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NEWSLETTER

Which is Dominant in Primary School Students' Vocabulary Knowledge and Reading Comprehension?

By Chen, H.J., Zhao, Y., Wu, X.C., Sun, P., Xie, R.B., & Feng, J

READING triangle theory points out that vocabulary knowledge and reading comprehension affect each other: good vocabulary knowledge will promote reading comprehension, and reading comprehension will deepen the learning of vocabulary knowledge. According to previous studies, the effect of vocabulary knowledge on reading comprehension was not consistent among different grades.

Recently, an empirical study published in *Journal of Psychology* systematically explores the longitudinal relationship between vocabulary knowledge and reading comprehension in different grades of primary school, where a total of 399 students (198 male students and 201 female students) in grade 1, 3 and 5 from two ordinary primary schools in Shanxi Province are selected for one-year follow-up survey, and the two measurement times are T1 and T2, respectively. This study uses cross lag model and tests the relationship between vocabulary knowledge and reading comprehension of children in low, middle and senior grades in primary school by SPSS 21.0 after controlling for phonological awareness, morpheme awareness, general cognitive ability and autoregressive effect. Research finding are as follows:

- The early years of primary school are at the stage of “learning to read”. The cross lag test in the lower grades does not find a significant predictive effect between vocabulary knowledge and reading comprehension, which is consistent with the results of some previous studies. In the early stage of children’s reading development, reading comprehension mainly involves the understanding and mastery of text information, so it is more influenced by the underlying factors such as phonological awareness and general cognitive ability. In addition, reading comprehension of children in lower grades is at a relatively basic stage of development and cannot be learned through reading. Therefore, reading comprehension at this stage cannot predict the development of vocabulary knowledge.
- Middle primary school children are in the transition to the stage of “learning through reading”. The cross lag test of middle primary school students finds that there is a two-way prediction relationship between vocabulary knowledge and reading comprehension, which is consistent with previous research findings. Children at this stage already have a

certain amount of vocabulary knowledge and can use vocabulary knowledge to understand text information, which further supports the theory of reading triangle. In middle primary school, vocabulary knowledge is very important for understanding, and rich vocabulary knowledge enables children to better understand the text. In turn, the understanding of the text can help children understand some of the meanings of new words and increase vocabulary knowledge.

- Senior primary school children are at the stage where reading comprehension affects vocabulary knowledge. The cross lag test of primary school seniors finds that T1 vocabulary knowledge cannot significantly predict T2 reading comprehension, while T1 reading comprehension can significantly predict T2 vocabulary knowledge. It could be speculated that the dominant role in the relationship between vocabulary knowledge and reading comprehension in primary seniors might be the influence of reading comprehension on vocabulary knowledge. As senior primary school children have acquired independent reading ability and reading materials are more abundant and complex, acquiring information through reading has become the main way for them to learn new knowledge.

Based on this result, the author suggests that reading teaching in primary school should be guided according to the developmental characteristics of children:

- The lower grades should consolidate and strengthen the language and cognitive abilities at the bottom level, such as phonetic awareness, to guide children to learn the basic skills of reading;
- On the one hand, we need to guide middle primary school children to learn vocabulary and promote their reading ability; On the other hand, it is necessary to cultivate student' reading comprehension ability and guide them to deduce and grasp the meaning of new words through context information.
- The influence of reading comprehension on vocabulary knowledge may be dominant among senior primary school students, so more energy can be put into reading training in teaching, so that students can become independent readers and learn from reading.

Inadequate research:

- The measurement of the reading comprehension ability of the lower grades in primary and secondary schools is based on sentence comprehension, but not on the higher level of discourse comprehension;
- The research mainly explores the depth of vocabulary knowledge, ignoring the influence of the breadth of vocabulary knowledge.

Therefore, the following research can simultaneously explore the depth and breadth of vocabulary knowledge, and further deepen the understanding of the relationship between vocabulary knowledge and reading comprehension in primary school.

Source: J Psychol, 2019; 51(8):924-993.

NEWSLETTER

Can Brain-Computer Interactive Technology Promote Effective Learning?

By Hu, H., Li, Y.X., Cao, Y.F., Zhao, Q.H. & Lang, Q.E.

BRAIN-computer interactive technology is a kind of information exchange technology to realize communication between brain and computer. To explore the effects of Brain-computer interactive technology on study, an experiment is designed to realize autonomous learning by perceiving and regulating learners' attention by implanting brain-computer interface into online English learning system. The study was based on 100 freshmen from X university randomly assigned to the experimental group and the control group with 50 students each. The students of experimental group are required to learn by the English learning system of enhanced concentration, and the other group by the traditional online learning system. The data which are collected by testing the students' performance, learning attitude, learning style adaptability and different learning styles are analyzed with the tool of SPSS software. The statistic results are as follows:

- The brain-computer interactive technology can timely reflect the learning state and learning behavior through the detection and monitoring of physiological signals of learners.
- When the brain-computer interactive technology is implanted into the online learning system, it can significantly improve academic performance, learning attention and learning attitude.
- By monitoring and controlling the process of study, brain-computer interactive technology meets the cognitive needs of learners.
- Brain-computer interactive technology enhances the intelligence of existing online learning systems
- The brain-computer interactive technology provides a new approach for promoting deep and effective learning.

The author believes that with the development of the application of artificial intelligence technology and big data analysis technology in the field of education, brain-machine interactive technology is bound to provide a feasible path for the construction of intelligent classroom and the development of intelligent education, and ultimately promote the in-depth teaching and learning and the comprehensive development of human beings.

Source: J Dist Edu, 2019; (4):54-63.

NEWSLETTER

What Impact Does Mobile Technology Have on Second Language Acquisition?

By Chai, Y.L., Li, Y., Chen, X.D. & Chen, J.W.

ALTHOUGH mobile technology is widely used in language learning, there is no agreement on its effects. A study published in *Modern Distance Education Research*, focusing on the impacts of mobile technology on second language acquisition; perform a meta-analysis on the 57 related experimental and quasi-experimental studies at home and abroad from 2006 to 2018.

The overall effect of mobile technology on second language acquisition (vocabulary, listening, speaking, reading, writing, translation and synthesis, etc.), the learning effect of different segments of students, the effect of teaching strategies, and the learning organization form are all analyzed.

Research findings are as follows:

- As for the overall effect, the study obtains a comprehensive effect value of 0.901 after homogeneity test and sensitivity analysis, proving that mobile technology has significant advantages over traditional learning methods in second language acquisition. In which, the writing effect value is the largest, followed by speaking, reading, vocabulary and listening, and the translation effect value is negative.
- For the learning effect of different periods, the study shows that the learning effect is the best in primary school, followed by college and junior high school, and the worst in senior high school.
- In terms of different teaching strategies, the research shows that strategies such as situation, games and activities, and teacher guidance can further improve the acquisition effects of vocabulary, speaking and writing in foreign language learning. In which situational strategy has the most significant effect, followed by teacher-guided teaching/learning strategy and activity strategy, and autonomous learning strategy.
- For different forms of learning organization, the study has shown that the effect value of informal learning is smaller than that of formal learning, which proves the support role of teachers' organization, management and guidance in second language acquisition activities supported by mobile technology.

This study shows that mobile technology has a strong positive effect on the motivation and effect of second language acquisition. However, the

results are limited by the number and duration of studies, and the effects in listening, reading, and in primary and secondary school stages need to be further verified by more studies. As situational awareness, augmented reality, speech recognition, wearable's and other technologies, the authors suggest to comprehensively consider the integration of learning goals and content in studying games and activities, select and use appropriate teaching strategies, attach great importance to the guidance of the teacher, and fully focus on personalized support for second language learning by new technology, as well as its application in specific language learning.

Source: Modern Dist Edu Res, 2019; 31(3):106-112.

NEWSLETTER

Education, Social Capital and the Multidimensional Poverty Transformation of Peasant Households Evidence from CFPS Micro Panel Data

By Su, J., Xiao, P., & Hu, Z.Y.

A STUDY published in *Education and Economy* uses data from the CFPS (China Family Tracking Panel Survey) to analyze the social capital stock of 5,063 peasant households in 2010, 2012 and 2014. This study constructs a multidimensional poverty indicator system with three dimensions and seven indicators and the panel logit model is used to empirically study the impact and heterogeneity of education and social capital on the transformation of household income poverty, living condition poverty and opportunity poverty. The results are as follows:

- In parallel transformation of income poverty, for each additional year of education received by the average worker, the probability of poverty alleviation of the low-income families will increase by about 7% (9%); non-poor households are about 11% (14%) less likely to fall into income poverty. For each additional unit of social capital, the probability of a family getting out of relative income poverty will increase by about 3%, while the probability of a family falling into relative income poverty will drop by about 3%.
- On the parallel transformation of living conditions and opportunity poverty, the data shows that with the improvement of labor force's education level, the probability of poor families getting out of living conditions and opportunity poverty increases significantly, and the probability of falling into living conditions and opportunity poverty decreases significantly. The increase of social capital accumulation has a significant positive effect on the escape from living conditions and opportunity poverty of peasant families, but the robustness needs to be verified.
- In the aspects of education, social capital and the gradient transformation of multi-dimensional poverty in rural households, the study finds that the increase of social capital accumulation will significantly improve the probability of multi-dimensional poverty alleviation of families under the standard of relative income poverty, but it can not play a positive effect on the multi-dimensional poverty reduction of absolute income poor families and the suppression of non-poor families from falling into multi-dimensional poverty. At the same time, the interaction between educa-

tion and social capital increases the probability of families getting out of multidimensional poverty, and the two show a mutually reinforcing complementary relationship.

- In terms of control variables, poor health among members significantly reduces the probability of a family being out of income poverty. The transfer of labor force employment will significantly increase the probability of rural households escaping from income, opportunity poverty and multidimensional poverty, and significantly reduce the probability of rural households falling into the above-mentioned poverty. The growth of family population reduces the probability of family getting out of living conditions poverty, but also increases the probability of family getting out of opportunity poverty. As the head of a household ages, the probability of a family falling out of income, opportunity, and multidimensional poverty rises and then falls; the probability of a family falling into such poverty is exactly the opposite. Compared with poor female-headed households, the probability of male-headed households escaping from relative income, opportunity and two-dimensional poverty is significantly reduced. In addition, there are significant differences in the effects of government subsidies, village characteristic variables and macroeconomic variables on the transformation of different types of family poverty.

The conclusion of this study indicates that the government's poverty alleviation policy in the future should be changed from single-dimension income poverty alleviation to multidimensional poverty alleviation. It should not only pay attention to the accurate assistance to the poor families that have been born, but also to the risk prevention of non-poor families falling into poverty. In terms of specific policy orientation, we should fully explore the diversified poverty alleviation values implicit in education institutions, improve the education subsidy system in rural areas, actively expand the channels and paths of education poverty alleviation, and provide educational support policies that meet the specific needs of different poor families. It is necessary to improve the poverty subsidy mechanism of rural areas, establish and improve the supervision mechanism and effect evaluation mechanism of various kinds of poverty subsidy.

Source: Edu Econ, 2019; 35(2):17-27+46.

NEWSLETTER

Are Children's Museums Really Educational?

By Gong, X., Zhang, H., & Zeng, M.C.

A STUDY exploring the effects of children's museums on their education is conducted based on 450 children aged four years old, including 230 children in the control group who adopt the family individual tourist model (FIT) of "parental companion" and "informal activities", and 220 children in the experimental group who implement the kindergarten group model of "teacher lead" and "official activities". In the study, children's creativity, cognition, problem solving ability, language, scientific literacy, self-confidence and learning quality are tested, and data are analyzed by using t-test, least-squares regression and propensity score matching. Results show that:

- In the FIT mode, the admission experience has a significant lifting effect on children's creativity (originality), cognition, scientific literacy, problem solving and self-confidence, especially the children's ability to add and subtract. In particular, the children's ability to add and subtract and cognitive scores increased significantly.
- In the kindergarten group model, the children's museum experience has a positive effect on their creativity (fluency), cognition, and problem solving.
- The activity experience of discovery pavilion has improved the ability of children in the family mode to a certain extent, and meanwhile the behavior of some parents has also changed.

