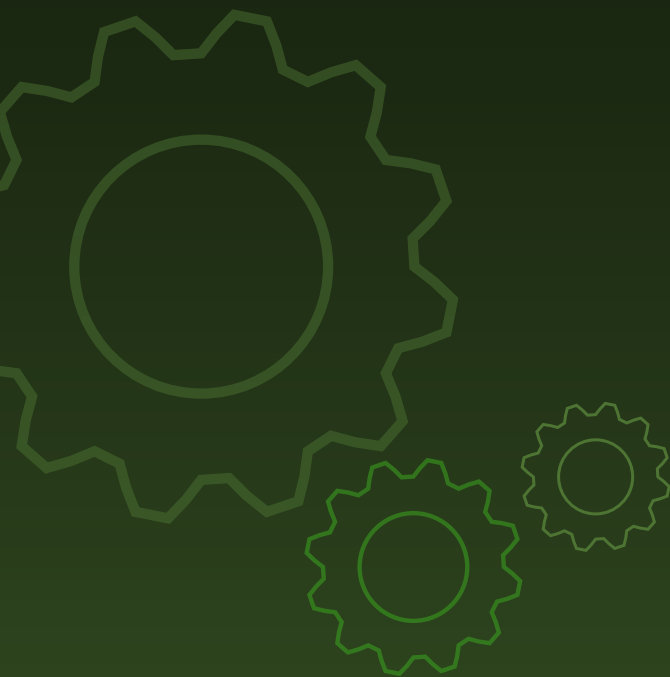
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