In addition, the study interviews with teachers and observations in the museum show that the educational effects brought by the weekend admission activities are more obvious, which also confirms the related effect of the kindergarten model. Moreover, the improvement effect in the field of scientific literacy and learning quality is also found.

Source: Museum, 2019; 3(3): 127-136.

NEWSLETTER

The Relationship between Parental Involvement and Children's Academic Performance

By Li, L., & Yuan, S.L.

IN order to explore the influence of parental participation in family education on students' academic performance, an empirical study based on social-ecological theory is published in *China Educational Technology*, and a chained intermediary model based on parental involvement and self-educational expectations is constructed.

In this study, a city in the west is used as the survey area, and a total of 4,565 valid questionnaires are obtained by cluster sampling. First, the study examines the direct impact of family socioeconomic status on academic performance. The results show that the direct effect is significant and the structural equation model fits well. Then, the mediation effect test is carried out: parental participation and self-education expectations are used as mediators, and the mediating effects reach a significant level. The chain mediation model is established, which includes both family participation and self-education expectations into the mediation, and the two paths are constructed to a significant level. Research findings:

- Parental participation and self-education expectation play a chain intermediary role in family socioeconomic status and academic achievement;
- Parents' participation in each dimension has different influences on self-education expectation and academic achievement, among which the family supervision dimension has a significant positive prediction effect on academic performance when self-education expectation is the intermediary.

Based on these, the researchers put forward suggestions from the perspectives of family, school and national society:

- Parents should change their minds, take the initiative to learn, and give full play to the permeable and long-term characteristics of family education; in the process of communication with the school, parents should assume their own responsibility to jointly face the development of students; pay attention to the development of ideological and moral character, and set up the concept of paying equal attention to study and moral character;
- At school level, teachers should truly uphold a good work style, truly treat each student equally, care for them, provide the help that students need; develop family-school cooperation with individuality, relevance,

- and effectiveness; form and improve the family committee system and promote the implementation of home-school cooperation.
- At social level, clarify the mechanism of influence between the state and society, promote education equity; facilitate the tripartite cooperation of “school-community-family”; pay attention to the cultivation of students’ psychological morality.

Source: Chin Edu Technol, 2019; 390(7):107-114.

An Empirical Study of the Influence of Continuing Education on Youth Entrepreneurship in Taiwan

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Abstract. *Despite the importance of lifelong education and its reported benefits for graduates entering the workforce, few empirical studies have evaluated the relationship between continuing education on entrepreneurship. In order to address this research gap, this study conducted secondary data analysis from the 2015 Adult Education Survey in Taiwan (AEST 2015) conducted by the Taiwan Ministry of Education. The purpose of this study was to determine the proportion of youth engaged in entrepreneurship (as measured by self-employment) and evaluate the relationship between continuing education and youth entrepreneurship. A sample from Taiwan was purposefully selected due to cultural factors which balance Eastern and Western approaches to education, allowing for better generalizability to a variety of populations. Data from a total of 2,696 valid participants was utilized. The results are as follows: a) the rate of youth entrepreneurship in Taiwan is moderate, at 8%; b) participation in continuing education demonstrated no significant relationship on youth entrepreneurship; c) entrepreneurial youth tend not to participate in continuing education, citing reasons including “lack of time” and “lack of necessary courses” at a frequency higher than non-entrepreneurial youth; and d) in terms of opportunities for future participation in continuing education, entrepreneurial youth placed less emphasis on the importance of transportation costs and tuition fees as compared to non-entrepreneurial youths. The results of this study suggest that continuing education courses are not currently meeting the*

needs of young entrepreneurs. Conclusions and suggestions are provided in terms of the evaluation of youth self-employment and continuing education opportunities for the promotion of entrepreneurship.

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Keywords: *Taiwan Youth; Self-employment; Entrepreneurship; Continuing Education*

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Conflict of Interests: None.

Introduction

SELF-employment ideally allows theoretical knowledge to be applied directly to gain advantages in the employment market, including increased savings, wealth creation, and social mobility (Quadri, 1999). Greater attention is being paid to the cultivation of practical and applied skills to meet the demands of industry, leading to a boom in research related to self-employment in recent years (Jia, et al., 2018). In terms of youth entrepreneurial, early advances in universities near Silicon Valley (Bates & Bates, 1997) began to establish links between the pragmatic demands of society and industry and university course content, overturning traditional theory- of higher education while simultaneously prompting an upsurge in youth entrepreneurship education around the world. In China, for example, “Popular innovation, entrepreneurship” has become a central educational policy aimed at promoting China’s economic transformation, upgrading and improving the quality and efficiency of teaching and learning, and promoting the development of an innovative and competitive nation (State Council of the People’s Republic of China, 2015). In fact, it is considered a fundamental social goal of developed and developing nations to foster the value-creation and “job making” potentials of youth through entrepreneurship initiatives (Arend, 2019).

Many scholars have begun to scrutinize the issue of youth entrepreneurship, focusing on how institutes of education can provide suitable curricula to meet the needs of students for fostering entrepreneurship at both the secondary and post-secondary levels. In terms of courses provided to high school students, some research has found an improvement in students’ perceptions of the feasibility of entrepreneurial endeavors, but no change in their intention to seek self-employment, with extra-curricular entrepreneurial experiences and students’ propensity towards entrepreneurship more predictive of entrepreneurial intention (Cardoso, et al., 2018). In terms of college students’ entrepreneurship, Bao et al. (2018) urge universities to strengthen courses emphasizing innovation and creativity while providing relevant practical training activities. A recent study of Nigerian college students analyzed their feelings regarding entrepreneurship education courses offered by the university, reporting a positive impact on self-employment and recommending that universities provide opportunities for students to interact with industry partners and engage in small-scale projects or business ventures (Afolabi, et al., 2017).

As a post-secondary education is increasing valued by youth seeking employment, college education and youth entrepreneurship should be closely linked. Nevertheless, although universities provide systematic and well-designed courses intended to have a direct effect on youth entrepreneurship, the role of continuing education must be evaluated. That is, the relationship between continuing education opportunities offered to youth after graduation and youth entrepreneurship should be evaluated. Due to the lack of continuing education institutes emphasizing entrepreneurship, developing related curricula is a critical issue, particularly given the strong link between academic institutions and economic development (Chowdhury, et al., 2019).

Research on entrepreneurship education at the university level noted that youth entrepreneurship could not solely rely on cultivation through curricula, but must take advantage of resources outside of the university (Afolabi et al., 2017). In fact, continuing education is seen as pivotal in enhancing the “start-up” and “human capital” aspects of entrepreneurship (Ács, et al., 2018). In fact, according to Lim, et al. (2019, p. 74) continuing education must include instructional factors that can “(a) effectively deliver learning content, (b) model ways of being, (c) cultivate ways of thinking, (d) facilitate self-efficacy, and (e) contribute to forming a better society.” Part of this involves experiential and hands-on learning, thus meeting the criteria of scholars who promote increased use of projects and links to industry partners (Afolabi, et al., 2017; Bao, et al., 2018; Cardoso, et al., 2018).

In sum, current studies on entrepreneurship education have largely concentrated on formal higher education environments, neglecting the potentially powerful role of continuing education in promoting youth entrepreneurship. The few studies on continuing education and entrepreneurship (Liberto, 2005; Wada & Muhammad, 2010) have failed to empirically evaluate the relationship between continuing education and youth entrepreneurship. To bridge this literature gap, this study used data from the 2015 “Adult Education Survey in Taiwan” (AEST 2015) released by Taiwan’s Ministry of Education (2018) and conducted secondary analysis.

The rationale for using data from Taiwan is due its unique blend of western and eastern cultures (Sun & Huang, 2018) leading to what Yang (2019, p. 15) refers to as “a mix of globalization, internationalization, religion, historic legacy, national policy, and local knowledge.” The difference between Eastern and Western environments has also been discussed in relation to youth entrepreneurship (Wang & Millington, 2011), finding that Chinese students were more strongly influenced by work experience, while Americans considered family background factors more seriously. Taiwan, on one hand, is deeply influenced by western culture (especially the United States), but also embraces Chinese traditional culture. Thus, this study uniquely seeks to use data from Taiwan to test the relationship between continuing education and youth education from a perspective where both Eastern and Western principles are valued, thus allowing us to cautiously generalize these results in order to provide suggestions and contributions for researchers and practitioners internationally. Based on data selected from the AEST 2015 that investigates the participation of young people in continuing education and the nature of their current employment, we can clarify how continuing education should be planned so as to have a positive effect on youth entrepreneurship. The four research questions of this study are:

- What is the frequency of entrepreneurship (self-employment) among youth?
- What is the frequency of participation in continuing education among youth?
- Does continuing education influence the entrepreneurial behaviors of youth?
- What differences exist between entrepreneurial and non-entrepreneurial youth in terms of reasons for and against enrolling in continuing education?

Literature Review

In recent years, there is a growing emphasis on the importance of self-employment. In terms of the influence of self-employment in individuals, research highlights both the benefits, such as potential mental and physical health benefits (Nikolova, 2019) and autonomy and work-life balance (Ortlieb, et al., 2017), as well as the drawbacks, such as stress and insomnia (Kollmann, et al., 2019) and relative insecurity and instability (Nazio & Gábor, 2017). Within the context of self-employment, international scholars have paid increasing attention to youth entrepreneurship, in particular. However, most studies discuss the incentive policies of local governments (eg., Rapp, et al., 2018) and policy support for innovation and entrepreneurship curriculum design by universities (Liu, 2018).

Research on Youth Entrepreneurship in Taiwan

While the government in Taiwan has proposed policies to encourage youth entrepreneurship (Ministry of Education, 2009), few studies have been conducted related to entrepreneurship. Most studies related to youth entrepreneurship have evaluated university environmental or policy factors unrelated to continuing education (eg., Yu, et al., 2017). One empirical study found in the literature was by Chen et al., (2015) who found no significant improvement in entrepreneurial intention after offering lectures by entrepreneurial industry experts, stating that hands-on experiences are more influential, while other traditional formal educational approaches add little to the promotion of youth entrepreneurship. Another study compared Taiwanese and Hong Kong university students, emphasizing the role of personality (Hsu & Wang, 2019), which is certainly a potential factor, but does not provide any recommendations for educational approaches for fostering youth entrepreneurship. Another paper offered general policy recommendations, without evaluating empirical data (Feng, 2016).

Most scholars, in fact, have explored the issue of youth employment from a broader perspective, largely emphasizing factors predicting youth employment instead of focusing on entrepreneurship. For example, Ding and Yan (2011) examined potential relevant factors influencing college students' employment, investigating the mediating effect of self-cognition and interpersonal relationships. From an even broader perspective, Liu and Lin (2011) explored the relationship among individual-level factors, learning outcomes, and graduation trends for different types of college students.

Research on Continuing Education in Taiwan

In addition to the lack of studies on youth entrepreneurship, very few studies related to continuing education in Taiwan have been published, apart from some which relate to adult education that target older segments of the population. Among the few examples in the literature with relevance to continuing education for youth are papers focused on the need for innovation (Lu, et al., 2016) and learner loyalty (Wang & Hsu, 2016) to enhance the competitiveness of continuing educational institutes. While innovative practices for enhancing youth entrepreneurship and attracting and retaining students in continuing education programs are important issues, the literature from Taiwan is lack-

ing in providing any suggestions related to entrepreneurship of any kind. Likewise, while other studies have been conducted with institutions for continuing education, the focus has been overwhelmingly on the health profession, such as nursing, which is not an appropriate avenue for self-employment.

Thus, some recommendations for continuing education must be found from the international literature. However, here too the literature is scant. Of the few papers found relevant to youth entrepreneurship in the context of continuing education are the following examples. In the context of non-formal education, overall, Pantea (2015) suggests that curricula should emphasize raising awareness of the social challenges facing young entrepreneurs. Bhat and Khan (2014) found that, while not currently being successfully executed, continuing education for entrepreneurship should provide research-based and needs-based instruction with more available courses. Karimi, et al. (2010) reiterate the general recommendations most commonly cited in the literature, such as the need for clear policy, industry-academic collaboration, embeddedness across the school curricula, and the use of hands-on projects to foster youth entrepreneurship.

Evaluating the Relationship between Continuing Education and Youth Entrepreneurship

As the concept of lifelong learning becomes more prevalent, continuing education is has become more important and valued. In particular, Technical and Vocation Education (TVE) in Taiwan has received a great deal attention from policy-makers, and funding for continuing education for TVE has been increased, with the Ministry of Education [MOE] (2010, p. 42) noting that “occupational continuing education must be more strongly promoted, and designed with a key focus on flexibility and practicality.” As such, the MOE advocates for developing creative thinking, increasing entrepreneurship-related courses, skill-based instruction, rewards for entrepreneurial performance, and offering business planning and counseling services (MOE, 2010) . Thus, compared to school-based entrepreneurial courses emphasizing theory and lacking in practical skills training, continuing education should emphasize the synergy of knowledge and practice (Jin, 2008). Logically, continuing education should be associated with youth entrepreneurship by instilling key competences required for youth entrepreneurship, and the motivation to pursue self-employment opportunities. Demonstrating this close relationship between continuing education and youth entrepreneurship, Liao (2013) pointed out that both the Taiwan and the Japanese governments provide courses specifically for young entrepreneurs.

Although a positive relationship between continuing education and youth entrepreneurship is expected, some specific questions must be explored. For example, the lack of relevant empirical evidence related to the role continuing education in developing youth entrepreneurship, and data on which continuing education pipelines are most effective. The evaluation of specific factors related to continuing education, such as tuition, class time, and course content, have yet to be clearly evaluated based on empirical data in terms of their contribution to youth entrepreneurship. As such, this study

uses responses from youth, aged 18 to 35, in relation to their entrepreneurship (evaluated by self-employment) and their participation in and perspectives towards continuing education.

Research Method

This study adopted data from the AEST 2015 survey in order to conduct secondary analysis. This section describes the data source, the background of subjects, and the corresponding data which was analyzed.

Data Source and the Background of Subjects

Since 2009, the Ministry of Education (MOE) of Taiwan has conducted a nationwide large-scale adult education survey every three years, entitled “Adult Education Survey in Taiwan”. The last survey was conducted in 2015 and released by the MOE in 2018 (Ministry of Education [MOE], 2018). The result of the survey released by the MOE serves as the source of the data used in this study. In the AEST 2015 survey, the population included adult over the age of 18 who were not currently enrolled in a formal educational institute (while students in continuing educational institutions were included). The survey was conducted through telephone interviews which asked respondents to answer all items from a questionnaire. Random sampling was carried out based on an established electronic database of telephone numbers from each town and urban area in Taiwan. The telephone interview was conducted with a random digital dialing (RDD) method for computer-assisted telephone interviewing (CATI). The data were evaluated for outliers, which were then removed systematically. At a confidence level of 95%, the sampling error was estimated at $\pm 0.93\%$ overall and between $\pm 3.00\%$ and $\pm 5.66\%$ for each county surveyed (MOE, 2018). Expert validity for the instrument was established a) through consultation meetings with experts before the questionnaire was finalized and b) the use of the questionnaire on four separate occasions. The representativeness of the questionnaire results in terms of location and gender were established through Chi-squared tests.

From the entire dataset of 11,000 participants, a sample of 2,696 youth between the ages of 18 and 35 was selected (1,249 males and 1,447 females; 1,412 unmarried and 1,284 married) for analysis.

Measurement

Among the variables evaluated by the AEST 2015, respondents were asked about their current work and participation in continuing education during their past year. For the purposes of this study, we have selected the following four relevant aspects for secondary analysis.

Work in the Past Year

According to the data from AEST 2015, we further classified respondents into two categories: “self-employed” and “employed by others” according to Question 7 of the demographic section posed to participants, which reads “What was your employment situation last year?” with options of “employer,” “privately hired,” “civil servant,” “unpaid family work,” and “self-employed,” in addition to “unemployed.”

Involvement in Continuing Education

The demographic section of the AEST 2015 also asks respondents regarding their participation in continuing education during over the past year. Question 8 asks students “Which of the following type educational organization do you belong to?” With a total of 18 possible items including various forms of continuing education (e.g. study courses organized by government or private organizations) in addition to options including various types of universities. If respondents indicated that they have participated in continuing education, a code of 1 was used for the data set. For respondents who did not participate in continuing education, a code of 2 was used.

Reasons for Not Participating in Continuing Education

In the “adult education” section of the AEST 2015 survey, Question 23 asks respondents “What is the most important reason why you did not participate in learning activities last year?” Reasons for not participating in any continuing education include “economic considerations,” “lack of time,” and “traffic inconvenience” and are listed in full in **Table 3** below. Participants were restricted to the selection of one choice which was considered most important to them.

Reasons for Willingness to Participate in Continuing Education in the Future

In view of whether the participants will participate in continuing education in the future, the “adult education” section of the AEST 2015 includes question 26, “If you have the opportunity to participate in education in the future, how important are the following factors? Responses to five-point Likert-type responses ranging from very important to very unimportant, including eight items, such as class time, tuition fees, and location, which are listed in full in Table 4 below.

Data Analysis

For the first research question regarding the frequency of entrepreneurship (self-employment) among youth the proportion of young entrepreneurs in Taiwan, and the second research question regarding the frequency of youth participating in continuing education, relevant data were first evaluation by descriptive statistics, including the percentage of youth reporting self-employment. Then, z-tests were used to test whether the difference between the proportion of entrepreneurs and non-entrepreneurs was statistically significant, as well as to compare the results of entrepreneurship and continuing education reported in the literature. A z test was the suitable analysis for determining

whether a difference in observed counts is significantly different from the expected proportion.

For the third research question, evaluating the relationship between continuing education and youth entrepreneurship, we first conducted a Chi-squared analysis to evaluate the correspondence between involvement in continuing education and entrepreneurship.

To answer the fourth research question, two approaches were needed. Since responses regarding reasons for not enrolling in continuing education utilized count data (single option), Chi-squared analysis was used to determine the significance of adjusted residuals, in order to determine the significance of differences between entrepreneurial and non-entrepreneurial youth. The data for reasons related to being willing to participate in continuing education in the future was based on Likert-type responses. As such, we used independent t-tests to evaluate the significance of the difference between the two groups in terms of the importance placed on each item.

Results

The Proportion of Entrepreneurship in Taiwan Youth

Descriptive statistics show that from the 2,696 youth aged 18 to 35 years that were surveyed, only 234 (8%) were classified as entrepreneurs, with the remaining 2,459 (94%) classified as non-entrepreneurial. The results of the z-test demonstrate that the proportion of entrepreneurs differed significantly from random chance, or a proportion of .5, ($z = -42.91$, $p < 0.01$), with the number entrepreneurial youth significantly lower than non-entrepreneurial youth. A more reasonable comparison, based on a report by International Labour Office (2017), would be the estimated global self-employment rates of 6.8% for upper-middle income countries and 23% for low-income countries. Using these proportions, Taiwan's youth entrepreneurship is actually higher than the average rate for upper-middle income countries ($z = 3.87$, $p < 0.01$), while lower than the average rate for lower-income countries ($z = -17.67$, $p < 0.01$). When compared to the youth self-employment rate in mainland China of around 15%, estimated by calculating employment and self-employment values from the report by Wang, Bao, Cao, and Kring (2016), Taiwanese youth have a relatively lower level of self-employment ($z = -9.19$, $p < 0.01$). As compared to Japan, with an overall self-employment rate of 4.6% (Niiyama, et al., 2018), Taiwanese youth demonstrated greater entrepreneurship ($z = 10.11$, $p < 0.01$).

The Proportion of Youth Participating in Continuing Education

Descriptive statistics show that from the 2,696 youth aged 18 to 35 years that were surveyed, 889 (33%) enrolled in continuing education, with the remaining 1,804 (67%) not taking any form of continuing education. The results of the z-test demonstrate that proportion of students enrolled or not enrolled in continuing education differed significant-

ly from random chance, or a proportion of .5, ($z = -17.68$, $p < 0.01$), with the number of youth in continuing education significantly lower than those who were not. A more reasonable comparison, based on a report by Organization for Economic Co-operation and Development (2010), would be the average continuing education enrollment rate for OECD countries of 40%. Using these proportions, Taiwan's continuing education enrollment rate is lower than the average rate for OECD countries ($z = -7.45$, $p < 0.01$), and lower than the averages of other Asian countries, such as Japan (42%) and Korea (50%), as reported in (OECD, 2018).

The Relationship between Continuing Education and the Entrepreneurship of Taiwanese Youth

In order to address the third research question, Chi-squared analysis was conducted (see **Table 1**), with the results showing that the enrollment in continuing education did not affect entrepreneurship ($\chi^2 = 0.07$, $p = 0.80$).

The Importance of Factors Influencing Youth Future Enrollment in Continuing Education

To answer the fourth research question, we first examined differences in terms of the reasons for not participating in continuing education between entrepreneurial and non-entrepreneurial youth. The overall Chi-square test results demonstrated that there were differences within the cross column table ($\chi^2 = 26.61$, $p = 0.01$) (see **Table 2**). Since adjusted standardized residuals match the t-distribution, adjusted residuals greater than an absolute value of 1.96 are significant at $p < 0.05$. The items for "lack of time" and "not providing the required course" met this criterion.

Finally, regarding factors influencing willingness to enroll in continuing education in the future, independent t-test results show that the two groups only have significant differences in terms of "tuition fees" and "transportation costs" (see **Table 3**). These items were perceived as less important by entrepreneurial respondents as compared to non-entrepreneurial respondents: tuition fees ($t = 3.29$, $p = 0.01$, $d = 0.24$) and transportation ($t = 2.76$, $p = 0.04$, $d = 0.20$). It should also be noted that course content, while not significantly different for the two groups, "course content" was deemed the most important factor, along with class time and location.

Discussion

Considering the importance of lifelong learning, continuing education has been advocated and promoted globally (Karimi et al., 2010). However, despite the global upsurge of youth entrepreneurship (Jia et al., 2018), most studies focus on traditional college education with no studies empirically evaluating the role of continuing education. In order to bridge this gap, this study conducted secondary analysis of Taiwan's AEST 2015 data set, since Taiwan is considered to represent elements of both Eastern and Western cultures (Sun & Huang, 2018; Yang, 2019), and thus can serve as a valuable

Table 1. Cross Column Table for Entrepreneurship × Enrollment in Continuing Education.

		Enrolled	Not Enrolled
Entrepreneurs	<i>n</i>	79	155
	%	33.8%	66.2%
Non-Entrepreneurs	<i>n</i>	810	1649
	%	32.9%	67.1%

Table 2. Cross Column Table of Entrepreneurship × Reasons for Not Participating in Continuing Education.

Reasons for not Participating	Counts			Adjusted Residuals
	Entrepreneurs	Non-Entrepreneurs	Total	
Work restrictions	150	11	161	.8
Economic considerations	17	0	17	1.3
Lack of time	792	92	884	2.7*
Family responsibilities are too heavy	117	6	123	1.5
Traffic inconvenience	13	3	16	1.5
Disqualification	3	0	3	.5
Required courses are not provided	52	11	63	2.6*
Improper course time	20	4	24	1.4
Don't know course information	143	7	150	1.8
Health factors	19	0	19	1.3
Not interested in learning	315	21	336	1.7
Lack of confidence in learning	8	0	8	.9
Total count	1,649	155	1,804	

Notes: χ^2 ($df = 11, N = 1,804$) = 26.61, $p = 0.01$. *indicates adjust residuals at the $p < .05$ level.

Table 3. Summary of *t*-tests for Factors Influencing Intent to Enroll in Continuing Education.

	<i>Mean (SD)</i>		<i>t</i>	<i>p</i>	<i>Effect Size (d)</i>
	Entrepreneurs (N=194)	Non-Entrepreneurs (N=2,050)			
Course Content	1.62 (0.68)	1.64 (0.65)	-0.33	0.74	0.03
Institutional Reputation	2.40 (1.08)	2.37 (1.03)	0.48	0.63	0.03
Teacher	2.02 (1.01)	1.90 (0.84)	1.75	0.08	0.14
Class Time	1.97 (0.85)	1.87 (0.81)	1.66	0.09	0.12
Location	1.96 (0.86)	1.90 (0.85)	0.88	0.38	0.07
Transportation Cost	2.27 (1.07)	2.07 (0.97)	2.76	0.04*	0.20
Tuition Fee	2.40 (1.06)	2.16 (0.99)	3.29	0.01*	0.24
Interpersonal Factors	3.28 (1.08)	3.25 (1.14)	0.38	0.71	0.00

Notes: The higher the value, the less significant it is. According to Cohen (1998), the effect size for independent t-tests adopt the d statistic with values below 0.2 indicates a small effect size.

benchmark, as well as providing some generalizable results for other nations and cultures.

The first finding is that only 8% of Taiwan's youth reported self-employment. While within the range of reported youth self-employment in Europe, but the range was from 4.3% to 11.1% in Germany (Ortlieb et al., 2017). Based on z-score analysis, Taiwan's youth entrepreneurship was higher than the average rate for upper-middle income countries, including Japan (Niyama et al., 2018), while lower than the average rate for lower-income countries, including China (Wang et al., 2016). Similarly, youth in Taiwan tend to not take the initiative towards pursuing continuing education, with far less participation than OECD countries and other developed Asian countries, such as Japan and Korea (OECD, 2018). We speculate that these phenomena reflect the blended nature of Taiwan's academic culture, positioned between traditional Chinese culture and Western culture. Thus while, Chinese culture, based on credentialism, tends to hold traditional academic higher education as a virtue at the expense of advocating youth independence and self-employment. Credentialism also places lower value on continuing education. This fits with the findings of Thomas (2009) who argues that academic pressure is a major factor hindering young entrepreneurs' willingness to start a business. On the other hand, Western aspects of Taiwan's educational culture emphasize individualism, which encourages entrepreneurship (Wang, & Millington, 2011). Therefore, even though the Taiwan government strongly advocates and rewards youth entrepreneurship and promotes continuing education (Ministry of Education, 2009, 2010), full implementation of policy has yet to yield strong results.

Based on our findings, continuing education is not associated with youth entrepreneurship. That is, enrollment or non-enrollment in continuing education demonstrated no relationship with youth entrepreneurship. This result is surprising, but may be due to the insufficiency of current continuing education programs in attracting, retaining, and inspiring learners to engage in entrepreneurship. Thus, in order to evaluate this finding, respondents' reasons for not taking continuing education were evaluated for entrepreneurial and non-entrepreneurial Taiwanese youth. Specifically, young entrepreneurs were reluctant to take continuing education due to two reasons: "lack of time" and "not providing the required courses". This can be explained by the fact that entrepreneurs often have less free time (Kollmann et al., 2019) and may choose not to continue their studies as a result.

However, the primary reason for their decision not to take continuing education courses is due to the reality that many neither official nor private continuing education institutions in Taiwan are currently providing the courses considered important for young entrepreneurs. This finding is potentially linked to the fact that entrepreneurs tend to be more autonomous and, as such, make responsible life decisions (Ortlieb et al., 2017). For entrepreneurship education, it is crucial to provide appropriate curriculum content which is research based (Bhat & Khan, 2014) and is integrated and includes hands-on activities (Karimi et al., 2010). This corresponds to the recommendations of Yang, et al. (2019), who claim that the main reason why entrepreneurship education in universities fails in its expected role is that the curriculum is more theoretical than practical. Furthermore, by analyzing the factors influencing the willingness of youth to participate in continuing education in the future, young entrepreneurs are less concerned with tuition fees and transportation issues than non-entrepreneurs. This might suggest that, if the course content fitted entrepreneurs' needs, factors such as tuition fees and commuting time would not affect their perception of the value of the program and resulting willingness to enroll.

Conclusions and Limitations

This study utilized AEST 2015 data collected by the government, with good reliability and validity. However, the data is based on interviews that may have been conducted up to five years and, thus, may not adequately reflect the current situation in Taiwan. Nevertheless, the results are a contribution, insofar as they demonstrate, with empirical data, the lack of correspondence between continuing education and entrepreneurship for youth, and the importance of factors such as time, course content, and classes fitting learners' needs, and the relative lack of importance based on tuition and travel expenses, for entrepreneurial youth.

Continuing education units must adapt to meet the challenges of increased competition, decreased funding, and widespread changes in educational delivery methods by fostering increased entrepreneurial activities (Downey, et al., 2006). However, according to our secondary analysis of AEST 2015 data, there is no strong relationship between continuing education and youth entrepreneurship in Taiwan. We suggest that educational reforms continue (MOE, 2010), according to the suggestions of scholars in

the area of youth entrepreneurship and continuing education, such as providing more practical experiences, and offering courses that will meet the needs of potential entrepreneurs (Afolabi, et al., 2017; Bao, et al., 2018; Cardoso, et al., 2018).

Furthermore, this study demonstrated that youth entrepreneurship in Taiwan is higher than more developed countries, but lower than developing countries, as well as mainland China. While this might be due to Taiwan's unique culture educational culture blending Eastern and Western values, it should be noted that the majority of self-employment in developing countries, as well as China, are family-based, agricultural, temporary, or non-contractual (International Labour Office, 2017). Self-employment is also associated with several negative outcomes, such as stress and insomnia (Kollmann et al., 2019) and insecurity and instability (Nazio & Gãos, 2017). As such, both the value and assessment of entrepreneurship should be further evaluated and other potential proxy variables explored in future studies.

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Research on the Influence of Teacher Variables on Students' Mathematical Achievements

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Abstract. *Based on the TIMSS2015 data, this study applied a hierarchical linear model to explore the influence of teacher variables on students' mathematics scores. Teacher variables were composed of teacher characteristic variables, teacher teaching variables, and teacher professional development variables. The teacher's characteristic variables were teaching age, gender, education, mathematics major, and mathematics education. Teachers' teaching variables were teaching expectations, teaching cooperation, teaching enthusiasm, classroom discussion, multimedia use, attention to homework, and emphasis on exams. Teacher professional development variables had mathematics knowledge training, mathematics education training, and mathematics curriculum training. Multi-layer linear analysis found that in the teacher's characteristic variables, the teacher's teaching age, gender, education, and mathematics major have a significant effect on the students' mathematics scores; In the teacher's teaching variables, teachers' teaching expectations, teaching enthusiasm, class discussion, and multimedia use have a significant impact on students' mathematics scores. In the teacher professional development variables, participation in mathematics knowledge training and mathematics education training had a significant positive impact on students' mathematics scores.*

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Problem

IN the evaluation of education quality, the learning effect of students has always been regarded as an important dimension to examine the effect of education. Among them, student achievement is one of the main indicators reflecting the effect of learning. Teachers are often considered to be the main factor affecting students' academic performance. Therefore, exploring the influence of teacher variables on students' academic performance through research has always been an essential research issue in educational research. The research of this problem can provide theoretical basis for improving students' learning, promoting the fair distribution of educational resources and the effective training of teacher education. It is a critical problem that has been continuously explored in the field of education.

Throughout the study of the influence of teacher variables on students' academic performance, it can be roughly divided into three categories. The first category was to study the influence of teacher characteristic variables on students' academic performance. The conclusions from this problem study are not the same. Huang and Xin found that teachers' gender, teaching age, education, and majors had no significant influence on students' academic performance (Huang & Xin, 2007); whereas Zhang found that teachers' gender, teaching age, and majors had a significant impact on student achievement (Zhang, 2012). The second category was to study the influence of teachers' teaching variables on students' academic performance. Teachers' teaching variables such as teacher's teaching plan, teaching behavior (Peterson, et al., 1978) (class introduction, classroom language, classroom questions, classroom feedback, class waiting, class summary (Huang, et al., 2009; Zhou & Bao, 2012; Huang, 2016; Gao & Zhang, 2016; Cao & Yu, 2017), teaching strategy (Walsh-Cavazos, 1994), teaching attitude (B ilent & Erden, 2006) were important factors affecting students' academic performance, and some teachers' teaching variables such as teacher's teaching cooperation and classroom discussion had no significant influence on students' academic performance (Zhang, 2010). The third category was to study the influence of teacher professional development variables on students' academic performance. Zhang and Xin found that teachers' preparation methods, peer listening courses, and teaching and research participation had no significant effect on student achievement (Zhang, 2010); but Zhao and Yan found that teachers' preparation ways, training participation, peer-to-peer assessment, and teaching and research participation have a significant impact on student achievement (Zhao, et al., 2013). From these studies we can find that although the teacher variables were closely related to the students' academic performance, the conclusions had not yet reached a consistent agreement. There are two reasons for this: first, the measurement tools developed by the researchers were different, and the quality of the different measurement tools was directly related to the research results. Herlihy et al

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indicated that the validity and reliability of the teacher evaluation system affect the conclusion of the role of teacher variables on student achievement (Herlihy, et al., 2005); second, the statistical analysis methods of choice are different, previous studies have not considered the Hierarchical nesting structure of teacher and student data, and traditional regression analysis of teacher variables and student variables as independent variables may cause bias in the results.

The research on the influence of teacher variables on students' academic performance has made two new developments in recent years. On the one hand, the quality of the measuring tools has improved. With the international emphasis on basic education, the emergence of international evaluation projects such as TIMSS and PISA has largely contributed to the improvement of the quality of measurement tools, which has led researchers to pay attention to the development of measurement tools, thereby promoting the quality of measurement tools. On the other hand, the methods of education statistics have been improved and improved. Samples of social science research often come from different levels and units. The resulting data is usually multi-level nested data, and the general statistical methods have problems for the processing of nested data. Therefore, with the continuous development of social sciences, Hierarchical linear models have begun to enter the eyes of educational researchers. This model solves the limitations of traditional regression analysis in dealing with multi-level nested data and becomes a new method of educational statistics research. In this context, we try to directly use the eighth-grade measurement data in TIMSS2015, and use the Hierarchical Linear Model (HLM) to analyze the influence of teacher variables on students' mathematics scores. In order to find teacher variables that can promote student achievement, this study proposes the following three questions:

- *Question 1: How does the teacher characteristic variable affect student mathematics scores?*
- *Question 2: How does the teacher's teaching variable affect student mathematics scores?*
- *Question 3: What effect does the teacher's professional development variable have on student mathematics?*

Methodology

Data Selection

The TIMSS project focuses on the development of students' mathematical and scientific academic achievements. TIMSS2015 collects information from students, teachers, and schools and encodes data by standardizing tests, questionnaires, and observing video lessons.

In TIMSS2015, a total of 45 countries participated in the eighth-grade standardized test. This study selected data from all countries participating in the eighth grade test and referred to it as TIMSS2015 data. All data is from the official TIMSS website (<http://timssandpirls.bc.edu/timss2015/>).

The subjects of this study were selected from the data of TIMSS2015. After eliminating the missing values of the relevant variables and satisfying at least 20 students per teacher, there are 45,321 student samples, the ratio of male to female is 1:1.4; the number of teachers is 1,806, and the ratio of male to female is 1:1.2.

Variable Selection and Description

Based on the data of TIMSS2015, this study explored the influence of teacher variables on students' mathematics scores based on the control of student variables in the nested relationship between students and teachers. Based on previous researches, the recent exploration of student family factors, teacher teaching factors and teacher professional development factors were introduced. At the same time, the TIMSS2015 standardized test questions and questionnaires were also adjusted and introduced into the study. Therefore, the dependent variable of this study is the student's mathematics score. The independent variable is divided into two layers:

- The first level is the student variables, which are divided into student background variables and learning motivation variables. Among them, student background variables: gender, age, family book collection, home computer, home learning desk, mobile phone, parental education (mother education, father education); learning motivation variables: mathematics learning interest, mathematics self-confidence. According to the Pearson correlation analysis, the mother's education and father's education are highly correlated, so the principal component analysis is used to form a new variable of parental education; other variables are not highly correlated. **Table 1** shows the definition and scoring of student variables.
- The second level is the teacher variable, which is divided into teacher characteristic variables, teacher teaching variables and teacher professional development. Among them, teacher characteristic variables: teaching age, gender, education, mathematics major, mathematics education major; teacher teaching variables: teaching expectation, teaching cooperation, teaching enthusiasm, classroom discussion, multimedia use, attention to homework, emphasis on exams; teacher profession development variables: mathematics knowledge training, mathematics education training, mathematics curriculum training. After Pearson correlation analysis, the teacher variables did not reach a high level of correlation. **Table 2** shows the definition and scoring method of teacher variables.

Data Analysis

Based on the data of TIMSS2015, this paper uses SPSS22.0 to organize data and use HLM6.08 for Hierarchical linear analysis. Taking the student's mathematics score as the dependent variable, without adding the independent variable, a zero model is established to test whether the sample data is suitable for Hierarchical linear analysis. On this basis, students and teacher variables are added to the previous model one by one to es-

Table 1. Definition and Scoring of Student Variables.		
Variable	Variable Description	Scoring Method
Student Variable		
Age	Calculated from the year of birth and month	Continuous type
Gender	Student gender	Discrete 2- point scoring, 1 for women, 2 for men
Family Collection	Family book collection	Discrete 5- point scoring, the higher the score, the more books
Home Computer	Is there a computer in the house?	Discrete 2- point scoring, 1 is yes, 2 is no
Home Desk	Does the student have a desk?	Discrete 2- point scoring, 1 is yes, 2 is no
Mobile Phone	Does the student have a mobile phone?	Discrete 2- point scoring, 1 is yes, 2 is no
Parental Education		(new variables formed by mother's education and father's education)
Math Interest	Do students like to learn mathematics?	Discrete 4- point scoring, the higher the score, the lower the mathematical interest
Mathematics Self-Confidence	Learning mathematics confidence	Discrete 4- point scoring, the higher the score, the lower the confidence

establish five models. For example, model 2 is based on model 1 to add student learning motivation variables, and finally form a complete Hierarchical linear model. On the basis of controlling student variables, the influence of teacher variables on students' mathematics scores is investigated.

The specific model is expressed as follows:

First level: student level

Dependent variable:

$$Y_{ij} = \beta_{0j} + r_{ij}$$

Second level: teacher level

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{teach year}) + \gamma_{02}(\text{gender}) + \dots + \mu_{0j}$$

subscripts "j" and "i" in the expression of the Hierarchical linear model represent the teacher's number and the student's individual number, respectively, and "ij" is the ith student in the jth class. β_{0j} represents the mathematical average of the students taught by the jth teacher. If the difference between teachers reaches a significant level, it is necessary to further analyze which factors of the teacher make the students' mathematics scores show significant differences.

The establishment of a Hierarchical linear model is presented in **Table 3**.

Table 2. Teacher Variables of the Definition and Scoring.

Variable	Variable Description	Scoring Method
Teacher Variable		
Teacher Characteristic Variable		
Teaching Age	Years of teaching	Continuous type
Gender		Consistent with student gender
Education		Discrete 7- point scoring, the higher the score, the higher the education
Mathematic Major	Whether the field of study is mathematics	Discrete 2- point scoring, 1 is yes, 2 is not
Mathematics Education	Is the field of study a mathematics education?	Discrete 2- point scoring, 1 is yes, 2 is not
Teacher Teaching Variable		
Teaching Expectation	Teachers' expectations for classroom teaching	Discrete 5- point scoring, the higher the score, the lower the expectation
Teaching Cooperation	Degree of cooperation between teachers	Discrete 4- point scoring, the higher the score, the lower the cooperation frequency
Teaching Passion	Degree of love for teaching	Discrete 4- point scoring, the higher the score, the lower the level of enthusiasm
Class Discussion	Frequency of discussion among students in the classroom	Discrete 4- point scoring, the higher the score, the lower the discussion frequency
Multimedia Use	Whether to use multimedia in classroom teaching	Discrete 2- point scoring, 1 is yes, 2 is not
Pay Attention To Homework	Frequency of arranging math assignments	Discrete 5- point scoring, the higher the score, the more important
Pay Attention To The Exam	Emphasis on classroom tests	Discrete 3- point scoring, the higher the score, and the less important it is.
Teacher Professional Development Variable		
Mathematical Knowledge Training	Whether to participate in mathematics knowledge training	Discrete 2- point scoring, 1 for participation, 2 for not participating
Mathematics Education Training	Whether to participate in mathematics education training	Discrete 2- point scoring, 1 for participation, 2 for not participating
Mathematics Course Training	Whether to participate in mathematics training	Discrete 2- point scoring, 1 for participation, 2 for not participating

Results

According to the statistical principle of the Hierarchical linear model, in order to explore the influence of teacher variables on students' mathematics scores, the first is to establish a zero model to estimate the contribution of teacher-to-teacher differences and intra-teacher differences (student differences) to the total difference, if the difference

Table 3. Establishment of Hierarchical Linear Model.	
Student Variable	Teacher Variable
Zero Model	
Model 1	Student background variable: Gender, age, family book collection, home computer, home desk, mobile phone, parental education
Model 2	Students learn motivation variables: Mathematical learning interest, mathematics self-confidence
Model 3	Teacher feature variables: Teaching age, gender, education, mathematics major, mathematics education
Model 4	Teacher teaching variables: Teaching expectations, teaching cooperation, teaching enthusiasm, class discussion, multimedia use, attention to homework, and emphasis on exams
Model 5	Teacher professional development variables: Mathematical knowledge training, mathematics education training, mathematics course training

between teachers is significant, it is necessary to further analyze which teacher variables make the students' mathematics scores show significant differences. The zero model results are presented in **Table 4**.

It can be seen from **Table 4** that the intra-class correlation coefficient ICC of the student's math score is 0.68, which means that about 68.42% of the total difference in the student's math score is caused by the teacher variable. At the same time, when the ICC is greater than 0.138, the difference between groups is significant (Dedrick, et al., 2009). This indicates that there is a significant difference between teachers, that is, the difference in mathematics scores of different teachers has reached a significant level ($p < 0.001$), which is consistent with previous empirical findings (Li & Ni, 2006).

Because of the significant differences among teachers, this study adds the three aspects of teacher variables to the second level of independent variables, and examines their influence on students' mathematics scores, thus providing some theoretical references for the improvement of teachers' teaching process. Due to space limitations, the full results of each model are listed in **Table 5**.

The Influence of Teacher Characteristic Variables on Students' Mathematical Achievements

Table 4. Estimation of Differences between Teachers and within Teachers in Mathematics Scores.

	Variance	Standard Error	Contribution Rate
Inter-Teacher	8,900.70	94.34	68.42%
Intra-Teacher	4,107.92	64.09	31.58%

Model 3 is to examine the impact of teacher characteristic variables on students' mathematical performance. The survey results showed: teacher's teaching age ($b = 1.09$, $p < 0.001$), gender ($b = -8.98$, $p = 0.025$), education ($b = 48.84$, $p < 0.001$), mathematics major ($b = 12.20$, $p = 0.005$). The impact on students' mathematics scores has reached a significant level. Compared with teachers with shorter teaching ages, teachers with longer teaching ages will have better mathematics scores for teachers who teach older classes. Female teachers have better math scores than those taught by male teachers. The higher the teacher's academic qualifications, the better the mathematics scores of the students in the taught class will be. Students in classes taught by non-mathematics teachers have higher math scores than those who were taught by teachers who graduated from mathematic major. In addition, the teacher characteristic variable explained 15.12% of the student's average math score difference.

The Influence of Teachers' Teaching Variables on Students' Mathematical Achievements

Model 4 includes the teacher's teaching variables based on Model 3, aiming to examine the influence of teacher's teaching variables on students' mathematics scores. The results of Model 4 indicate: teacher's teaching expectations ($b = -23.53$, $p < 0.001$), teaching enthusiasm ($b = 9.72$, $p = 0.002$), class discussion ($b = 18.01$, $p < 0.001$), multimedia use ($b = -11.90$, $p = 0.005$) has a significant impact on students' math scores. The higher the teacher's teaching expectation and the higher the frequency of multimedia use, the more helpful the mathematics scores of the students in this class. The higher the number of class discussions, the less effective the teaching. The teacher's enthusiasm for teaching has a negative predictive ability for students' mathematics scores. This may be due to the occurrence of the "Simpson's Paradox" or the poor original grades of the corresponding students of the teachers. The specific reasons still need further investigation and research. In addition, the teacher's teaching variables reduce the variance of students' mathematics scores to 6556.75, explaining 8.85% of the students' average math scores.

The Influence of Teachers' Professional Development Variables on Students' Mathematical Achievements

Model 5 is based on Model 4 and incorporates three variables of teacher professional development. The main examination is the influence of teacher professional development (mathematics knowledge training, mathematics education and mathematics training) on students' mathematics scores. The results of Model 5 analysis show that teachers' mathematics knowledge training ($b = -9.98$, $p = 0.041$) and mathematics education training ($b = -14.15$, $p = 0.005$) have significant influence on students' mathematics scores. The mathematics course training ($b = 8.11$, $p = 0.078$) had no significant effect on the student's mathematics scores. This shows that teachers' participation in mathematics knowledge training and mathematics education training will have a positive effect on classroom teaching, so that the average mathematics score of the students taught is higher. These three variables explain the student's average math score difference of 1.13%.

Conclusion and Discussion

Teachers are a pivotal factor influencing students' learning outcomes. The study found that, in overall, the addition of teacher variables has led to a significant decline in teacher variability. The teacher characteristic variable explained 15.12% of the difference in the average mathematics score of the students; the teacher teaching variable explained 8.85% of the difference in the average mathematics score of the students; the teacher professional development variable explained 1.13% of the difference in the average mathematics score of the students. Specifically, the results of each variable's impact on student mathematics are also presented in Table 5. These findings provide a basis for improving teachers' classroom teaching, strengthening teachers' professional development, and formulating relevant educational policies.

The Teacher's Teaching Age Has a Significant Impact on the Student's Mathematical Performance

The results in **Table 5** show that the teacher's teaching age can have a significant predictive effect on students' mathematics scores. At the same time, in the literature that has explored the relationship between teachers' teaching age and students' mathematics scores, the conclusions are not completely consistent. For example, the relationship between teachers' teaching age and the student's learning is positively related, or only affects the student's learning to a certain extent, or the two do not matter (Huang & Xin, 2007; Zhang, 2012; Zhang, 2010; Xie, et al., 2008; Xin, et al., 2004). This shows that it is not the teacher's teaching age that has a direct impact on the students' mathematics scores. However, These factors affect teachers' understanding of the knowledge and grasp of the teaching process, making teachers with a longer teaching age pay more attention to the combination of mathematical knowledge and students' cognitive level and laws, thus showing that the students' mathematical results will be better. This shows that relevant education departments and schools should not exclude new teachers. They should pay more attention to the development trend of new teachers and provide more

Table 5. The Influence of Teacher Factors on Students' Mathematics Scores.

Hierarchical Linear Model	Variable	Fixed Effect		Random Effect		
		Regression Coefficient (B)	SEM	Inter-teachers	Intra-teachers	Interpretation Rate
Zero Model				8,900.70	4,107.92	
				7,196.61	3,822.46	19.15%/6.94%
Model 1		Student Background Variable				
	Gender	4.04***	0.70			
	Age	-6.92***	0.61			
	Family Book Collection	7.87***	0.31			
	Home Computer	7.31***	0.67			
	Home Desk	0.19	0.75			
	Mobile Phone	1.38	0.83			
	Parental Education	8.66***	0.50			
				8,474.77	3,204.58	/16.16%
Model 2		Student Learning Motivation Variable				
	Mathematical Learning Interest	-7.31***	0.39			
	Mathematics Self-Confidence	-25.23***	0.52			
				7,193.02	3,204.52	15.12 % /
Model 3		Teacher Characteristic Variable				
	Teaching Age	1.09***	0.18			
	Gender	-8.98*	4.01			
	Education	48.84***	3.36			
	Mathematic Major	12.20**	4.26			
	Mathematics Education	-5.25	3.82			
				6,556.75	3,204.09	8.85 % /
Model 4		Teacher Teaching Variable				
	Teaching Expectation	-23.53***	2.45			
	Teaching Cooperation	3.94	2.29			
	Teaching Passion	9.72**	3.11			
	Class Discussion	18.01***	2.33			

(Continued)

	Multimedia Use	-11.90**	4.20		
	Pay Attention To Homework	-1.13	1.84		
	Pay Attention To The Exam	-5.21	3.90		
				6,482.58	3,204.15 1.13 % /
	Teacher Professional Development Variable				
Model 5	Mathematical Knowledge Training	-9.98*	4.89		
	Mathematics Education Training	-14.15**	4.94		
	Mathematics Course Training	8.11	4.61		

Note: *: $P < 0.05$, **: $P < 0.01$, ***: $P < 0.001$. Interpretation rate refers to the percentage of decrease in teacher-to-teacher variation between teachers and teachers compared to the previous model after adding a new factor.

channels for the communication between new teachers and expert teachers. This is more conducive to narrowing the differences in teaching mathematics among students.

Teacher's Academic Qualifications, Mathematics Knowledge Training, and Mathematics Majors Will Significantly Affect Students' Mathematics Scores

The results in **Table 5** show that the higher the teacher's academic qualifications, the better the mathematics scores of the students in the taught class will be. Students who have participated in mathematics knowledge training have better math scores. Students in classes taught by non-mathematics teachers have higher math scores than those who were taught by teachers who graduated from mathematic major. Generally speaking, teachers with high academic qualifications have more knowledge of mathematics, and teachers who participate in mathematics knowledge training will have a better understanding of the methods of teaching mathematics. Comparing the influence of these three variables on students' mathematics scores, it is found that the mathematics knowledge and methods of teaching that teachers have had positive effects on students' mathematics scores. However, students in classes taught by non-mathematics teachers will have higher math scores. There may be two reasons for this. First, compared to non-mathematics teachers, those graduated from mathematic major have more knowledge, but their ability to teach mathematical knowledge to students in the corresponding grade is not as good as non-mathematics teachers. Second, the focus of the two types of teachers is different from that of the current basic education.

Teachers without background of mathematics major will pay more attention to the training of students' mathematics skills. Teachers of mathematics majors pay more

attention to the cultivation of students' mathematical thinking and mathematics thinking. However, for the improvement of students' test scores, it is better to train students' math skills. In addition, mathematics education is designed to help students master the mathematics, skills, ideas, and methods necessary for modern life and further learning. Therefore, in the process of teaching, teachers can not choose the sea tactics solely for the test results, nor can they focus only on the improvement of mathematical thinking and neglect the students' ability to accept at this stage. This shows that the cultivation of mathematical knowledge and skills, mathematical ideas and methods complement each other. Teachers should pay attention to this and organically combine them, so that students can understand the ideas and methods of mathematics in the training of mathematics knowledge and skills. At the same time, it is recommended that the education department or school regularly organize mathematics knowledge training to provide more ways for teachers to master the methods of teaching mathematics.

The Influence of Teachers' Mathematics Education Major and Mathematics Education Training on Students' Mathematical Achievement

The results in **Table 5** show that there is no significant difference in the mathematics scores of the students taught by the mathematics education majors and the non-mathematics education teachers. Students who have participated in mathematics education training have better math scores. Comparing the influence of two variables on students' mathematics scores, it is found that teachers master more mathematics education theories have positive effects on students' mathematics scores. However, the teaching effects of teachers in mathematics education and non-mathematics education teachers are not significantly different. The reason may be that the teaching of traditional mathematics education theory does not use actual cases as a carrier. Therefore, teachers cannot truly apply the learned education theory to classroom teaching, thus making the effect of educational theory learning greatly compromised. In view of this, it is recommended to combine educational theory and practice when teaching educational theory, to provide teachers with more practical teaching cases, or to answer the problems encountered by teachers in real teaching. In addition, the relevant education departments are also encouraged to regularly organize mathematics education training, and strive to implement education theory into classroom teaching.

Overall, the study has made some meaningful conclusions. At the same time, there are problems in this study, through the interpretation of inter-teacher variation. We find that the addition of teacher variables does cause a large decline in teacher-to-teacher variation, but there are still large inter-teacher differences. There are two reasons for this: First, the TIMSS study is conducted once every four years, so the student's math scores are not continuous, and the characteristics of the student's current math scores cannot be linked to the teacher factors at this time. Secondly, the student's academic performance itself is affected by many factors, and is also affected by the initial mathematics scores, and the students' mathematics scores themselves may also dif-

fer. Therefore, the influence of teacher variables on students' mathematics scores is still somewhat exploratory.

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Patterns of Bullying Victimization among Adolescents in China: Based on a Latent Profile Analysis

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Abstract. *This study was to explore potential patterns of bullying victimization among adolescents in China. By cluster sampling, Delaware Bullying Victimization Scale-Student (DBVS-S), Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder Scale-7 (CAD-7) were administered to 3,761 school adolescents in Hunan Province. Latent profile analysis (LPA) was conducted on victimization by verbal, physical, social and cyberbullying. We found that (i) There is a high degree of co-occurrence among four subtypes of bullying victimization. Four latent classes were identified, including an all-type (traditional and cyber) bullying victimization class (1.5%), a traditional victimization class (3.9%), a mild traditional victimization class (14.9%), and a non-victimization class (79.6%). (ii) Males, middle school students, rural students and poor students were more likely to be all types of victims. (iii) There was a graded relationship between the four latent classes and the level of depression as well as anxiety.*

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Introduction

BULLYING victimization refers to the phenomenon that an individual is bullied or injured by one or several peers for a long time or repeated times (Olweus, 1993), with the characteristics of power imbalance, deliberateness, repetitiveness, and harmfulness (Smith & Wilson, 1998), and is an essential risk factor affecting the physical and mental health of Children and adolescents (Gini & Pozzoli, 2009, Hawker & Boulton, 2000). Studies have shown that victims of bullying have higher risks in social and emotional problems, and are more prone to psychological introversion problems such as depression and anxiety (Li et al., 2012; Menesini et al., 2009). Among the various types of people who are involved in the bullying, the proportions of victims of bullying are the highest. A survey of tens of thousands of elementary and middle school students in Norway found that about 15% of students were involved in bullying, of which about 9% were victims of bullying (Olweus, 1993). Zhang (2002) found that nearly one-fifth of elementary and middle school students in China were involved in school bullying, and 14.9% of students were victims of bullying. A comparative study of bullying in China and the US show that 22.05% of American students and 21.77% of Chinese students have been bullied (Xie et al., 2016).

For the victims, bullying is a serious life event. Compared with ordinary life events, repeated and persistent bullying produces a negative impact on individual's body and mind more profoundly. Besides, there are many forms of bullying including verbal, relational, physical, and cyber-bullying (Crick & Grotpeter, 1995; Olweus, 1993; Björkqvist, 1994; Smith et al, 2008). Accumulating data have shown that there is a high degree of symbiosis between various forms of bullying (Raskauskas & Stoltz, 2007; Li, 2007; Smith, Mahdavi et al, 2008; Nylund et al., 2007; Wang et al., 2010; Zhang et al., 2014). Most victims often suffer from more than one form of bullying. Within the victims, the forms of bullying and their combinations are different, the severity of bullying is different, and the victims are heterogeneous.

Previous studies on campus bullying include the demographic characteristics of victims, the impact of bullying on individual mental health, introversion and extroversion, etc (Zhang et al., 2000; Schwartz et al., 2001; Zhang, 2002; Chen & Le, 2002; Chen et al., 2013; Wu et al., 2016). Regardless of the results, there was a problem that ignores the heterogeneity within the victims. Positive Psychology, especially Psychological Elasticity Research, showed that the difference in mental health among disadvantaged individuals was more noteworthy than the difference among different groups (Rutter, 2000; Wan & Tang, 2016; Zhang et al., 2016). Understanding the heterogeneity within the victims can help people differentiate the different nature of the victim sub-groups. On this basis, the study of different models of sub-groups was carried out to provide more targeted programs for different sub-groups in the formulation of bullying prevention and intervention programs. We explored the model of bullying in school, which was based on the characteristics of the heterogeneity of bullying, and the demographic characteristics and mental health of various types of bullying.

Latent Class Analysis (LCA) has been being used widely in heterogeneous group classification in many fields such as sociology, biomedicine, and psychology. LCA is a technique based on the response of individual manifest variable to the tendency to divide individuals into a few mutually exclusive Latent Class variables (Qiu, 2008). LCA classification can ensure the greatest difference among latent classes and the smallest difference within the class. At the same time, the latent characteristics of each class can be judged according to the response modes of each item in the scale, and the proportion of the population of each class in the whole group can be understood, and explore the heterogeneous classification mode within the group.

Of the studies of latent class of bullying, a LCA of the incidence of physical bullying, verbal bullying, social exclusion, rumors, and cyberbullying in American teenagers divided the subjects into three classes: full-type victim groups (9.7% for men and 6.2% for women), Verbal/Social victim group (28.1% male, 35.1% female), and uninjured group (62.2% male, 58.7% female) (Wang et al., 2010). Zhang (2014) conducted potential class analysis on the occurrence of physical bullying, verbal bullying and relational bullying among students of grades 4, 6 and 8, and divided the subjects into four classes: verbal-body bullying (10.8%), verbal-body-social bullying (10.6%), verbal-social bullying (5.8%) and victimless bullying (72.9%). Li (2015) analyzed the subjects in grades 7, 8, 10 and 11 of two schools and found three types of bullies: all types of bullying (10.3%), cyber/verbal/social bullying (47.5%) and non-bullying (42.2%). These study tools, involving the crowd, and concluded that the results were inconsistent; for the victims, the bullying measurement used in the study were scored higher, if use the LCA, the original score points to 0/1 class for subsequent analysis. Due to the lack of accuracy of discrete data (Zhang et al., 2010), data information will be lost when continuous data is converted into discrete data resulting in deviation of classification results. Therefore, this study will use the Latent Profile Analysis (LPA) to extend the method of latent variables, so as to explore the pattern of Chinese bullying victimization more accurately.

Therefore, our study intends to study the co-occurrence characteristics of the detection of four common forms of bullying victimization, including cyberbullying, and then build an LPA model based on the data of the four forms of bullying victimization, to explore the different bullying victimization patterns and their main demographic characteristics of Chinese adolescents. Based on the consideration of the heterogeneity within the bullying-victimized group, the psychological introversion of different bullying victimization patterns (depression, anxiety) and their differences were further discussed.

Objects and Methods

Objects

The method of cluster sampling in eight areas of Hunan Province was used. A total of 3,788 middle to high school students (age range of 11 to 20 years old, $M = 15.03$, $SD = 1.685$) from 20 schools (including 13 city schools, 7 township and rural schools) were

included. To remove the demographic variable information (such as gender), recycling effective questionnaire was 3,761, and the effective rate was 99.29%. Detailed sampling information is shown in **Table 1**.

Research Tools

Delaware Bullying Victimization Scale-Student (DBVS-S)

DBVS-S (2016 Chinese Edition) was adopted. The scale has a total of 17 items, which are divided into four dimensions: verbal bullying (4 items), physical bullying (4 items), social/relational bullying (4 items) and cyber bullying (4 items). Item 13 “I was bullied in this school” is a screening item, which is not included in the data analysis (Bear et al., 2016). The scale was introduced by Xie (2015). The Chinese edition of the latest revision was adopted in this study (Xie et al., 2018). The Cronbach’s α coefficient of DBVS-S was 0.906, and the fitting factor of the four-factor model confirmative factor analysis was good (CFI = 0.922, RMSEA = 0.043 [0.040-0.046]). The scale uses the Likert six-point score, “1” = “never”, “2” = “occasionally”, “3” = “one or two times a month”, “4” = “once a week”, “5” = “multiple times a week” and “6” = “every day.” The higher was the score, the more serious was the bullying.

Patient Health Questionnaire Depression Scale -9 (PHQ-9)

PHQ-9 was used to assess the frequency of depressive symptoms in the past two weeks. The scale has a total of 9 items, of which the 9th item “whether there is suicidal or self-mutilation thought” is not a clinical intervention for this study, and suicide or self-mutilation was detected. The investigator could not provide further evidence for subjects who have a positive answer. Based on ethical considerations and referring to the practices of similar studies, we did not include it, and only the first 8 items were used in the test. The scale uses the Likert four-point score, “0” = “nothing at all”, “1” = “with a few days”, “2” = “more than half of the number of days”, “3” = “almost every day”. The higher the rate was, the more severe the depressive symptoms were. Cronbach’s α coefficient was 0.850 when PHQ-9 was revised (Hu et al., 2014). The Cronbach’s α coefficient of PHQ-9 in our sample data was 0.834, and the fitting factor of the one-factor model confirmative factor analysis was good (CFI = 0.933, RMSEA = 0.074 [0.068-0.080]).

Generalized Anxiety Disorder Scale-7 (CAD-7)

GAD-7 was used to understand the frequency of anxiety symptoms such as stress and anxiety in the past two weeks. The scale consists of 7 items in total, and the scale adopts Likert four-point score, “0” = “none”, “1” = “several days”, “2” = “more than half of the days”, and “3” = “almost every day”. The higher the score was, the more serious the anxiety symptoms were. Cronbach’s α coefficient was 0.93 when GAD-7 was revised (Qu & Sheng, 2015). The Cronbach’s α coefficient of GAD-7 in our sample data was 0.884, and the fitting factor of the one-factor model confirmative factor analysis was good (CFI = .973, RMSEA = 0.063 [0.056-0.071]).

Table 1. Participants Distribution Information.

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	Total
Male	197	244	234	462	310	376	1,823
Female	224	233	254	459	414	354	1,938
Total	421	477	488	921	724	730	3,761

Procedure

All data were collected by the paper questionnaire, and the class was taken as the unit for a group test. Before the test, we communicated fully with the sample school, obtained support from the school and informed consent from the parents (or guardians) of all the sampled students. The experimenters were specially trained graduate students in psychology, and each class was equipped with 1-2 experimenters. The test time was during the school break or self-study class, and the time for the participants to complete the questionnaire was about 15 minutes. The head teacher is required to be present during the test (only present without patrolling). The experimenter explained the instructions and sample questions to the participants in detail. Of the instructions, experimenter explained the meaning of the survey and emphasized that the test content was only used for scientific research. The questionnaire was collected and taken away by the experimenters on the spot and would not be reviewed by the school or teachers. The sampling began in early December 2016 and lasted about one month.

Statistical Analysis

Mplus 7.4 was used for Latent Profile Analysis, and SPSS 22.0 was used for multiple logistic regression analysis and variance analysis of Latent Profile Analysis results.

Results

Incidence and Co-Occurrence Percentage of Different Types of Bullying

During data processing, as long as the score of each item in DBVS-S was ≥ 3 , that is, the participants selected “once or twice a month” or more were considered to have been bullied by the dimension represented by this item. Individuals subjected to verbal, physical, and social bullying of any kind or more were classed as traditional bullying victims.

The incidences of four types of bullying victims were: verbal bullying, 31.53% (male 37.74%, female 25.70%); physical bullying: 20.55% (27.65% for males and 13.88% for females); social bullying 19.60% (22.65% for males and 16.72% for fe-

males); cyberbullying, 4.3% (5.76% for males, 2.94% for females). Verbal bullying is the most common type of bullying among males, followed by physical bullying; verbal bullying is the most common type of bullying among females, and social bullying is the second most common type. The percentage of victims of each type by other types is shown in **Table 2**: when cyberbullying occurred, the probability of traditional bullying occurring at the same time was 87% (89.5% for males and 82.5% for females); when traditional bullying occurred, the probability of simultaneous cyberbullying was 9.8% (11.4% for males and 7.7% for females).

From the perspective of the co-occurrence characteristics of the four types of bullying victims, the co-occurrence rate of verbal bullying was the highest. Victims of physical, relational and cyber bullying were usually victims of verbal bullying. The three types of traditional bullying victimization have high co-occurrence. The occurrence of cyberbullying among Chinese teenagers was often accompanied by traditional bullying.

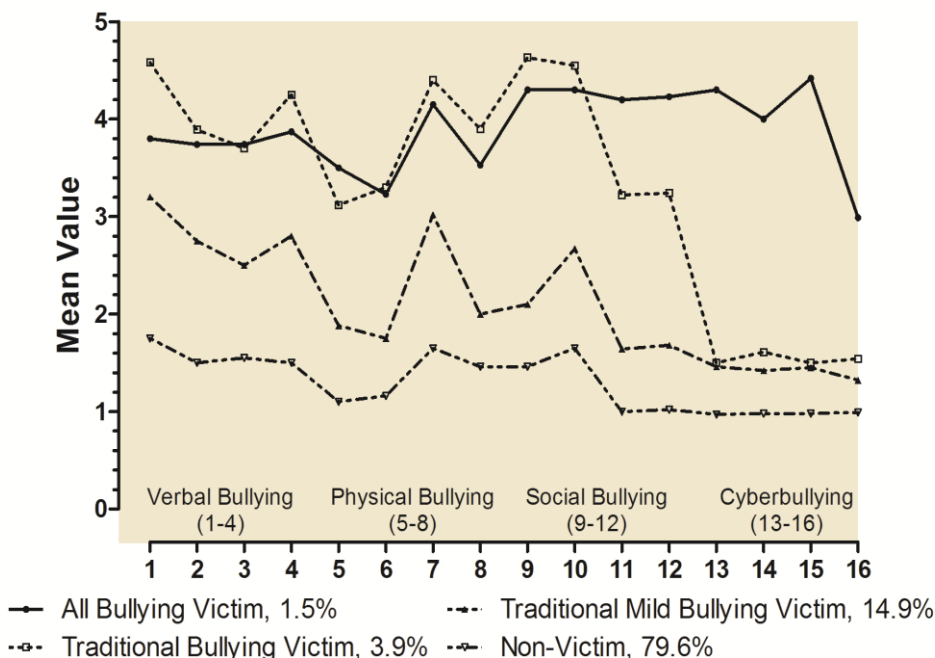
The Results of Latent Profile Analysis of Adolescent Bullying Victims

To further explore patterns of bullying victimization among adolescents, we then conducted LPA based on the occurrence degree (i.e. frequency) of each type of bullying. The fitting indexes of 2-5 classes were extracted and summarized in **Table 3**, and conducted a model test. The Model adaptation test indexes mainly include: Information Evaluation Index AIC, BIC, sample size-adjusted BIC, aBIC, Entropy index, Likelihood Ratio Test Index LMR-LRT and Likelihood Ratio Test Index Based on Bootstrap (BLRT). The smaller the three information evaluation indicators are, the better the model fits. Entropy ranges from 0 to 1, and Entropy closer to 1 indicates the more accurate the classification. Entropy < 0.60 is equivalent to over 20% of individuals with a classification error, and Entropy = 0.8 indicates an accuracy of over 90%. The p-values of the two indexes of LMR-LRT and BLRT reach a significant level, indicating that the k classes' models are significantly better than the k-1 classes of models (Qiu, 2008).

The data showed that the conclusion of the various information indicators was not consistent. The Entropy values of the five models exceed 0.8, and the BIC is the smallest when the five classes are retained. However, the LMR-LRT values are not significant when the 5th class are retained, indicating that the 5th class are not excellent. In the 4th class, the LMR-LRT and BLRT indicators of the 4th class are significant, and the average probability (column) of the 4th class of the adolescents (rows) comprehensive consideration, the 4th class is selected as best model (Nylund et al., 2007). The estimated conditional mean and individual value distribution on the 4 latent class model on the 16 items of bullying (reordering by dimension after removing the 13th question of the original scale) is shown in Figure 1.

From **Figure 1**, the mean conditions of the four latent classes on the 16 items of the four factors of bullying victimization are significantly different, showing different characteristics. Among them, Class 1 (C1) has a high mean value in the four bullying dimensions, accounting for 1.5% of the total subjects. According to its score charac-

Figure 1. Estimated Conditional Means of Four Latent Class of Bullying Victims.



teristics, C1 is defined as “all-type (traditional and cyber) bullying victimization class”. In Class 2 (C2), the mean value of the conditions in the dimension of cyberbullying was significantly lower than C1. The score trend and mean value of the conditions in items 1-12, namely the three dimensions of traditional bullying victimization, were similar to C1, which was defined as “a traditional victimization class”, accounting for 3.9% of all subjects. The score trend of class 3 (C3) in the three dimensions of traditional bullying victimization was similar to that of C2, but the mean value of the conditions was lower than C2. The mean value of the conditions in the dimension of cyber bullying was consistent with C2. Therefore, C3 was named as “a mild traditional victimization class”, accounting for 14.9% of all subjects. Class 4 (C4) was named “non-victimization class”, accounting for 79.6% of all subjects.

Multivariate Logistic Regression Results of Demographic Variables for Four Latent Classes

This research further explored the demographic characteristics of bullying victimization patterns based on the results of LPA. LPA results as dependent variables, gender (female as a reference), grade (high school as a reference), school type (city as a reference), boarding situation (day reading as a reference), and self-evaluation academic record

Table 2. The Prevalence of All Four Types of Bullying.^a

	Traditional Types Of Bullying Victims				Cyber-bullying (%)
	Verbal bullying (%)	Physical bullying (%)	Social Bullying (%)	Traditional Bullying (%) ^b	
Total (n=3,761)					
Traditional Bullying (n=1,436)					9.8
Verbal bullying (n=1,186)	-	53.7 ^c	50.1 ^c		10.6 ^c
Physical bullying (n=773)	80.9	-	62.0		15.5
Social bullying (n=737)	80.6	65.0	-		16.8
Cyberbullying (n=162)	77.8	74.1	76.5	87.0	-
Male (n=1,823)					
Traditional bullying (n=825)					11.4
Verbal bullying (n=688)	-	59.0	50.6		12.1
Physical bullying (n=504)	80.6	-	61.9		16.5
Social bullying (n=413)	84.3	75.5	-		20.1
Cyberbullying (n=105)	79.0	79.0	79.0	89.5	-
Female (n=1,938)					
Traditional bullying (n=611)					7.7
Verbal bullying (n=498)	-	44.08	49.4		8.6
Physical bullying (n=269)	81.4	-	62.1		13.8
Social bullying (n=324)	75.9	51.5	-		12.7
Cyberbullying (n=57)	75.4	64.9	71.9	82.5	-

a. The percentage of each type of victim who was bullied by the other type.

b. If an individual is bullied by one or more types of verbal bullying, physical bullying or social exclusion, it is considered as the traditional bullying victimization type.

c. For example, among the 1,186 victims of verbal bullying, 53.7%, 50.1%, and 10.6% are also victims of physical bullying, social exclusion, and cyberbullying.

(successful results as a reference) as self variables were subjected to multiple logistic regression analysis. Among them, the non-victimization class (C4) was used as the reference category for comparison, and the Odd Ratio coefficient was obtained through analysis. The OR coefficient reflected the ratios of different genders, grades, urban and rural locations, boarding situations, and self-assessment academic performance in the

Table 3. Summary of Latent Profile Analysis Fit Information.

Index	Model Number			
	2	3	4	5
Total (n=3761)				
AIC	134,874.143	127,284.693	123,542.594	118,438.308
BIC	135,179.532	127,696.034	124,059.887	119,061.552
aBIC	135,023.834	127,486.318	123,796.153	118,743.799
Entropy	0.991	0.988	0.962	0.994
LMR-LRT (p)	< 0.001	0.1096	0.0261	0.6154
BLRT (p)	< 0.001	< 0.001	< 0.001	< 0.001

Table 4. Multivariate Logistic Regression Results of Demographic Variables for Four Latent Classes.

		All-type(traditional and cyber) bullying victimization (C1)		A traditional victimization (C2)		A mild traditional victimization (C3)	
		OR	CI (95%)	OR	CI (95%)	OR	CI (95%)
Gender	Female	1.000		1.000		1.000	
	Male	4.241**	2.303-7.809	1.794**	1.275-2.523	2.338**	1.925-2.838
Grade	12th Grade	1.000		1.000		1.000	
	7th Grade	9.471**	3.741-23.977	15.029**	6.636-34.038	3.803**	2.703-5.349
	8th Grade	3.609*	1.296-10.050	11.070**	4.876-25.131	3.372**	2.425-4.689
	9th Grade	1.991	0.636-6.237	8.402**	3.658-19.295	2.635**	1.883-3.688
	10th Grade	1.237	0.437-3.500	2.096	0.870-5.052	1.084	0.781-1.504
	11th Grade	1.338	0.446-4.015	2.147	0.860-5.361	1.067	0.751-1.517
School Location	Urban	1.000		1.000		1.000	
	Rural	5.238**	3.062-8.961	4.513**	3.216-6.331	2.824**	2.340-3.409
Boarding Situation	Day-student	1.000		1.000		1.000	
	Boarder	1.342	0.745-2.149	1.427	0.982-2.074	1.037	0.854-1.258
Academic Record (Self-Assessed)	Poor	1.000		1.000		1.000	
	Medium	0.613	0.337-1.116	0.563*	0.381-0.831	0.775*	0.617-0.973
	Excellent	0.400*	0.172-0.935	0.534**	0.326-0.876	0.751*	0.570-0.990

Note. * $P < .05$, ** $P < .01$.

potential categories of bullying victims. The results of multinomial logistic regression are shown in **Table 4**.

Taking the C4 as the reference group, C1, C2, and C3 were compared with it. The OR results showed that the distribution of victims of bullying was affected by gender, grade, school location, and student performance, the effect of boarding was not significant.

Compared with females, males in the groups C1, C2 and C3 were suffered more bullying and victimization. Compared with the senior 3 students, in the C1, the bullying of the junior 1 and junior 2 students was more serious. The bullying injury among the junior 3, senior 1, and senior 2 students was not significant from that of the senior 3 students. In the C2 and C3, there are more bullying victims in the three grades of middle school, and the phenomenon of bullying in senior 1 and senior 2 students is not significant from that of senior 3 students. Compared with urban students, among the three classes of C1, C2 and C3, there are more bullying injuries among rural students. There was not significance in the victimization of boarding and day students. Compared with students with lower graders, there was not significance in bullying among students with poor grades and middle grades in the C1 class. Students with higher grades were less likely to suffer from bullying than those with lower grades. Among the C2 and C3, students with middle grades and excellent grades were less likely to suffer from bullying than those with poorer grades.

Comparison of Depression and Anxiety Symptoms among Latent Classes of Juvenile Bullying

The results of the analysis of variance are shown in **Table 5**. The depression scores of adolescents in different categories of bullying victims ($F(3,3757)=104.136, p < 0.01, \eta^2 = 0.077$) and anxiety scores ($F(3,3757)=121.953, p < 0.01, \eta^2 = 0.089$) was significant. The multiple comparison results show: The depression and anxiety scores in C1 were significantly higher than those in the other three groups. The depression and anxiety scores in C2 were lower than those in C1, which was significantly higher than that in C3 and C4. The depression and anxiety scores in C3 were significantly higher than those in group C4.

Discussion

The Co-Occurrence Characteristics and Heterogeneity of Juvenile School Bullying Model

We explored the patterns of four common forms of bullying using latent profile analysis. There were four modes of bullying victimization in the tested adolescents: all-type (traditional and cyber) bullying victimization class, a traditional victimization class, a mild traditional victimization class, a non-victimization class. There were significant differences in the scores and trends of bullying victims in each group indicating the heterogeneity of bullying victims. There are three bullying victimization classes (C1, C2, and C3)

Table 5. Comparison of Depression and Anxiety Symptoms among Latent Classes.

	C1 (n=58)	C2 (n=147)	C3 (n=544)	C4 (n=3,012)	F	η^2
Depression	11.90±6.072	10.60±5.004	8.80±4.427	6.60±4.037	104.136**	0.077
Anxiety	10.43±4.946	9.18±4.881	7.54±4.390	5.09±3.949	121.953**	0.089

Note: Data are depicted as Mean ± SD.

in the four modes, accounting for a total of 20.4%, among which the mild traditional victimization class has the largest number of people and the all-type bullying victimization class has the smallest number. This indicates that bullying and victimization phenomenon is prevalent in Chinese schools at present, and the distribution of all classes is pyramid-like, and the more severe the bullying, the less the number of people suffering from bullying.

Among the three classes of bullying victims, the C1 and C2 were subjected to more serious traditional bullying, and the C3 group was subjected to mild traditional bullying. It can be seen that three forms of traditional bullying usually occur together. In terms of conditional means, verbal bullying is the most common form of bullying, which is consistent with the co-occurrence rate of the various forms of bullying in **Table 2**. In addition, compared with the C2 and C3, only all types of bullying victims have more serious cyberbullying, which indicates that the cyberbullying of teenagers is more serious, and the victims may also suffer or encounter other traditional types of bullying. Victims of cyberbullying are often victims of traditional bullying, which is consistent with previous studies (Raskauskas & Stoltz, 2007; Li, 2007; Smith et al., 2008). The results also support the hypothesis that cyberbullying is an extension of campus bullying (Zhang et al., 2015; Zhu et al., 2014).

Demographic Characteristics and Analysis of Their Depression and Anxiety Indicators of Different Types Bullying Victims

The analysis of demographic characteristics of victims of different types of bullying showed that there are differences in demographic variables such as gender, grade level, school location, and academic achievements. Compared with females, in all three types of bullying mode, males are more likely to be bullied, and the gender differences in bullying patterns are consistent with previous studies (Rivers & Smith, 1994; Zhang et al., 2000; Chen & Le, 2002; Chen et al., 2013). This suggests that more attention should be paid to the bullying of males. Of the grade level, the overall bullying is declining with the growth of grades. The bullying in middle school students is significantly more than that of high school students, but it has slightly different in different types. In the C1, bullying and victimization in the first and second grade were much higher than in other

grades. In the C2 and C3, the three middle school grades are higher than the high school grades, and the severe bullying and victimization mainly occur in the middle and lower middle grades in middle school. A comparison of urban and rural schools showed that students whose schools are located in rural areas have a higher proportion of bullying than those whose schools are located in urban areas, which supported the previous findings (Wu et al., 2016). In practice, national and local governments should strengthen the prevention and control of bullying in rural schools. Previous studies regarding the impact of boarding on bullying suggested that the management system of rural boarding schools was not perfect and rural boarding students may lead to more bullying than urban boarding students (Wu & Hou, 2017; Wu et al., 2016). In this study, the comparison between day students and boarders showed that boarding students were more likely to suffer from bullying than day students, but there was no significant difference with the type of bullying. It may be due to the interaction between school location and boarding. The differences between rural and urban school boarding and the underlying mechanisms need further studies. Students with different self-assessment performance have different proportions in each bullying mode. In general, students with poor self-assessment scores are more likely to be bullied, which is consistent with previous report (Schwartz et al., 2001). Compared with students with poor and middle-level self-assessment scores, students with excellent self-assessment scores in C1 are less likely bullied, and students with middle and excellent self-assessment scores in C2 and C3 group are less likely bullied than those with poor self-assessment scores. Taken together, the self-assessed high academic performance in Chinese adolescent students seems to be an advantageous factor in protecting themselves from being bullied.

The results of the depression and anxiety scores of different types of victims showed that there were significant differences in the scores of depression and anxiety, and the higher the frequency of bullying suffered, the higher the level of depression and anxiety would be. It is worth emphasizing that the scores of a mild traditional victimization class and the questionnaire on the two scales of depression and anxiety are significantly higher than the non-victimization class, which means that as long as the students have the experience or feeling of being bullied, even if the frequency of bullying is not high, but it will produce a more serious negative impact on individual's mental health. The results of the depression and anxiety scores of the victims of each model support the "zero tolerance" of bullying on campus (Zhao & Wang, 2018).

Education and Intervention Enlightenment

In 2017, China issued the Guidance on Preventing and Controlling Bullying and Violence among Primary and Middle School Students, which shows the importance of controlling school bullying at the national level (Yao, 2017). Among the people who are involved in the bullying on campus, the proportion of bullying victims was the highest (Hu, 2017), and it has important practical significance. From our study, when students were noticed to have been suffering from a certain type of bullying, they should be paid more attention to the situation, i.e. whether they have suffered from multiple types of bullying at the same time, especially cyber bullying. Our findings indicated that the de-

gree of bullying was relatively more serious than the imagination. The exploration of bullying patterns of victims aimed to understand the qualitative differences within the bullied group. We found that even mild bullying can produce serious negative impact on students' depression and anxiety. Therefore, in daily study life, teachers and parents should pay attention to the signs of bullying and victimization, and should not ignore the stigmatization, malicious mocking and other minor encroachment behaviors in the communication with students, so as to find and stop bullying and victimization in time, and to prevent further deterioration of the situation. In addition, the study also suggests that male, junior in high school, middle school, lower grade, rural schools, poor self-rated academic performance are the demographic characteristics of the high incidence of bullying victimization.

Conclusions

In this study, the potential profile analysis was used to explore the bullying victimization patterns of adolescents at school, and the demographic characteristics and psychological introversion problems (depression and anxiety) were analyzed, and we draw conclusions below:

- Among the victims of school bullying, the four common types of bullying, namely verbal, physical, relational and cyber bullying, are co-occurring, and there are four typical patterns of school bullying victimization: all-type (traditional and cyber) bullying victimization class (1.5%), a traditional victimization class (3.9%), a mild traditional victimization class (14.9%), a non-victimization class (79.6%).
- Verbal bullying is the most common form of bullying, and most victims of cyber bullying are also victims of traditional bullying. Different demographic characteristics (gender, grade, school location, self-assessed academic performance) will affect the bullying mode of victimization. Male, middle school, rural school, and low self-evaluated students are more vulnerable to bullying.
- Even mild bullying involvement can produce a serious negative impact on an individual's mental health, and this is the solid evidence for a "zero tolerance" to bullying.

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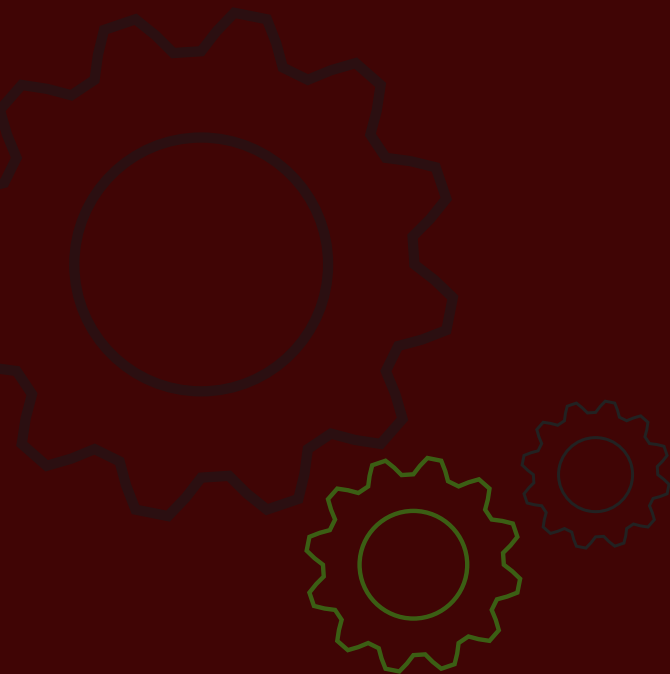
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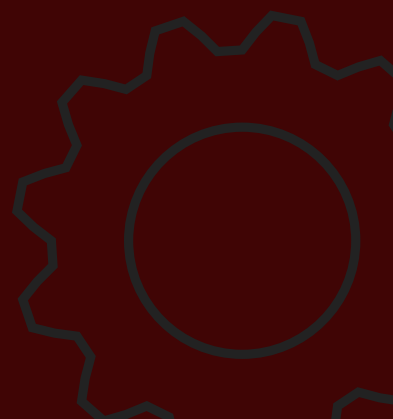
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